



# STeP

Sanitation Technology  
Platform

# J-OP MARKET LANDSCAPE — PHILIPPINES

SEPTEMBER 2017

## The Sanitation Technology Platform

Please Note: This report is a good faith effort by RTI International to accurately represent information available via secondary and primary sources at the time of the information capture. The report is confidential and proprietary and only for internal uses and not for publication or public disclosure.



## TABLE OF CONTENTS

### Introduction

Philippines Market Strategy

Philippines Market Analysis

Policy and Regulatory Landscape

Market Landscape

Commercial Landscape

Financial Landscape

# The Philippines is an archipelago made up of 7,107 islands covering 115,831 square miles.

**Population:** 101 million (2015), 1.72% annual growth rate.

**GDP:** USD 291 billion (2015)

**Poverty:** 26.3% of the population lives below the poverty line (2015)

**Income Classification:** Lower middle income (World Bank)

**Local Government Structure:** The Philippines comprises 18 provinces, 145 municipalities, and 1,489 cities, which are further divided into barangays, or districts. Today, there are 33 highly urbanized cities (HUCs) with populations greater than 200,000 people and an annual income of P50 million (USD 100,000) per year in addition to another 18 municipalities with a population greater than 150,000.

Twelve metropolitan areas comprise multiple municipalities. While each municipality has their own elected government, some metro areas are also governed by a metropolitan development authority (MDA). MDA's exercise regulatory and supervisory authority over the delivery of metro-wide services, including the provision of water, sanitation, and solid waste management.





# More than 30 million people in the Philippines lack access to improved sanitation facilities.

Poor sanitation results in more than P67 billion (USD 1.24 billion) in annual losses to the Philippine's economy (PEM, 2003) and leads to 55 deaths every day. Less than 5% of households are connected to sewerage networks (2013), with most households using poorly designed or maintained septic tanks.

Outside Manila, water supply and sanitation services are provided by water districts (WDs), government-owned and controlled corporations that provide services within a franchise area at the request of a local government unit (LGU), or a private-sector operator. According to the Philippines Association of Water Districts, there are 514 operational water districts, many of which provide services to more than one city or municipality.

The Clean Water Act of 2004 (CWA) requires LGU's and WD's to create septage management programs; however, most lack the funds, capacity, and technical experience to undertake such efforts. Where treatment plants are not available, private desludging companies commonly empty septic tanks on an as-needed basis rather than by a regular collection schedule, and they discharge the septage into undisclosed locations.

In 2013, the National Government enacted the National Sewerage and Sanitation Management Program, setting off a spate of new projects. Since then, the Philippines has seen an increase in the number of sewage and septage treatment plants, although overall coverage rates still remain low.



# The renewable energy landscape and need for solid waste management indicate compatibility with the J-OP.

## Solid Waste Overview

35,000 metric tons per day (MTPD) of municipality solid waste (MSW) are collected nationwide (2013). Per capita generation is an average 0.4 kg per person per day, 56% of which is biodegradable (food and yard) waste. Landfilling is the dominant method of solid waste treatment, although many landfills function as open dumpsites, putting an estimated 27% of the municipal population at risk of exposure to waterborne disease. Historically, gasification and anaerobic digestion projects have been permitted in the Philippines; however, in June 2016, the Supreme Court reversed it's previously prohibitive position on thermal combustion technologies.



## Renewable Energy Overview

As of 2014, 25% of the Philippines total energy supply came from renewable sources with more than 720 individual projects in operation. Major growth areas are in hydropower and solar energy. Biomass sources are still in their infancy making up 0.25% of total generation. The National Renewable Energy Program plans to expand renewable energy capacity to 39% of total energy generated by 2030 and has created an enabling policy environment to promote project development. Retail industrial electricity prices reach upwards of P11(USD 0.23) per kWh and a feed in tariff for biomass exists at P6.63 (USD 0.14) per kWh.



## Water Reuse Overview

Water reuse is not widely practiced in the Philippines, and limited information is available on practices nationwide. This trend is likely a product of the country's rich water resources (average annual rainfall ranges from 39 to 197 inches across different regions of the country) and limited infrastructure to deliver treated water to end users. Supporting regulations include effluent discharge requirements, drinking water quality standards, and water reuse standards for agricultural and irrigation purposes.



# In-country assessments included visits across a representative sample of relevant and interesting cities.

Diversity Factors	Metro Manila	Metro Cebu	Bacolod City	Puerto Princesa	Dumaguete City
Population	12.9 million	2.2 million	561,875	222,673	131,377
Geographic Location	Luzon; national grid connectivity	Central Visayas; national grid connectivity	Central Visayas; national grid connectivity	Mimaropa; no national grid connectivity	Central Visayas; national grid connectivity
Water District Ownership Structure	Private	Public	Public	Public	Public
Level of wastewater /FSM Infrastructure	Moderate Coverage	Limited coverage	No Coverage	No Coverage	100% coverage
Potential J-OP Use Case	Biosolids; Co-Locate with STP/FS-STP; J-OP + Existing FSTP; J-OP + New FSTP <sup>1</sup>	J-OP + New FSTP; J-OP + Existing FSTP with feedstock aggregation or MSW	J-OP + New FSTP	Possible 1-engine J-OP + New FSTP with MSW	None (City too small for a 1-engine J-OP with MSW)
Pending Activities	None	Currently building 4 new FSTPs; 1 became operational 8/16	Terms of reference (TOR) pending for collection plus FSTP	TOR pending for new FSTP	None; FSTP already operational (first public plant in PH)

## Selected Cities and their FSTPs



NOTE: Cities in Mindanao, Philippines, were automatically disqualified because of travel advisories in the area. <sup>1</sup> Fecal sludge treatment plant.



STeP conducted interviews with stakeholders across the project development value chain.





## TABLE OF CONTENTS

Introduction

**Philippines Market Strategy**

Philippines Market Analysis

Policy and Regulatory Landscape

Market Landscape

Commercial Landscape


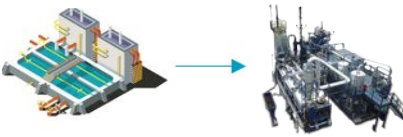
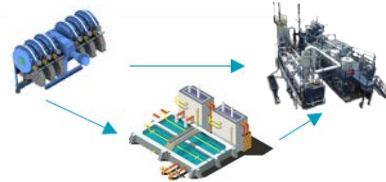
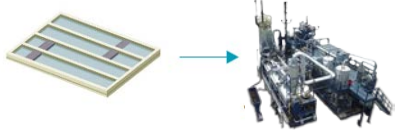
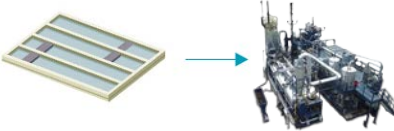
Financial Landscape

**STeP**


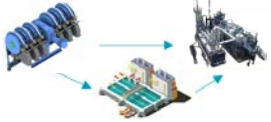
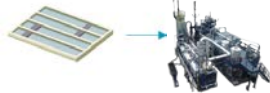
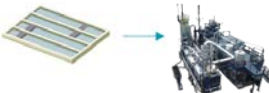
Sanitation Technology  
Platform



# The priority-use cases for the Philippines are integrating a J-OP with existing FS-STPs/FSTPs or building new FSTPs.

Stand Alone J-OP	Biosolids Processing	J-OP co-located with STP/FS-STP
<p><i>J-OP processes raw fecal sludge (FS) (no pre-processing) and supplements energy balance with MSW</i></p>  <ul style="list-style-type: none"> <li>• Solids content of available FS is too low (e.g. ~1-2%), making the J-OP uncompetitive.</li> </ul>	<p><i>Biosolids produced at a sewerage treatment plant used as feedstock for J-OP</i></p>  <ul style="list-style-type: none"> <li>• There is a small market for the 2-engine J-OP in Manila. Of the 60 STPs, most are &lt;50 MLD with the largest being 100 MLD. Systems will require feedstock aggregation. Multiple 1-engine J-OP units may be preferred.</li> </ul>	<p><i>Raw FS dewatered: liquid effluent treated by co-located STP and solids treated by J-OP</i></p>  <ul style="list-style-type: none"> <li>• Moderate market for the 2-engine J-OP in Manila. The city is rapidly expanding underground sewer connectivity with plans to achieve 100% coverage by 2037. Co-location will prevent stranding assets.</li> </ul>
<p><b>J-OP Integrated into Existing FSTP</b></p> <p><i>J-OP added to <u>existing</u> FSTP to process solids produced by the FSTP</i></p>  <ul style="list-style-type: none"> <li>• Small market for the 2-engine J-OP at existing FSTPs in Manila and the 1-engine J-OP in Cebu. Most FSTPs are too small to support a system.</li> </ul>	<p><b>J-OP integrated into New FSTP</b></p> <p><i><u>New build</u> FSTP dewateres FS and processes liquid, J-OP processes solids (and potentially MSW)</i></p>  <ul style="list-style-type: none"> <li>• Largest market for the J-OP. By incorporating MSW, the market increases by nearly 2X.</li> </ul>	<div style="border: 1px solid black; padding: 10px;"> <p>A FS-STP is a treatment facility that processes both fecal sludge (FS) and sewage. Typically, FS enters the plant via an independent sedimentation tank, followed by dewatering. Filtrate from the dewatering process is combined with sewage in the primary treatment step.</p> </div>

# The J-OP can achieve a value proposition addressing market needs in each of these use cases.

	Biosolids Processing	Co-located with STP/FS-STP	J-OP Integrated into New FSTP	J-OP Integrated into an Existing FSTP
				
Market Need Addressed	<ul style="list-style-type: none"> <li>• Need exists in Manila because of long solids-transport distances.</li> <li>• Existing treatment processes may not achieve complete pathogen destruction, although further evidence required to confirm this.</li> <li>• Electricity expenditures are significant due to high per unit prices.</li> </ul>	<ul style="list-style-type: none"> <li>• Inadequate sanitation coverage—either via sewerage or FSM.</li> <li>• National regulations mandate the provision of septage and sewerage services. National goal established that all LGUs develop septage management systems and that HUCs develop sewer systems by 2020. Evidence shows that even HUCs are opting for septage over sewerage management solutions.<sup>1</sup></li> <li>• Treatment of solids from STPs and FSTPs is a latent need- it would achieve health benefits. However, this need has not yet been articulated by municipalities or other actors.</li> </ul>		
Value Proposition	<ul style="list-style-type: none"> <li>• Eliminates biosolids transport costs.</li> <li>• Offsets onsite electricity consumption</li> <li>• Complete pathogen destruction.</li> </ul>	<ul style="list-style-type: none"> <li>• 100% pathogen destruction, 100% of the time.</li> <li>• Provides a reliable supply of electricity that can offset a portion of onsite electricity costs.</li> <li>• Lower cost alternative to co-composting, especially in cities without well-developed markets for compost (e.g., where compost is highly valued: &lt; USD \$165 or &lt; USD \$135 areas where land prices are low) (See slide 55).</li> </ul>		

<sup>1</sup> Examples from the Philippines: Cagayan de Oro, Naga, General Santos, Zamboanga City, Iloilo, Cebu

# Country specific populations required by the J-OP dictate market size and help inform market strategy.

Philippines Specific Population Required		
	1-engine J-OP	2-engine J-OP
FS Only 	400K people	800K people
50% FS + 50% Solid Waste 	200K people	400K people

Note: Analysis assumes the regional minimum population served for south east asia (SEA) based on the Bill & Melinda Gates Foundation (BMGF) 10-Country Study along with regional weighted average total solids content based on a literature review of pits and septic tanks. Mass flow to the JOP equals 13.7 dry TPD. Assumes perfect collection and delivery efficiency.

# The potentially addressable market for the J-OP in the PH is 42-78 units – dominated by the 2-engine J-OP.

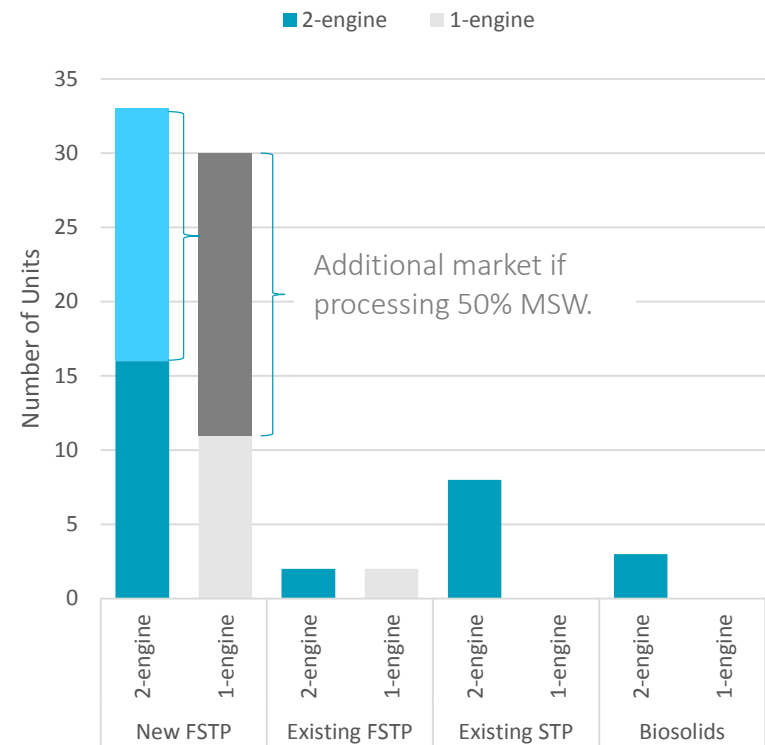
By pursuing a strategy that combines deployment of both the 1-engine and 2-engine J-OP, the total potential market size is 42 units without MSW and 78 units with MSW. This is comprised of 13-43 1-engine and 29-46 2-engine systems.

Of those, the 2-engine J-OP would capture the largest market share and therefore, should be prioritized for the Philippines market. This is particularly true if the option to burn significant quantities of MSW (or other waste) exists. The option to burn MSW is not necessary to open up the market for either J-OP but will be necessary to fully exploit it, given the large number of mid-sized cities in the Philippines. Note: for an individual plant, the ability to burn MSW may still represent an important strategy for fecal sludge supply risk mitigation.

Co-location (with an STP/FS-STP or FSTP) use case is a market with some small scale, although it is limited to Metro Manila and Cebu where more sizable facilities exist in combination with large FSM populations. Co-location increases the attractiveness of this use case as an early part of market entry for the Philippines. The biosolids use case is limited to Manila. Two additional cities have STPs however, the plants are too small to support even an 1-engine J-OP. FS-processing J-OP's deployed in Manila will likely transition to biosolids processing facilities as households are transitioned to sewers.

## Total Market Potential in the Philippines

by size and use case

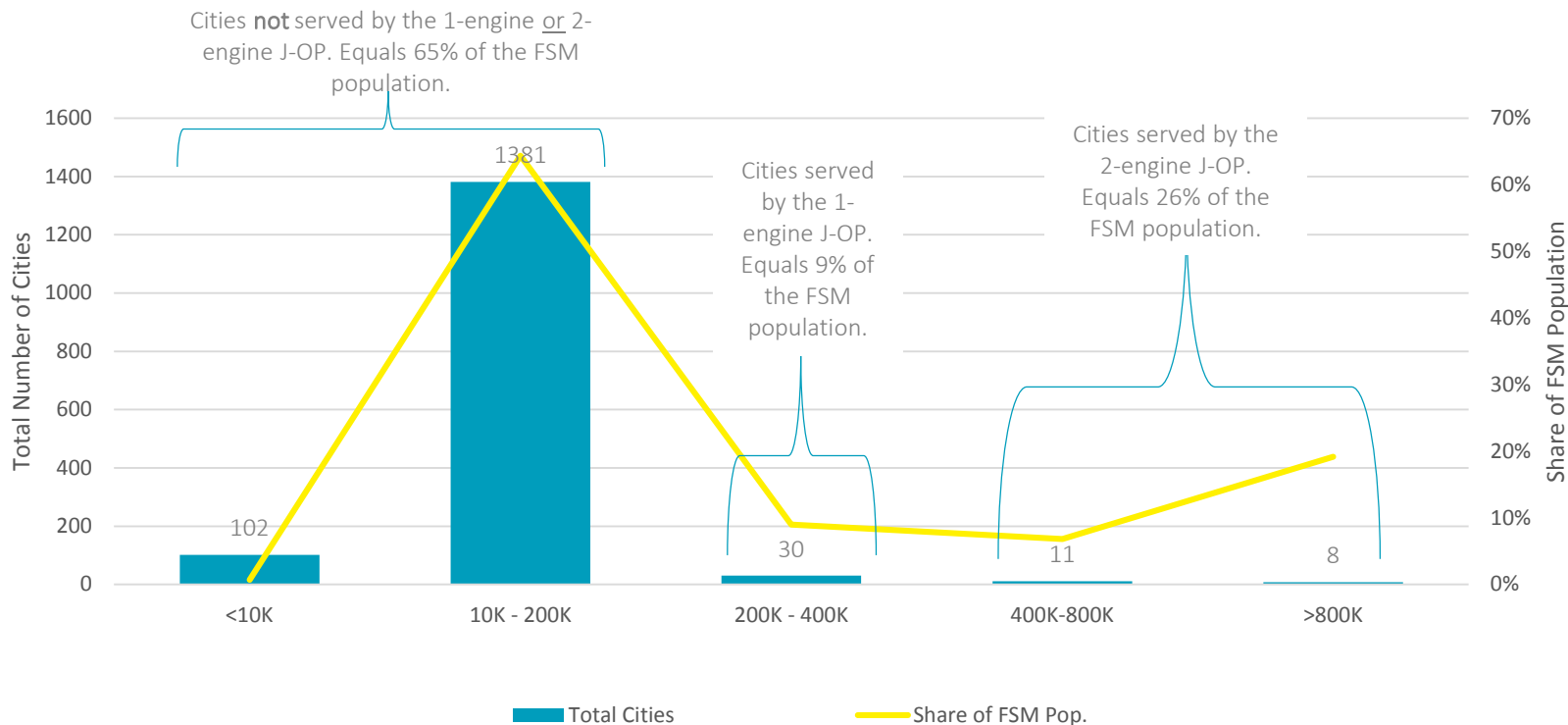




# 35% of the total FSM population can be served by the 1-engine and 2-engine J-OP's.

If the J-OP can be scaled down further (i.e. smaller than an 1-engine J-OP), there is an opportunity to serve the estimated 1,381 towns in the Philippines with populations greater than 10,000 people, representing ~64% of the total FSM population.

Populations Served by the J-OP in the Philippines  
by population served by the 1-engine and 2-engine J-OP systems



\*Cost competitiveness was not evaluated at scales smaller than the 2-engine J-OP. Analysis based on best available performance data at the time of publication.

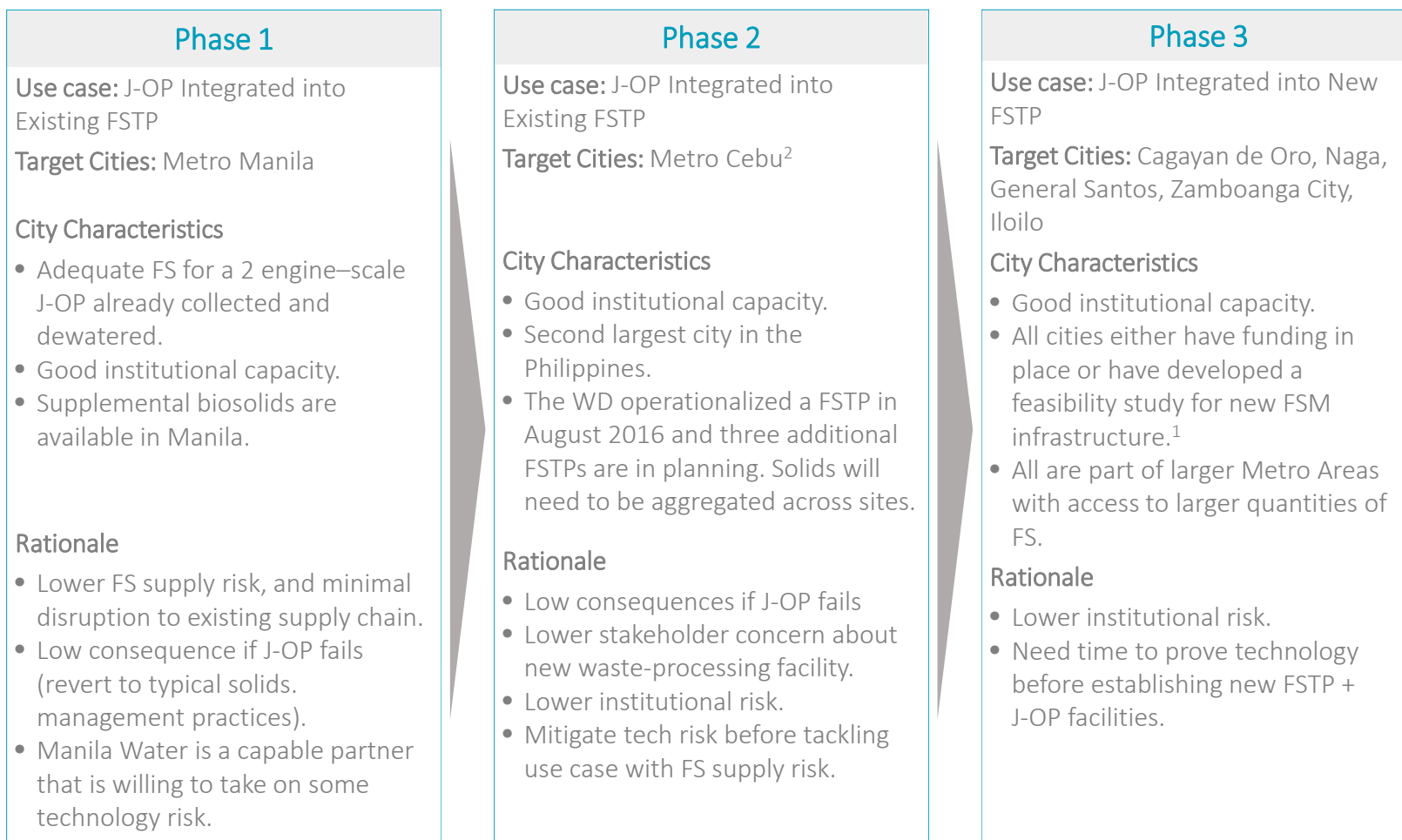
## A number of barriers to entry will have to be overcome in the Philippines.

	Barrier to Entry	Mitigation Actions
Aversion to risk	WDs do not take on new technology risk and commonly require that a technology be operational in the Philippines to be considered in a tendering process. LGU's considering solid waste management projects were more lenient in terms of the physical location of a demonstration facility, although preference would be for South East Asia (SEA), where MSW streams are more similar in nature.	Engage and partner with established local partners for pilot project facilitation and on-going project development support. The best path to market in the Philippines will likely be through Manila Water first and then through other locally prominent firms. With a reputation as the leader on water supply and treatment in the country and a hunger to take on new service areas in the Philippines and beyond, Manila Water is actively seeking new technologies that are economically self-sustaining and can yield transferable benefits to their customers (i.e., reductions in cost, improvements in service). The company is willing to explore piloting opportunities but would look to others to buy down the risk through shared investment.
Water Districts favor the bundling of services	Of the public agencies developing projects under a build-operate-transfer (BOT) model, all are bundling treatment with collection and requiring service providers to undertake both. Of the publically developed projects evaluated, the operating entity is also providing septage collection.	The need for collection and treatment services may impact a commercial partner's local partnership strategy. Consider partnering with a local firm with desludging experience to enter markets in the Philippines. This is particularly true in cases where septage collection and treatment are currently non-existent.

## Barriers continued

	Barrier to Entry	Mitigation Actions
Vendor fatigue	LGU's are experiencing vendor fatigue. Local solid waste management stakeholders are continually approached by technology providers promising to convert their waste into energy for minimal or no cost. Water districts appear to be insulated from this phenomenon. Vendors will reportedly execute a Memorandum of Understanding with the cities and never return. As a result, there is a great deal of skepticism towards technology providers.	The issue of credibility is partially absolved by the Gates Foundation brand; however, further engagement with LGUs and water districts is not advised until the J-OP has been thoroughly trialed with MSW of varying compositions and FS and supporting data can be provided.
Poor FS collection rates	Only a small share of FS generated is currently collected AND delivered for treatment (~3,000m <sup>3</sup> /d).	Work with a city willing to invest in increased collection (e.g., education, enforcement) or adopt an integrated model in which the FSTP operator is also the FS collector.
Availability of financing but inability to access it	WDs and LGUs lack the capacity and technical experience to undertake project planning activities. Manila Water and Maynilad Water possess strong in-house project development capabilities because of their size and prior experience; however, outside of Manila, city agencies require outside assistance to develop projects.	Permitting and financing are contingent on the existence of a tariff structure and feasibility assessment. The BMGF or the commercial partner will either need to (1) provide upfront technical assistance or (2) deploy systems in cities that have recently received technical assistance from other donor agencies (e.g., U.S. Agency for International Development [USAID]).

# Market entry should be sequenced to pursue easier targets first and address risks in a stepwise fashion.



<sup>1</sup> According to “East Asia and the Pacific Region Urban Sanitation Review, Philippines Country Report, World Bank study, 2013. <sup>2</sup> Cities in Phase 3 may move into Phase 2 depending on how quickly they progress with their planned projects.



## Establishing relationships with local partners will be critical to penetrating the Philippines market.



Manila Water Company, Inc. is a Manila-based private water company with new business ventures across SEA. Manila Water treats and distributes potable water to more than 6 million residents across Manila. In addition, it operates 78 vacuum trucks and owns and operates 41 sewerage treatment plants and 2 septage treatment plants.

Manila Water is actively seeking new technologies for sewage/septage and MSW management. STeP met with Robert (Boogz) Baffrey and team, who expressed an interest in exploring pilot project opportunities around the J-OP.



With a focus on Metro Manila, Maynilad Water Services, Inc. has the largest customer base in the Philippines. Maynilad provides water and wastewater services to 17 cities and metropolitan areas in Metro Manila, includes desludging and septage treatment. The company maintains and operates 19 wastewater treatment plants, some of which co-process septage.

Since 2007, the company has spent P47 billion to improve and expand water services and plans to continue accelerating water investments through its concession period, ending in 2037.



EnviroKonsult is a dominant player in the septage collection and treatment sector with strong ties to Manila Water and Maynilad Water. EnviroKonsult is the Number 1 desludging truck supplier in the Philippines and, since 2013, has become a dominant player in septage treatment because of its unique BOT value proposition.

EnviroKonsult is technology agnostic and is willing to explore the adoption of new technologies. Currently, the company offers a mechanized septage treatment system that includes a rotary composting unit, which could be replaced with an alternative sludge-management technology.

*Both Manila Water and Maynilad Water have laid out individual 25-year plans to provide 100% sewage + septage collection and treatment by 2037.*

# The Philippines market presents key technology implications for J-OP system deployment.

Use Case	Biosolids Processing /Co-Locate with STP/FS-STP	J-OP Integrated into Existing FSTP	J-OP Integrated into New FSTP
Capacity targets (Based on existing infrastructure)	Existing STPs range from 6.5-100 MLD	20-814 m <sup>3</sup> /d raw septage	Planned facilities range from 50-240 m <sup>3</sup> /d. Largest market segment will generate 7-142 m <sup>3</sup> /d. <sup>2</sup>
Cost targets	Consider the value of developing a smaller scale J-OP as a mechanism for capturing a greater share of the potential market.		
Capital cost (2-engine J-OP) <sup>1</sup>	Unknown	\$2.8M (J-OP Only)	\$2.8M (J-OP Only); \$6.6M (J-OP + FSTP)
- Labor	Minimize labor requirements (to meet WDs' need to keep headcount low)		
- Footprint	Minimize footprint, odors and other public nuisances in order to take advantage of city's willingness to site systems in central areas		
<b>Inputs</b>			
FS / biosolids min. solid content system must process	Dewatered biosolids and septage: 20% TS	Raw septage: 1%–2% Dewatered septage: 20% TS	Raw septage: 1%–2% TS
MSW	Identify dewatering technologies that are best fit for likely FS characteristics	N/A	Identify off-the-shelf effluent treatment solutions and conduct necessary engineering design to integrate with the J-OP
<b>Outputs</b>			
Power	Optimize to maximize power output, take advantage of RE incentives & high electricity prices		
Water	Little value; treat to non-potable standard (case-by-case)		
Air emission	Must meet Clean Air Act 2004 requirements		

<sup>1</sup> Capex to be competitive with co-composting. Estimate assumes solids must be managed. Cost estimates assume 90% debt at subsidized rates. Low land price & high compost value. STeP did not evaluate biosolids management costs through the course of this study. Capital cost targets are exclusive of hauling costs, which may lead to a higher willingness to pay. <sup>2</sup> Largest market segment is cities with FSM populations ranging from 10K-200K. Per capita FS accumulation rate assumed to be 0.72 l/p/d (source: BMGF 10-Country Study, regional average).

# Market entry can take two potential paths, depending on local partnership development outcomes.

The plan below describes a set of actions that currently appear necessary for a commercial partner to successfully achieve entry into the Philippines market. It is assumed that (1) the decision to enter the Philippines market has already

been made, (2) they are focused on the Philippines market, and (3) they are well funded and committed to moving quickly.

## Philippines Market Entry Action Plan

		Category	Timeframe														
1	Establish a relationship with Manila Water for the purpose of introducing the J-OP to the Philippines market through the establishment of a pilot facility in Manila. Explore funding sources available to cover the cost of the pilot project—likely to be 50% of capex (e.g., ADB, other local grant facilities)	Commercial	Immediately														
2	Register the J-OP technology with the National Department of Science and Technology.	Technology	Short term														
3	Depending on the commercial partner’s envisaged value chain position, explore potential partnership with EnviroKonsult or the incorporation of a local operating company—a pre-requisite to pursuing projects in the Philippines.	Commercial	Short term														
<table border="1"> <thead> <tr> <th>In Partnership with EnviroKonsult</th> <th>As Independent Operating Entity</th> </tr> </thead> <tbody> <tr> <td>4</td> <td> <td>In collaboration with EnviroKonsult, begin project exploration in Metro Cebu.</td> <td>Evaluate dewatering and effluent treatment technologies—select the best fit for likely FS supply characteristics in the Philippines and conduct any necessary engineering design work to integrate the selected technology option.</td> <td>Market-making / technology</td> <td>Short term</td> </td></tr> <tr> <td>5</td> <td> <td>Begin business development with Phase 3 cities and, perhaps before selling a FSTP, pursue joint development of an innovative project that increases the sludge capture rates from septic tanks.</td> <td>Begin business development in Metro Cebu. Explore opportunities to establish a J-OP to process already dewatered solids from existing FSTPs.</td> <td>Market-making</td> <td>Medium term</td> </td></tr> </tbody> </table>		In Partnership with EnviroKonsult	As Independent Operating Entity	4	<td>In collaboration with EnviroKonsult, begin project exploration in Metro Cebu.</td> <td>Evaluate dewatering and effluent treatment technologies—select the best fit for likely FS supply characteristics in the Philippines and conduct any necessary engineering design work to integrate the selected technology option.</td> <td>Market-making / technology</td> <td>Short term</td>	In collaboration with EnviroKonsult, begin project exploration in Metro Cebu.	Evaluate dewatering and effluent treatment technologies—select the best fit for likely FS supply characteristics in the Philippines and conduct any necessary engineering design work to integrate the selected technology option.	Market-making / technology	Short term	5	<td>Begin business development with Phase 3 cities and, perhaps before selling a FSTP, pursue joint development of an innovative project that increases the sludge capture rates from septic tanks.</td> <td>Begin business development in Metro Cebu. Explore opportunities to establish a J-OP to process already dewatered solids from existing FSTPs.</td> <td>Market-making</td> <td>Medium term</td>	Begin business development with Phase 3 cities and, perhaps before selling a FSTP, pursue joint development of an innovative project that increases the sludge capture rates from septic tanks.	Begin business development in Metro Cebu. Explore opportunities to establish a J-OP to process already dewatered solids from existing FSTPs.	Market-making	Medium term		
In Partnership with EnviroKonsult	As Independent Operating Entity																
4	<td>In collaboration with EnviroKonsult, begin project exploration in Metro Cebu.</td> <td>Evaluate dewatering and effluent treatment technologies—select the best fit for likely FS supply characteristics in the Philippines and conduct any necessary engineering design work to integrate the selected technology option.</td> <td>Market-making / technology</td> <td>Short term</td>	In collaboration with EnviroKonsult, begin project exploration in Metro Cebu.	Evaluate dewatering and effluent treatment technologies—select the best fit for likely FS supply characteristics in the Philippines and conduct any necessary engineering design work to integrate the selected technology option.	Market-making / technology	Short term												
5	<td>Begin business development with Phase 3 cities and, perhaps before selling a FSTP, pursue joint development of an innovative project that increases the sludge capture rates from septic tanks.</td> <td>Begin business development in Metro Cebu. Explore opportunities to establish a J-OP to process already dewatered solids from existing FSTPs.</td> <td>Market-making</td> <td>Medium term</td>	Begin business development with Phase 3 cities and, perhaps before selling a FSTP, pursue joint development of an innovative project that increases the sludge capture rates from septic tanks.	Begin business development in Metro Cebu. Explore opportunities to establish a J-OP to process already dewatered solids from existing FSTPs.	Market-making	Medium term												



## TABLE OF CONTENTS

Introduction

Philippines Market Strategy

**Philippines Market Analysis**

Policy and Regulatory Landscape

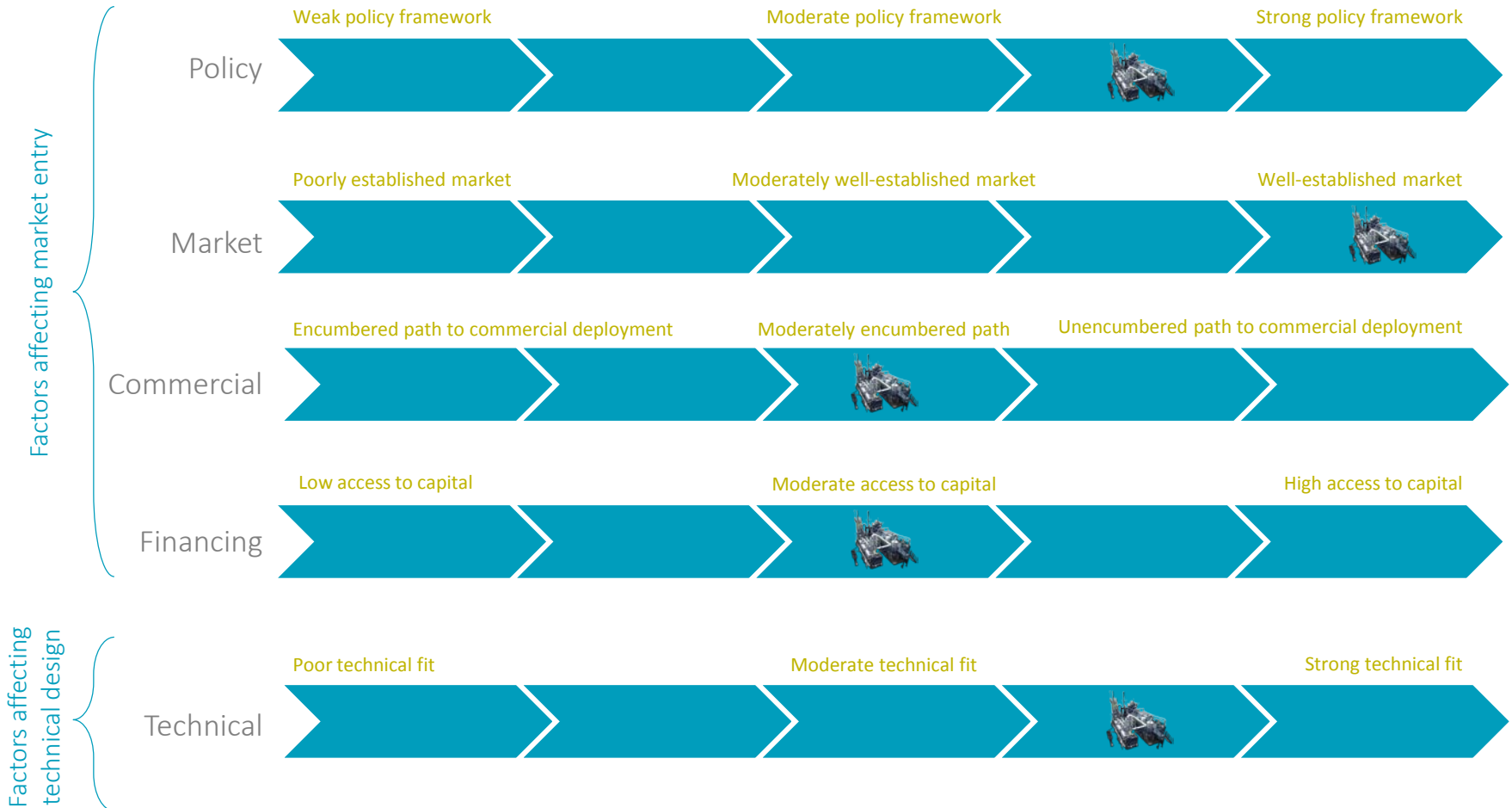
Market Landscape

Commercial Landscape

Financial Landscape



# The Philippines is an attractive market for the J-OP, with many of the prerequisites for success in place.



# Enabling policies are in place to support a J-OP but could be improved through enhanced enforcement.



The CWA (Republic Act No. 9275) mandates that LGUs provide sewage or septage management services to their customers by 2020. LGUs are also required to allocated land for the development of FSTPs. WDs, where present, are the implementing entity responsible for service provision. LGUs are required to issue a local ordinance; a mechanism to facilitate regularized septage collection, typically every 5 years; and the implementation of an environmental services fee, which is commonly paid in the form of a surcharge applied to each cubic meter of drinking water consumed or with an annual property tax.

Until recently, combustion-based waste-to-energy technologies were not permitted in the Philippines. However, in June 2016, the Supreme Court reversed its previous ruling, opening the door to new technologies, presuming they meet the requirements of the Clean Air Act and that all MSW undergo pre-sorting.

Numerous supportive RE policies are driving the scale-up of nation-wide capacity although biomass appears to be a lower priority than solar, wind, hydro, and geothermal power. Policy mechanisms in place include:

- financial incentives to lower investment costs (e.g., tax and duty exemptions) and
- mechanisms to increase competitiveness—feed in tariff (FIT); for biomass (USD 0.14/kWh), mandatory biofuels utilization and Renewable Portfolio Standard.

Despite the steady development of new septage management programs, enforcement mechanisms are weak and the country does not appear to be on track for all LGUs to meet the 2020 mandate.

# The market for FSTPs in the Philippines is significant and growing with 21 facilities built.



The current market for septage treatment plants in the Philippines is strong with 21 facilities already in operation and 18 cities and metro areas in various stages of implementing new septage management programs. Existing FSTPs range in size from 20 to 814 m<sup>3</sup>/day, with eight processing more than 100 m<sup>3</sup>/day. In aggregate the facilities treat 3,000 m<sup>3</sup>/day of septage. Numerous other facilities are in the pipeline. Notably, Puerto Princesa and Bacolod are both in the process of issuing requests for proposals for FSM services, and Cebu is preparing a proposal to JICA for treatment equipment for two additional FSTPs. All proposed facilities are expected to use mechanical treatment technologies.

According to the “Philippines Country Report”, World Bank (2013), there are an additional 14 cities or metro areas that have either secured funding or developed feasibility assessments for new FSM systems, four of which have

populations greater than 500,000 people (Metro Naga, Cagayan de Oro, Zamboanga City, General Santos).

Separately, WWTPs continue to be constructed in Manila where the city’s two concessionaires have laid out ambitious goals to achieve 100% wastewater and septage treatment by 2037. In 2016 alone, Maynilad Water earmarked over PHP 6 billion (USD 120 million) for wastewater programs in Valenzuela, Pasay, Muntinlupa, Paranaque, and Cavite City, and Manila Water is nearing construction on one the largest wastewater treatment plants in the country, the Ilugin STP (100 MLD).

# The value of electricity is high, and capable local partners are positioned to bring the J-OP to market.



Water districts pay heavily for electricity to pump, treat and distribute potable water and industrial retail electricity rates are high, ranging from P4.66 (USD 0.10) to P11.20 (USD 0.23)/kWh (2011). In addition, reliability of supply varies. In Palawan Island, where 100% of the electricity is supplied by PALECO, a cooperative that generates 100% of it's supply from diesel fuel, the WD uses generators 30% of the time during the summer months.

With a tropical climate, the Philippines has significant water resources. As a result, water reuse is not practiced in a systematic way. No markets for ultrapure water were identified by interviewees, although there are industries in the Philippines that could be potential buyers, such as semi-conductors and other electronics.

Unsurprisingly, there was a need to see an in-country demonstration of the J-OP in the Philippines. India was viewed as being too far away and too different. Most cities were very interested in hosting a demonstration site—provided they were isolated from the technology risk and another organization paid for plant.

Business models may not be limited to a publically owned

and operated system. The BOT model is growing ever-more popular in the Philippines with Cebu and Bacolod both developing systems under this model. Key advantages are that the city does not have to obtain financing for the plant and can master operations over the (typically) 5-year concession agreement. This is very important to WDs, in particular because, in many cases, this is their first foray into septage treatment. Service fees range from P800/m<sup>3</sup> to P1,500/m<sup>3</sup> (USD 16-30/m<sup>3</sup>) to collect and treat septage.

The best path to market in the Philippines will likely be through Manila Water first and then through other locally prominent firms. Manila Water is actively seeking new technologies that are economically self sustaining and can yield transferable benefits to their customers (i.e., reductions in cost, improvements in service). The company is willing to explore piloting opportunities but would look to others to buy down the risk through shared investment. Additionally, TORs require that respondents have a least one contract similar in nature In the Philippines and water districts admittedly favor local firms, further emphasizing the need for local partnerships. EnviroKonsult, a technology agnostic design, construction, and O&M firm, is one potential partner.

# Numerous financing options are available to WDs and LGUs, although they appear challenging to access.



While national grant and other loan programs exist, interviewees expressed difficulty and a lack of desire to access capital. National development banks and commercial banks, along with the Local Water Utilities Association (LWUA) and Oxfam, offer project financing with annual rates ranging from 0% to 12%. In addition, the NSSMP has established a capital grant program available to LGU's that can cover up to 40% of the total project cost, with assistance offered to secure the remaining 60%. Across financing institutions, a feasibility assessment, local ordinance, and tariff structure must be in place prior to securing funds. In spite of availability of capital, not a single city has qualified for the grant and of the septage plants

evaluated, only Puerto Princesa was planning to finance their project. Remaining projects were either funded through capital improvement budgets, outsourced through a BOT contract, or developed with 100% grant funding from external aid organizations (e.g., JICA). Access to capital appears hindered by a lack of institutional capacity to undertake pre-project planning activities and may be a real challenge for WDs and LGUs, prompting them to gravitate towards the BOT model.

# The J-OP, with suitable pretreatment, is a good technical fit for the Philippines market.



**Solids Content of Septage:** The total solids (TS) content of septage in the Philippines is reportedly very low (1-2%). Septic tanks are the dominant type of onsite sanitation and are often poorly constructed and maintained. Low solids content in the septage will significantly impact the volume of septage required to yield necessary mass flows to the J-OP and means that the J-OP will need to be coupled with upfront dewatering and effluent treatment steps. This could be achieved through co-location with an FSTP or an STP. In addition to low solids content, any FS treatment system may have to contend with high inorganic content. Data from Dumaguete reveals that FS dried in a drying bed is only 15% organic, the rest of which is inert material such as sand. It is uncertain how much inert material is coming from the drying bed versus a poorly functioning septic tank.

**Land:** The small footprint of the J-OP was viewed as a positive characteristic by interviewees—largely because of high population density and scarcity of land. In densely populated cities such as Manila and Cebu, facility siting is occurring in neighborhoods and commercial areas, while in more diffuse cities such as Puerto Princesa and Bacolod, planned facilities are being sited on the outskirts of town or near existing waste processing facilities.

**Emissions Regulations:** The Philippines regulations for air emissions, waste to energy facilities, etc are not likely to present a barrier to the J-OP—detailed evaluation will be required at a later date.

**Demand for Dewatered Fecal Sludge/ Fertilizer for Land Application:** None of the facilities visited received monetary compensation for their dewatered FS, although several perceived solids as having some value, gifting it back to the city in exchange for their participation in the project or to the surrounding community.

**Solid Waste:** LGUs and Manila Water, were highly interested in the J-OP's ability to process MSW. According to national law, MSW must be presorted and only residual wastes can be treated in a WTE plant.





## TABLE OF CONTENTS

Introduction

Philippines Market Strategy

Philippines Market Analysis

**Policy and Regulatory Landscape**

**The Sanitation Landscape**

The Solid Waste Landscape

The Renewable Energy Landscape

The Reuse Water Landscape

Market Landscape

Commercial Landscape

Financial Landscape

**STeP**

Sanitation Technology  
Platform

# The Philippines has a relatively robust sanitation policy that assigns responsibility and sets management guidelines.

The Clean Water Act of 2004 and the Sanitation Code of the Philippines of 1975 provide the regulatory framework for sewage and septage management programs.

Enacted in 2004 by the Department of Environment and Natural Resources, the CWA assigns responsibility for policy making, oversight, fee generation, land allocation and service provision. The CWA:

- requires that water districts provide sewerage and septage management services to all customers;
- requires LGUs to prepare compliance schemes;
- authorizes water districts and local government units to impose taxes and fees to cover costs associated with sewerage and septage services;
- requires LGUs to allocate land for septage and sewerage treatment plants;
- tasks the Department of Public Works and Highways (DPWH) with developing a national sanitation and sewerage program and allocating funds for the development of sewerage and septage facilities by mid 2016; and
- requires the Department of Health to formulate guidelines on the collection, treatment, and disposal of sewage.

The Sanitation Code:

- describes basic septic tank requirements (shape, construction material, location) and
- indicates that effluent from septic tanks can be discharged into a sub-surface soil, an absorption field or discharged into a stream or body of water if it conforms to the quality standards prescribe by the National Water and Air Pollution Control Commission.

## In 2013, the DPWH developed the NSSMP to aid compliance with the Clean Water Act.

The National Sewage and Septage Management Program (NSSMP) is a multi-faceted program that provides financial support and technical assistance to LGUs to catalyze the development of new projects. The program was developed by the the Philippines DPWH with the support of the World Bank and the Water and Sanitation Program, along with inputs from numerous other national government agencies.

**Objective:** Enhance the ability of local implementers (LGUs and WDs) to build and operate sewage and septage management systems in urban areas.

**Features:** The NSSWP is a bottom-up, demand-driven project development process that offers national government support and incentives. The program sets national targets to increase sewage and septage management and direct investment to projects. A clear process for project development is defined in addition to a toolkit including various resources to help local implementers.

### NSSMP TARGETS

#### (Outside Manila Area)

By 2020, all LGUs will have developed a septage management system and the 17 highly urbanized cities (HUCs) will have developed a sewerage system

By 2020, approximately 43.6 million people will have access to septage treatment facilities and about 2.3 million will have access to sewerage treatment facilities

By 2020, P26.3 billion will have been invested in sanitation improvement projects

By 2020, about 346 million kg of BOD will have been diverted from the environment per year as a result of sewerage and septage management projects

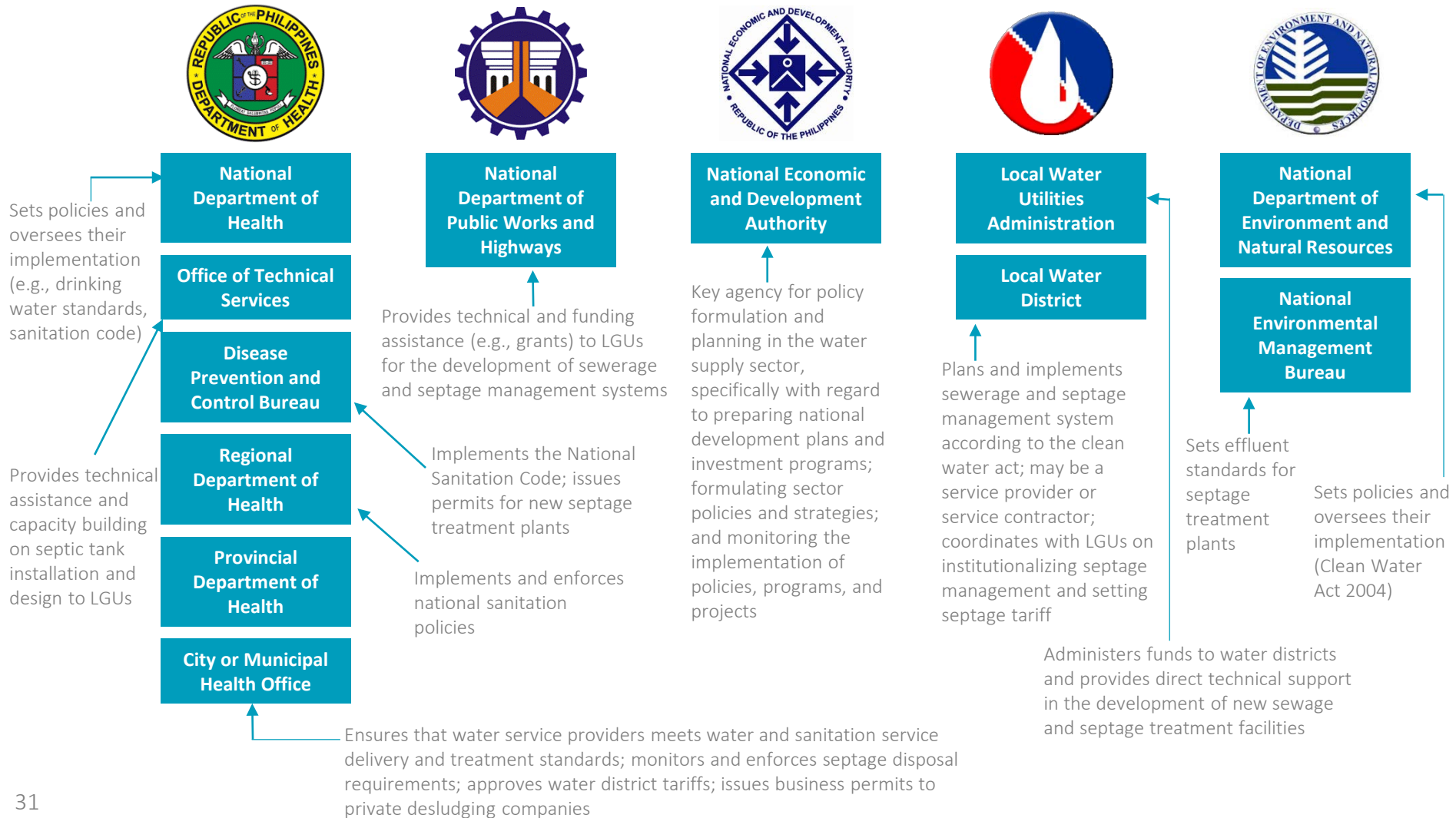


## The NSSMP is supported by an enabling policy environment.

Regulation	Description
Code on Sanitation of the Philippines	Septic tanks must be water-tight, inspected once a year, cleaned when the sludge has reduced the liquid capacity by 50%, and the sludge must be treated and disposed of properly. It is unlawful to discharge untreated effluent of septic tanks or sewage treatment plants to bodies of water without approval of the Secretary of Health.
Clean Water Act	The CWA establishes the LGUs' role in maintaining good water quality. By 2020, LGUs are mandated to have their own septage and sewerage services in place. All industrial, commercial, and residential buildings should be connected to existing sewerage systems in HUCs. For non-HUCs, septage management systems shall be employed. LGUs are required to provide land for treatment facilities.
Operations Manual on the Rules and Regulations Governing Domestic Sludge and Septage	All septage haulers and septage treatment facilities must secure an Environmental Sanitation Clearance (ESC) from the Center for Health Development of the DOH. Proper collection, treatment and disposal of the septage are required.
Plumbing Code of the Philippines	It is unlawful for any person to deposit into any plumbing fixture connected to the excreta and storm drainage systems any oils, greases, or other things that could cause damage to the drainage system or public sewer.
Presidential Decree 198	A water district may require, construct, operate, and furnish facilities and services for the collection, treatment, and disposal of sewage, waste, and storm water. The water district may require all buildings used by human beings to be connected to the sewer system within such reasonable time as may be prescribed by the district. Failure to connect can be grounds for the water district to deny water services to the non-compliant building. A water district may prescribe and collect fees for sewerage services furnished.
Local Government Code	Barangays are primarily responsible for general hygiene and sanitation services. Provinces, municipalities, and cities are responsible for building drainage and sewerage infrastructure. LGUs may impose a special levy on the lands within their jurisdiction specially benefited by public works projects or improvements funded by the LGU concerned. However, the special levy shall not exceed 60% of the actual cost of such projects and improvements.

# Institutional Framework—Sanitation

Office of the President





## TABLE OF CONTENTS

Introduction

Philippines Market Strategy

Philippines Market Analysis

### Policy and Regulatory Landscape

The Sanitation Landscape

**The Solid Waste Landscape**

The Renewable Energy Landscape

The Reuse Water Landscape

Market Landscape

Commercial Landscape

Financial Landscape

**STeP**

Sanitation Technology  
Platform



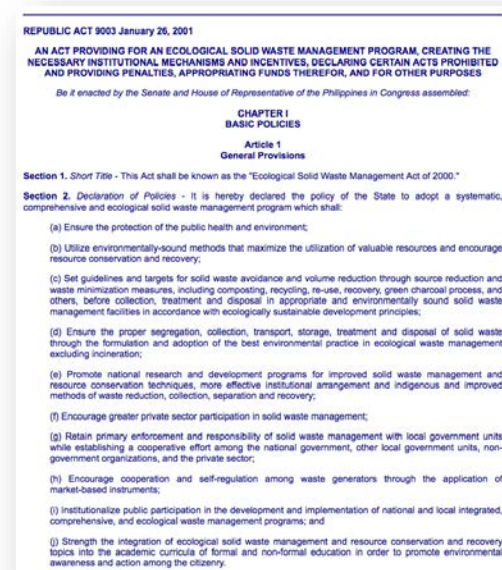
# The Ecological SWM Act and the Clean Air Act are the key policies governing the conversion of waste to energy.

The Ecological Solid Waste Management Act of 2000 and the Implementing Rules and Regulations that followed in 2001, promote a reduce-reuse-recycle approach (3Rs) to SWM.

Historically, the Clean Air Act of 1999 prohibited the incineration of municipal, biomedical, and hazardous waste, while mandating that LGUs promote source segregation, recycling, and composting instead. Although the Renewable Energy Act of 2008 opened the door to the anaerobic digestion, fermentation, and gasification of biodegradable wastes, **it was not until June 2016 when the Supreme Court reversed the ban on incineration, that combustion-based technologies were permitted for use in the Philippines.**

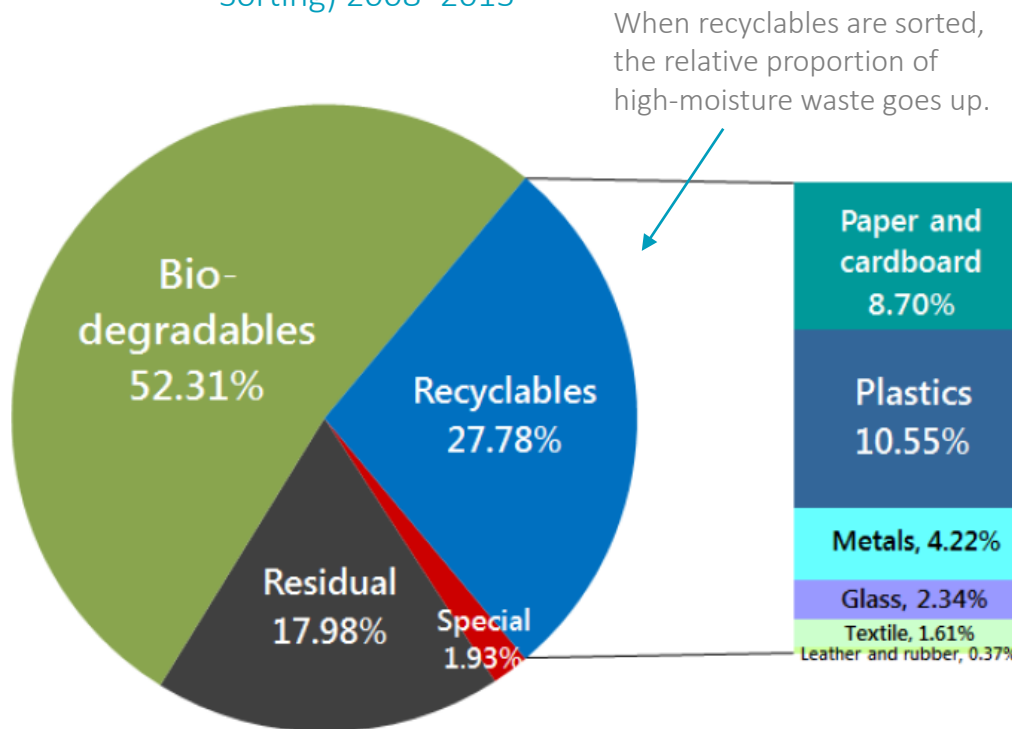
Conditional features include the following:

- Emissions must not exceed those established by the Clean Air Act 1999. Emission limits can be found in Appendix C.
- Municipal solid waste must undergo separation at the source. A complete list of cities with source separation programs can be found in Appendix C.



# MSW composition is ~50% high-moisture, bio-degradable waste, requiring selectivity &/or pre-treatment.

Typical Composition of MSW in the Philippines According to WAS (Before Sorting) 2008–2013



Typical Moisture Content by Waste Type

Waste Type	Typical Moisture Content (%)*
Paper and Cardboard	4%–10%
Plastic	1%–4%
Metal	2%–6%
Glass	1%–4%
Textile	6%–15%
Food	50%–80%
Garden	30%–80%
Leather	8%–12%

# Institutional Framework—Solid Waste

## Office of the President



**National Solid Waste Management Commission**

Prepares the National Solid Waste Management Framework; approves local SWM plans in accordance with RA 9003 rules and regulations; reviews and monitors the implementation of local SWM plans; develops and implements a program to assist LGUs in the identification of markets that are diverted from disposal facilities through the 3Rs; manages the SWM fund and allocates capital equipment grants; develops and prescribes procedures for the issuance of permits and clearances

Comprises 14 members from the government sector (e.g., Department Environment and Natural Resource, Department of Health, Department of Public Works and Highways, Department of Agriculture) and three members of the private sector



**National Department of Environment and Natural Resources**

Establishes methods and parameters to measure waste collection and disposal; issues rules and regulations to implement the Ecological Solid Waste Management Act 2000; issues environmental compliance certificates

**National Ecology Center**

**Secretariat of the NSWMC**

Provides technical support to LGUs

Day-to-day management of the National Solid Waste Management Commission

**National Environmental Management Bureau**

Sets policies on air quality for waste to energy technologies

**Provincial Solid Waste Management Board**

Reviews and integrates municipal SWM plans into the provincial SWM plan

**Regional Environmental Management Bureau**

Monitors emissions criteria of projects within their region

**Municipal Solid Waste Management Board**

Prepares, submits, and implements local 10-year SWM plan; manages the collection and disposal of residual and special wastes; coordinates across all of its barangays; adopts cost recovery measures

**Provincial Environmental Management Bureau**

Coordinates with regional EMB on monitoring standards compliance

**Barangays**

Collects biodegradable and recyclable wastes; executes education campaigns; establishes and operates materials recovery facilities



## TABLE OF CONTENTS

Introduction

Philippines Market Strategy

Philippines Market Analysis

### Policy and Regulatory Landscape

The Sanitation Landscape

The Solid Waste Landscape

**The Renewable Energy Landscape**

The Reuse Water Landscape

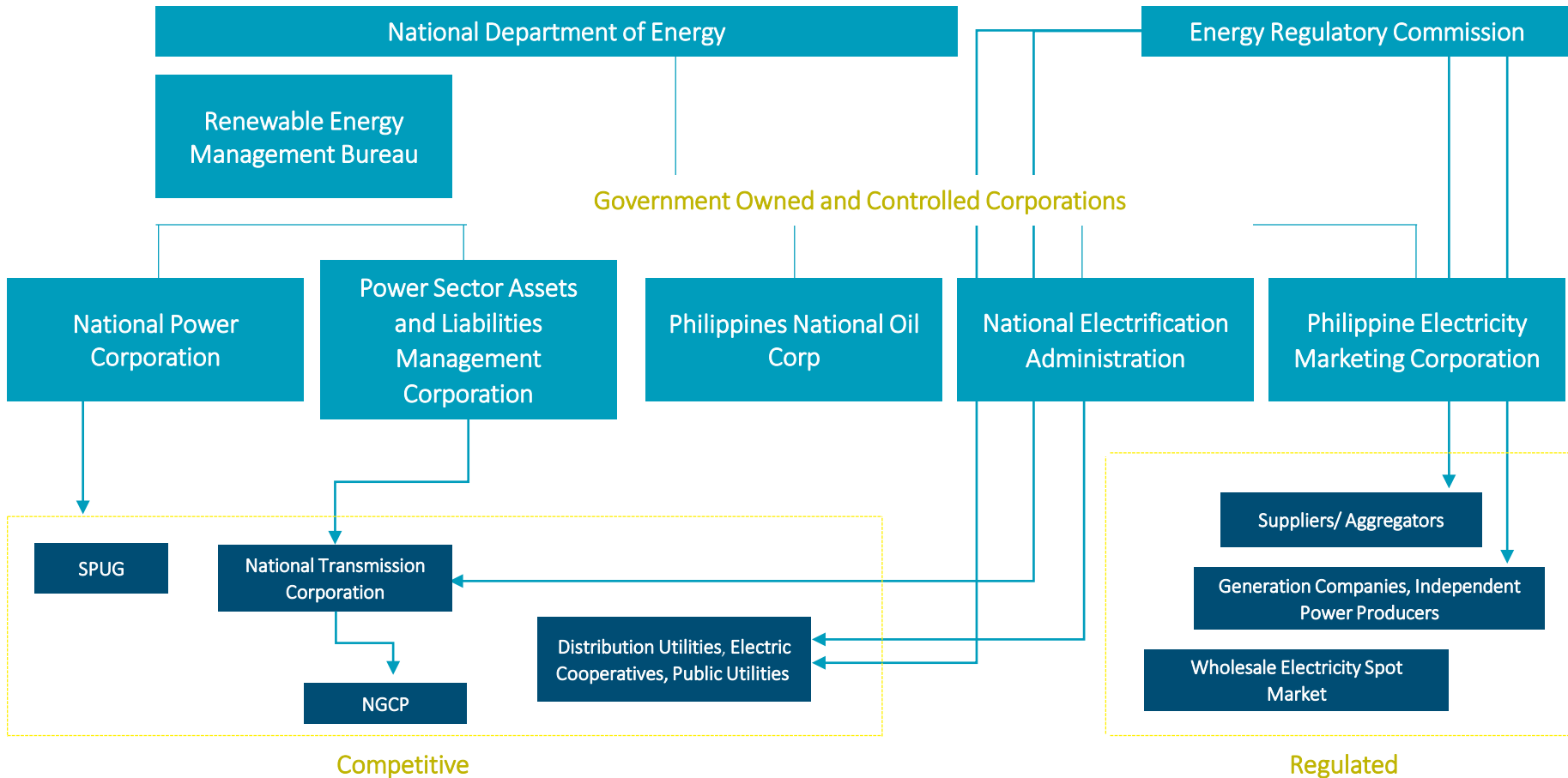
Market Landscape

Commercial Landscape

Financial Landscape

# Institutional Framework—Renewable Energy

Office of the President



Agencies and Corporation	Role/Responsibility
National Department of Energy	<ul style="list-style-type: none"> <li>• Prepares, integrates, coordinates, supervises, and controls all plans, programs, projects, and activities of the government relative to energy exploration, development, utilization, distribution, and conservation.</li> </ul>
Renewable Energy Management Bureau	<ul style="list-style-type: none"> <li>• Formulates and implements policies, plans, and programs related to the accelerated development, transformation, utilization, and commercialization of renewable energy resources including emerging energy technologies.</li> </ul>
National Power Corporation (NPC)	<ul style="list-style-type: none"> <li>• Generates and sells electricity from undisposed generating assets and independent power producer (IPP) contracts of PSALM.</li> <li>• Performs missionary electrification.</li> </ul>
National Electrification Administration (NEA)	<ul style="list-style-type: none"> <li>• Prepares electric cooperatives (ECs) to operate in a competitive market.</li> <li>• Provides financial, institutional, and technical assistance to distribution utilities (DUs) to make them highly competitive in delivering quality service.</li> <li>• Reviews and revises regulatory policies to enhance the viability of electric cooperatives.</li> </ul>
Power Sector Assets and Liabilities Management Corporation (PSALM)	<ul style="list-style-type: none"> <li>• Manages NPC assets and liabilities.</li> <li>• Manages NPC Privatization process.</li> <li>• Assumes NPC debt and IPP Contracts.</li> <li>• Administers Universal Charge (UC) which is collected every month by the distribution utilities from all electric consumers. The UC fund is used to finance, as specified by law, missionary electrification, environmental protection projects, and payment of National Power's stranded debts.</li> </ul>
Energy Regulatory Commission (ERC)	<ul style="list-style-type: none"> <li>• Independent, quasi-judicial regulatory body.</li> <li>• Promotes competition, ensures customer choice, and penalizes abuse of the market.</li> </ul>
Philippine Electricity Marketing Corporation (PEMC)	<ul style="list-style-type: none"> <li>• Operates and governs the wholesale electricity spot market (WESM), a commodity market where electricity is traded.</li> </ul>
Philippines National Oil Corporation (PNOC)	<ul style="list-style-type: none"> <li>• In charge of the exploration, exploitation, and development of all energy resources in the country.</li> </ul>
National Transmission Corporation (Transco)	<ul style="list-style-type: none"> <li>• Provides nationwide electricity transmission for the electricity generated by the NCP.</li> </ul>



Other Actors	Role/Responsibility
Distribution Utilities (DU's) and Electric Cooperatives (EC's)	<ul style="list-style-type: none"> <li>• Provides distribution services and connections to its system for any end-user within its franchise area.</li> </ul>
Generation Companies (GC)*, Independent Power Producers (IPP)	<ul style="list-style-type: none"> <li>• Operates facilities used in the generation of electricity.</li> <li>• Secures a certificate of compliance from the Energy Regulatory Commission (ERC).</li> <li>• Secures health, safety and environmental clearances from appropriate government agencies under existing law.</li> <li>• Complies with cross-ownership provisions.</li> <li>• Complies with the PGC, WESM Rules and other relevant issuances.</li> </ul>
Suppliers/Aggregators	<ul style="list-style-type: none"> <li>• Engages in retail supply of electricity with Contestable Customers (an end-users who has a choice of supplier, as may be determined by the ERC in accordance with RA 9136).</li> <li>• Secures Supplier's license from the ERC.</li> <li>• Demonstrates and complies with technical capability, financial capability, and creditworthiness requirements for Suppliers.</li> <li>• Complies with rules and regulations concerning abuse of market power, cartelization, and other anti-competitive or discriminatory behavior.</li> </ul>

# Demand for alternative sources of electricity is driven by moderate to poor reliability and the high price of electricity.

**Regulatory Context:** The Renewable Energy Act of 2008 (REA) is the legal framework enabling the sale and distribution of renewable energy (RE). The REA codifies numerous policies hospitable to RE development such as the establishment of RE standards, a green energy option allowing buyers of electricity to choose RE as their source of energy, and net metering (although not yet implemented).

**Grid Reliability:** Grid reliability in the Philippines is variable, with some cities experiencing more brownouts than others. All five cities visited (except Manila) reported regular, unplanned brownouts. Some stakeholders reported higher frequency of brownouts during summer months when demand is high. As a result, large consumers of electricity (including water districts) operate gen-sets to supply back-up power during these times.

**Competing Sources of Renewable Energy:** 30% of the nation's electricity supply comes from renewable sources: solar, wind, geothermal, wave, and biomass; 40% is derived from coal and 30% from natural gas.

**Financial Incentives for RE Generation:** Numerous policy mechanisms are in place to promote the adoption of RE technologies. Mechanisms are broadly categorized as those that lower the initial investment cost and those that increase competitiveness of the electricity.

## Policies Aimed at Reducing Investment Cost:

- For the first 7 years of commercial operations, the RE developer is exempt from income taxes levied by the national government. The developer may alternatively choose to accelerate depreciation. Following the income tax deferral period, the RE developer is given a corporate tax rate of 10% (but only if the RE developer passes the savings onto the customer).
- The RE developer is allowed duty-free importation of RE machinery, parts, and equipment for 10 years upon receiving certification by the Department of Energy.
- Preferential real-estate tax rates.
- Net operating loss carry-over for the first 3 years of commercial operation (if not deducted from gross income), for the next 7 consecutive taxable years following the loss.
- Cash incentive for missionary electrification.
- Payment of transmission charges.
- Exemption from universal charge.

## Policies Aimed at Increasing Competitiveness:

- RE generation benefits from feed-in-tariffs (FITs) in the Philippines. Biomass-to-energy projects are guaranteed a sale price of P6.63/kWh (USD 0.14) for 20 years once the project commences.
- The Department of Energy does not require that biomass plants share a percentage of their net profits with the national government or LGUs, unlike other RE projects that gift between 1% and 1.5%, after capital repayment.
- Renewable portfolio standards.



## TABLE OF CONTENTS

Introduction

Philippines Market Strategy

Philippines Market Analysis

### Policy and Regulatory Landscape

The Sanitation Landscape

The Solid Waste Landscape

The Renewable Energy Landscape

**The Reuse Water Landscape**

Market Landscape

Commercial Landscape

Financial Landscape

# Institutional Framework—Water Reuse

Office of the President



## The PNSDW sets quality standards. Effluent reuse is only established in the agriculture sector.

Taking direction from the World Health Organization (WHO) and the U.S. Environmental Protection Agency (USEPA), the [Philippines National Standards for Drinking Water \(PNSDW\) 2007](#) establishes threshold limits for microbiological and chemical parameters in drinking water and provides guidelines for assessing water quality. Water safety plans are required to ensure that WDs monitor the quality of water and assess risks to the safe supply of water throughout sourcing, production, and distribution.

In 2007, the national government also issued [Procedures and Technical Requirements for the Issuance of a Certification Allowing the Safe Reuse of Wastewater for Purposes of Irrigation and Other Agricultural Uses](#). The predominant application for reuse water in the Philippines is agriculture and, thus, the Department of Agriculture has established quality parameters and contaminant limits and guidelines on the use of treated effluent on crops. Agriculture is the only sector that has established regulations on the use of treated water. Key elements of the order include

- the reuse of wastewater for irrigation, fertilization, aquaculture, and other agricultural purposes shall require a certification from the Department of

Agriculture; applications for certification of wastewater reuse are included in the order;

- treated wastewater quality limits are set for chemical and microbial properties for the health and safety of humans, animals, and the environment; and
- a distinction between irrigation and fertilization water is offered including classes and characteristics and where it can be used.

Drinking water quality standards can be found in Appendix C.

## A demand for ultra-pure water may exist but was not easily identified through stakeholder interviews.

**The Market:** The market for ultra-pure and other grades of water was not readily apparent, indicating that more targeted research should be committed to this before entering the Philippines market. Preliminary research suggests that the country has rich water resources, although treated water still doesn't reach 100% of the population. Potential buyers of potable quality water in the Philippines could include power plants, electronics manufacturing, refineries, and petrochemical plants.

Semiconductor and electronics industries are prevalent in the Philippines. As of the first quarter of 2013, there were more than 424 electronics firms operating in the Philippines, and according to the Philippine government, its semiconductor and electronics industry is the largest contributor to the country's manufacturing sector, accounting for 41% of total exports in 2013 and bringing in USD 918 M in foreign and domestic investments. Most of the country's electronics manufacturing is located in Metro Manila, Calabarzon, Northern and Central Luzon, and Cebu.

Coal-fired power plants could also be a potential end user of treated water. As of May 2015, the Philippines had 17 operating coal plants with 29 approved for commissioning by 2020. The plants are spread across the islands with the largest new developments in Batangas, Zamboanga City, Bataan, Olongapo, and Davao del Sur.

**Water resource availability:** The freshwater storage capacity and the high rate of precipitation suggest that the country has adequate supply for its agricultural, industrial, and domestic uses. However, seasonal and geographic variations are considerable, often resulting in water shortages in highly populated areas, especially during the dry season.

Despite these periods of insufficiency, the reuse of treated effluent is not systematically practiced in the Philippines. Of the STPs and FSTPs visited, all were discharging their effluent to the local environment or using a small portion of it for on-site vehicle washing.





## TABLE OF CONTENTS

Introduction

Philippines Market Strategy

Philippines Market Analysis

Policy and Regulatory Landscape

**Market Landscape**

    | **Market for Septage Management**

        | Existing and Proposed Septage Treatment Plants

Commercial Landscape

Financial Landscape

# Market needs suggest the J-OP could realize a value proposition in the Philippines.

## Need for Septage Management

There is a clear need for improved septage management in the Philippines. Sewerage coverage is low nationwide (est. 8% based on design capacity of existing WWTPs), and the collection and treatment of septage is currently inadequate. The national government recognizes the role that septage management must play in achieving the country's sanitation goals and has actively developed policies and supportive programs to incentivize project development. While there has been a considerable uptick in septage projects developed, most cities lack the institutional capacity to take advantage of the loan program available to them without the help of outside technical support. Interestingly, even large cities such as Cebu, the Philippines' second largest metro area, and Bacolod, are opting for septage management systems rather than piped sewers. In Cebu, the general substrate is limestone, making digging in the area difficult, which is a likely contributor to this decision.

Today, there are 4 metro areas and 13 additional cities with a total population reaching more than 9 million that are planning to develop septage management programs (World Bank)

## Value Proposition of Septage Management / J-OP

Septage management's value proposition is to provide cities with a lower-cost alternative to sewers and centralized wastewater treatment systems.

The J-OP's value proposition, when paired with an existing

STP or as part of a new FSTP, is to be a lower-cost alternative to other solids-processing solutions, including co-composting (unless compost is highly valued—see slide 55). Cost competitiveness with other biosolids processing technologies was not evaluated and should be further explored. The J-OP also has the potential to provide 100% pathogen destruction more consistently than other solid-processing technologies—since pathogen reduction is sensitive to operational factors in a composting facility.

In addition, the J-OP has the potential to reduce solids-transport costs in Manila, where Maynilad Water transports material 107 km one way from their Project 7 Plant to a composting facility for processing.

## Need for Enhanced Biosolids Treatment

The need for enhanced biosolids treatment options is limited to Manila where dewatered biosolids are composted in distant regions; however, in most other cases, dewatered fecal sludge solids are given away for direct land application. While there are no existing laws prohibiting this practice, data from the Dumaguete Septage Treatment Plant show that their drying beds are not adequately eliminating pathogens. Water districts appeared open and interested in technologies that could enhance the utility of their solids. It is currently not known whether biosolids composting facilities in the Philippines are achieving adequate pathogen destruction.

The J-OP was met with many positive reactions and a few points of concern.



# The potentially addressable market for the J-OP in the PH is 42-78 units – dominated by the 2-engine J-OP.

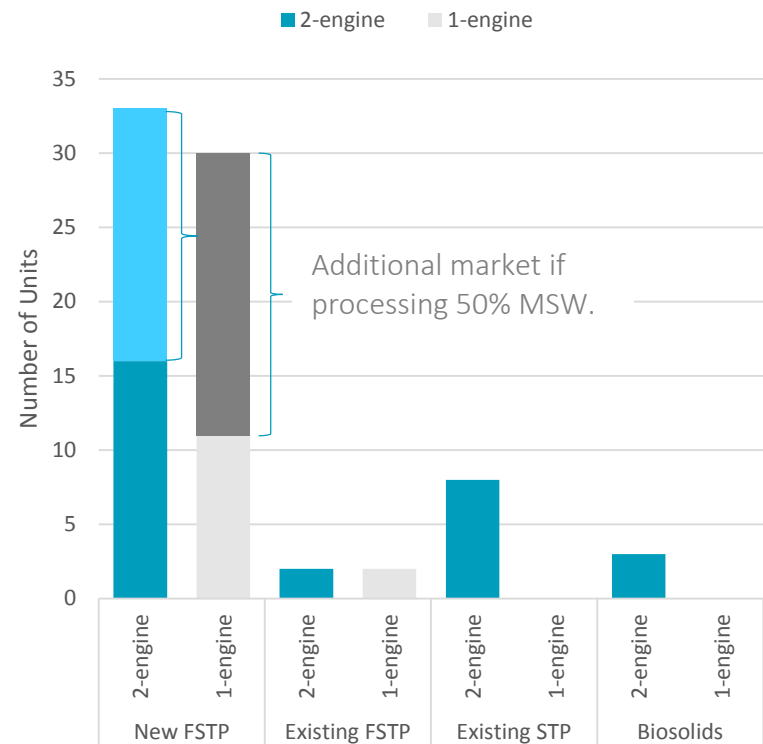
By pursuing a strategy that combines deployment of both the 1-engine and 2-engine J-OP, the total potential market size is 42 units without MSW and 78 units with MSW. This is comprised of 13-43 1-engine and 29-46 2-engine systems.

Of those, the 2-engine J-OP would capture the largest market share and therefore, should be prioritized for the Philippines market. This is particularly true if the option to burn significant quantities of MSW (or other waste) exists. The option to burn MSW is not necessary to open up the market for either J-OP but will be necessary to fully exploit it, given the large number of mid-sized cities in the Philippines. Note: for an individual plant, the ability to burn MSW may still represent an important strategy for fecal sludge supply risk mitigation.

Co-location (with an STP/FS-STP or FSTP) use case is a market with some small scale, although it is limited to Metro Manila and Cebu where more sizable facilities exist in combination with large FSM populations. Co-location increases the attractiveness of this use case as an early part of market entry for the Philippines. The biosolids use case is limited to Manila. Two additional cities have STPs however, the plants are too small to support even an 1-engine J-OP. FS-processing J-OP's deployed in Manila will likely transition to biosolids processing facilities as households are transitioned to sewers.

## Total Market Potential in the Philippines

by size and use case





## TABLE OF CONTENTS

Introduction

Philippines Market Strategy

Philippines Market Analysis

Policy and Regulatory Landscape

### Market Landscape

Market for Septage Management

Existing and Proposed Septage Treatment Plants

Commercial Landscape

Financial Landscape

# There are 21 septage treatment plants in the Philippines processing a combined 3,000 m<sup>3</sup>/day.

**Number of Operating Septage Treatment Plants:** 21

**Number of Planned Septage Treatment Plants:** Two in Cebu, one in Puerto Princesa, one in Bacolod (based on primary research). Fourteen additional cities are reported to have either obtained funding or developed feasibility assessments for new projects (according to World Bank).

**Capacity:** 20–814 m<sup>3</sup>/day

**Treatment Technologies in Use:** Mix of ponds and mechanized plants. Seven plants (20–25 m<sup>3</sup>/day) in the Province of Sarangani (Mindanao) are using sedimentation ponds, in addition to Dumaguete, while all remaining facilities are using mechanical systems.

**Solids Management:** Many septage treatment plants gift their dewatered solids to homeowners, nurseries, and the city, free of charge (Lapu Lapu, Dumaguete). Others pay to transport solids to composting facilities (Manila Water and Maynilad Water).

## Septage Treatment Plants in the Philippines







## TABLE OF CONTENTS

Introduction

Philippines Market Strategy

Philippines Market Analysis

Policy and Regulatory Landscape

Market Landscape

### Commercial Landscape

#### Market for End Products

Economic Analysis

Partners

Procurement and Permitting

Financial Landscape



# Markets for electricity are strong, supported by high electricity prices. There is a limited market for heat.

## Electricity

**Potential End Users:** Grid, WDs, nearby industry. The REA permits RE generators to sit behind the meter, opening the door to a wide variety of end users. WDs are also large consumers of electricity for water extraction, treatment and distribution with reported monthly electricity expenses ranging from P3 million (USD 60K)/month in Puerto Princesa to P7 million (USD 140K) /month in Bacolod.

**Demand:** Demand is high due to variability of supply and high prices. There are many independent power producers in the market but most appear to be located outside of urban centers and sell electricity to the grid.

**Current Market Value:** Retail industrial price of electricity ranges from P8 (USD 0.16) – P11.5 (USD 0.23)/kWh.

**Production Cost of Competing Sources:** Diesel is P8 (USD 0.16)/kWh; coal is P4 (USD 0.08)/kWh; natural gas is P6 (USD 0.12)/kWh

**Regulatory Context:** Regulatory environment for renewable energy generation is favorable, supported by numerous financial and regulatory incentives and national RE targets.

**Financial Incentives:** FITs and income tax and duty exemptions

## Heat

**Potential End Users:** Coca-Cola is using waste heat (steam) from a biogas-to-energy plant in San Nicolas, Ilocos Norte, to heat the plants cleaning equipment but the nature of the J-OP energy source would likely lead to it being rejected as a source of inputs for the food and beverage industry on public-relations grounds. Industrial users of heat typically rely on petroleum products.

**Demand:** In 2012, demand for petroleum products including gasoline, diesel, fuel, bunker oil, kerosene, LPG, AVGAS, AVTURBO, and asphaltin, totaled 3,854.23 kToe.

**Current Market Value:** P4.05 (USD 0.08)/kg to produce steam against the low sulfur fuel oil's P4.43 (USD 0.09)/kg.

**Financial Incentives:** None identified

# Markets for ash & dewatered solids exist but are not likely to influence technology selection or system economics.

## Ash

**Potential End Users:** Cement Manufacturers- Cemex, LefargeHolcim, Northern Cement Corp, Pacific Cement Corp, Taiheiyō Cement, Local construction companies

**Demand:** Cement is the primary building material in the PH (homes, roads, etc.). Several coal-fired power plants are reportedly selling fly ash to nearby cement manufacturers. Ash must meet requirements set forth by the cement company. According to Lafarge Philippines (now LafargeHolcim), two thirds of the Philippines market has converted to the use of blended cements, including fly ash. Fly ash can become an important solution as cement manufacturers move to 'green' their operations. In 2012, Lafarge Republic signed a deal with GNPower Mariveles Coal Plant Co. in Bataan to buy fly ash. Cemex Philippines signed a similar deal with Korea Electric Power Corp to do the same in Cebu.

**Current Market Value:** Unknown

**Regulatory Context:** Ash is permitted for disposal in a Category 4 landfill. Ash is not classified as hazardous waste in the Philippines.

**Financial Incentives:** None

## Dewatered Solids

The market for dewatered solids are of interest because of its potential to compete with technologies that convert solids to energy or other valuable products (e.g. compost)

**Potential End Users:** Compost/fertilizer manufacturers, nurseries, homeowners and farmers for direct land application

**Demand:** Demand appears to be low, evidenced by the fact that all stakeholders interviewed were either giving away their dewatered solids, free of charge, or paying to transport them to a composting facility.

**Current Market Value:** According to Go Organic! Philippines (2016), the commercial price of organic fertilizer is P250 to P350 (USD 5-7) per 50-kilo bag (USD 100-140 / MT) and the price of improved inorganic fertilizer is P1,500 to P2,000 (USD 30-40) per 50-kilo bag (USD 375-800 / MT). There does not appear to be a market for dewatered bio-or fecal sludge solids. Maynilad pays to transport its biosolids to a composting facility and neither pays a tipping fee or receives payment for receipt of the delivered material.

**Financial Incentives:** None specifically although there are incentives under the Philippine Organic Agriculture Act to produce organic goods, which may inadvertently stimulate demand for compost derived from dewatered solids.



## TABLE OF CONTENTS

Introduction

Philippines Market Strategy

Philippines Market Analysis

Policy and Regulatory Landscape

Market Landscape

### Commercial Landscape

Market for End Products

#### Economic Analysis

Partners

Procurement and Permitting

Financial Landscape

# The J-OP is a cost-competitive solids-processing technology but is not cheaper than land-applying.

The graph to the right shows the septage treatment fee (see box for definition) required for a project based on the specified technology to achieve an NPV of 0 (i.e., fully cover all capital and operating costs over the project’s lifetime), given Philippines-specific data on key cost and revenue drivers, and financing arrangements (see table).

The results indicate that a FSTP which uses a J-OP to process the solids will be:

- **More cost-effective** than co-composting the solids in both high and low land price scenarios, and unless the value of compost is very high, co-composting would become competitive if **bulk** compost prices reached USD 135 (low land price areas) or USD 165 (high land price areas).
- **Less cost-effective** than simply land-applying or landfilling untreated fecal sludge solids from the FSTP (note: the difference between the basic FSTP and the FSTP + J-OP scenario suggest a city would have to pay around USD 0.35/m<sup>3</sup> of septage for the additional public health benefits achieved by the J-OP achieving 100% pathogen destruction).

**Septage treatment fee:** This fee represents a range of economic instruments that could be used to cover the cost of the FSTP—for example, a tipping fee the plant charges truck operators to dump septage or a fee paid by the municipality to a plant who then recovers this cost through other means (e.g., local taxes).



### Key input assumptions for the Philippines

<b>Cost drivers</b>	Capex, basic FSTP: USD 3.8 million, J-OP: USD 1.4 million, co-composting USD 1.9 million Land, high price: USD 120; low price: USD 60.
<b>Revenue drivers</b>	Electricity: 20 c/kWh; septage treatment fee is modeled (see above); compost is modeled
<b>Financing</b>	90% debt- 8.5 year loan at 6.5%



## TABLE OF CONTENTS

Introduction

Philippines Market Strategy

Philippines Market Analysis

Policy and Regulatory Landscape

Market Landscape

### Commercial Landscape

Market for End Products

Economic Analysis

#### Partners

Procurement and Permitting

Financial Landscape

# Manila Water Company, Inc., is a Manila-Based private water company with new business ventures across Southeast Asia.

## Overview

Formed in 1997, Manila Water is a publicly listed water supply company. In 2015, the firm earned P16 billion (USD 320 million) in revenues, and held more than P80 billion (USD 1.6 billion) in assets. Manila Water is a subsidiary of the Ayala Corporation, the Philippines' oldest conglomerate. The International Finance Corporation, Mitsubishi Corporation, and First State Investment Management, among others, also hold shares in the company. The company has a 25-year exclusive concession agreement to service the East Zone of Metro Manila.

## Service Provision

Manila Water treats and distributes potable water to more than 6 million residents across Manila. In addition, it operates 78 vacuum trucks and owns and operates 41 sewage treatment plants and 2 septage treatment plants. Regular desludging services are provided every 5 years at no additional charge, while emergency desludging services incur a fee.

## In Their Own Words

<http://www.manilawater.com/Pages/Home.aspx>

<http://www.manilawater.com/Pages/Our%20Facilities.aspx>

## Other Activities

In 2010, Manila Water and the Philippine Tourism Authority formed a joint venture called Boracay Island Water Company, Inc. With an initial capitalization of P300 million (~USD 6.5 million) and a 25-year concession agreement, the company has been tasked with developing, operating, and managing the water and sewerage system of the Philippines' most popular tourist spot. With the development of numerous subsidiaries, Manila Water has made a strategic commitment to expand their business activities into Vietnam, Indonesia, and Myanmar and other areas in the Philippines.

## Initial Feedback

Manila Water is actively seeking new technologies for sewage/septage and MSW management. STeP met with Robert (Boogz) Baffrey and team who expressed an interest in exploring pilot project opportunities with around the J-OP. Initial impressions were that capital costs were much higher than other STP technology, but that net energy production was a differentiating and potentially negating factor. Typically, Manila Water pilots a new technology before launching it commercially. Even before a pilot, the technology would need to demonstrate financial and technical performance on a demonstration basis (India facility will suffice).



## With a focus on Metro Manila, Maynilad Water has the largest customer base in the Philippines.

### Overview

Formed in 1997, Maynilad Water Services following Benpres Holding Corporation and Suez Lyonnaise de Eaux won the exclusive right to provide water and wastewater services to the West Zone of Metro Manila. Today, a joint venture between Metro Pacific Investment Corporation and DMCI Holdings, Inc. holds a 83.96% stake in Maynilad Water. Since 2007, the company has spent P47 billion (USD 930 million) to improve and expand water services and plans to continue accelerating water investments through its concession period, ending in 2037.

### Service Provision

Maynilad provides water and wastewater services to 17 cities in Metro Manila, including desludging and septage treatment. The company maintains and operates 19 sewage treatment plants, some of which co-process septage. The Dagat-Dagatan Sewage and Septage Treatment Plant in Caloocan was the first facility of its kind in the Asia-Pacific Region to achieve ISO accreditations for quality management, environmental management, and occupational safety. Maynilad has a coverage area of 540 km<sup>2</sup> and a customer base of 1.3 million people, the largest in the country.

### In Their Own Words

<http://www.mayniladwater.com.ph/company.php>

<http://www.mayniladwater.com.ph/facilities-wastewater.php>

### Other Activities

In 2016, Maynilad Water announced it will be spending P13.6 billion (USD 270 million) on water and wastewater infrastructure projects. While some of the funds are earmarked for plant improvements, most will be used for water and piped wastewater treatment systems. Because of a string of financial, legal, and regulatory disputes through the early 2000s and repeated ownership issues ending in 2007, the company focus appears to be local (Metro Manila).

### Initial Feedback

STeP met with Ryan Ollio, plant manager of the Project 7 Sewage and Septage Treatment Plant in Quezon City. Perhaps because of his job function, Mr. Ollio only expressed interest in the J-OP if Maynilad Water's role was limited to providing dewatered solids in exchange for monetary compensation (e.g., revenue share agreement). STeP recommends revisiting pilot opportunities with Maynilad Water through an alternative point of contact.



# EnviroKonsult is a dominant player in septage collection and treatment.

## Overview

EnviroKonsult Equipment and Services Inc. is the Number 1 desludging truck supplier in the Philippines and, since 2013, has become a dominant player in septage treatment. Since 2001, the company has supplied more than 150 desludging trucks to Manila Water and Maynilad Water and is a contracted provider of desludging services.

## Service Provision

In 2013, EnviroKonsult built its first septage treatment plant in Bay, Laguna. The system is fully mechanized and processes 60–100 m<sup>3</sup>/day using mechanical dewatering and membrane bioreactor technology. The company developed its second plant in Metro Cebu in 2016 and, according to the city of Bacolod, is positioned to respond to their upcoming tender as well. The company provides (to name a few):

- desludging and septage collection,
- septage treatment plant operations and maintenance,
- plant design and construction, and
- training and consultancy.

EnviroKonsult offers a unique value proposition in the Philippines through their BOT project development model.

## Initial Feedback

EnviroKonsult is a technology agnostic service provider that would be willing to explore the adoption of new technologies. Currently, the company offers a mechanized septage treatment system that includes a rotary composting unit, which could be replaced with an alternative solids management technology.



**FMF Fully Mechanized Facility**

**Septage Management Program (SMP)**

Design, Construction, Implementation, Operation, and Financing

**Quick Guide: How to Establish an SMP**

Pre-Investment Study	Feasibility Study
Inter-Agency Requirements	LGU Ordinance, Land and Right-of-Way LIRUA, Tariff Approval Other Agencies (DENR, DOH, DPWH, etc.)
Bidding Modalities and Legal Bases	Service Contract RA 9184 Design, Build, Supply RA 9184 PPP- JV, BOT, BOO NEDA Guidelines and BOT Law

**FEATURES**

- Fully Automated
- Compact
- Modular/Expandable
- Fast and Easy Installation
- Non-clog Belt Screens
- No Nuisance
- No Odor

**COLLECTION & TRANSPORT**

- Desludging Operations (since 2001)
- Vacuum Trucks (over 140 units sold)
- Parts and Service (over 1000 inventory - 24/7)

**TREATMENT**

- Packaged Facility
- Septage Acceptance
- Sludge Dewatering
- MSR/Centrifuge Treatment

**RE-USE**

- Water: Garden, Ponds, Irrigation, Industrial
- Sludge: Compost, Landfill

**Comply Now!**

**100 DAYS**

**ISO 14001:2004 CERTIFIED and ISO 9001:2008 CERTIFIED**

**ENVIROKONSULT** Equipment and Services, Inc. [www.envirokonsult.com](http://www.envirokonsult.com)

Executive Offices: Konsult Haus 8030 Faria Road, Pook dela Paz, Old Balara, Quezon City 1119  
Tel (832) 952-4122 • Text/Fax (832) 952-2991

Project Management Office: F.T. San Luis Avenue, Brgy. Puypuy, Bay 4033, Laguna • Mobile 0927-493-1760

**BROWISH** **WATERKONSULT**



## TABLE OF CONTENTS

Introduction

Philippines Market Strategy

Philippines Market Analysis

Policy and Regulatory Landscape

Market Landscape

### Commercial Landscape

Market for End Products

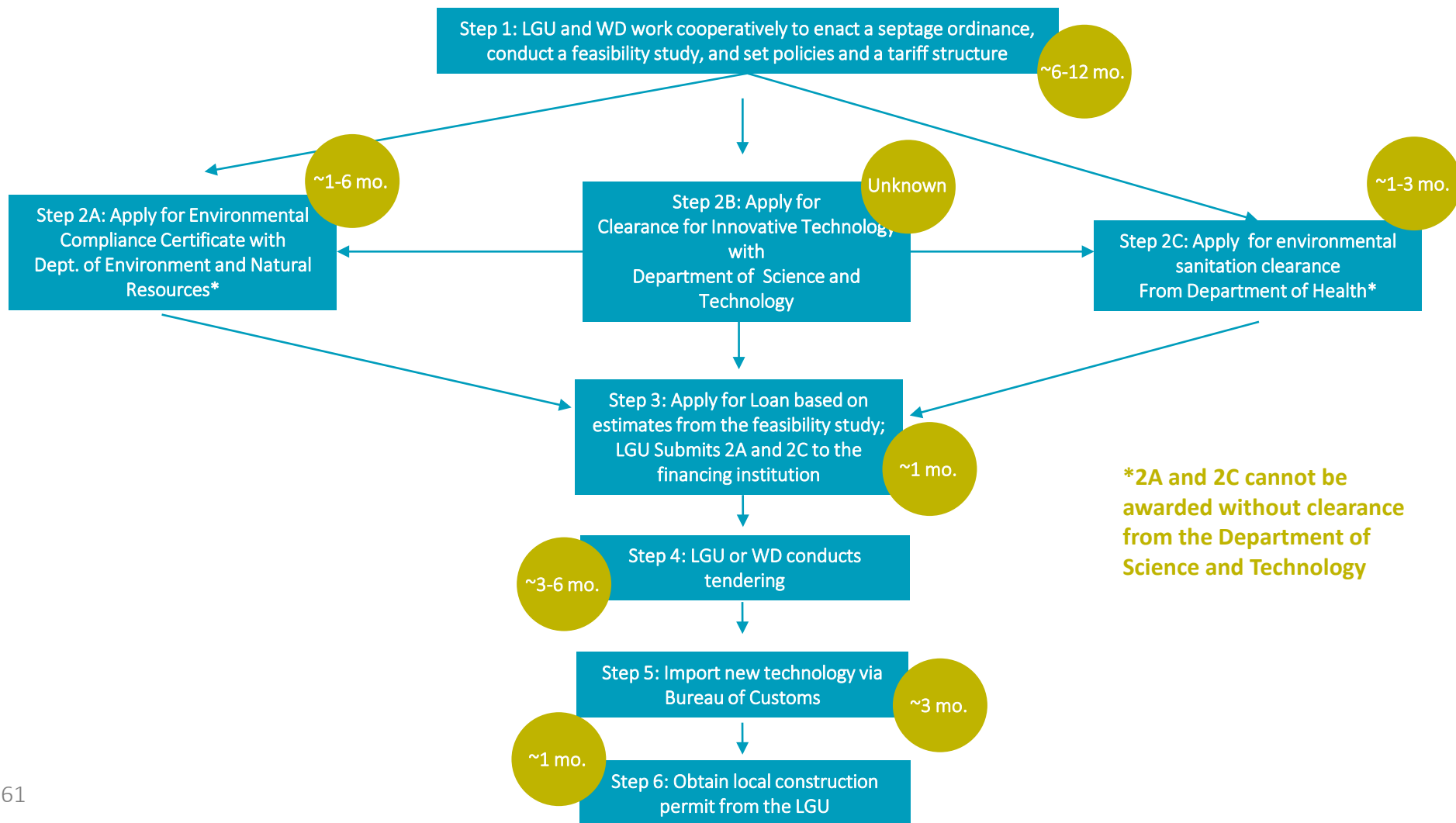
Economic Analysis

Partners

**Procurement and Permitting**

Financial Landscape

# The process for permitting a new septage treatment technology takes approximately 12 months in the Philippines.





# New technologies must be approved and registered before being brought into the Philippines market.

**Certifying Agency:** The National Department of Science and Technology

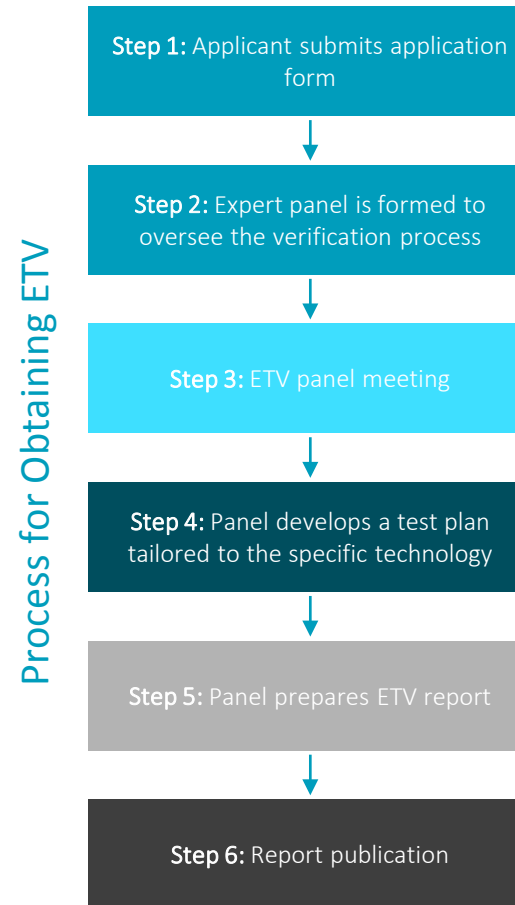
**Website:** <http://etvphilippines.ph/>

**What is the Environmental Technology Verification (ETV) Protocol?** ETV is a testing and reporting protocol that conducts actual tests on technologies, supervised by a pool of experts, to determine whether the technology operates effectively based on the claims of the supplier.

**Application Forms:** <http://etvphilippines.ph/downloads/>

**Cost:** Unknown

**Evaluation Criteria:** Tailored to the particular product or technology. To include: functional performance, environmental benefits, implementability, regulatory issues, maintenance requirements. For more information, see: <http://etvphilippines.ph/download/forms/Technical-Protocol-ver-0322.pdf>



# Outside of Manila, Publically Owned/Operated, and BOT are the dominant project development models for FSTPs.

Project Proponent	Plant Owner	Financing	Operation and maintenance	Prevalence
LGU	LGU	Government Banks	LGU; May be contracted out	Rare Example: Cebu Dewatering Plant
	WD	LWUA	WD	Common Examples: Baliwag and San Jose Del Monte
	Private Co	Commercial bank, government bank, self funded	Private Co	Rare Examples: Manila Water and Maynilad Water
LGU/WD Partnership	LGU/WD	Blend: Government banks + LWUA	Joint management	Rare Example: Dumaguete City
WD	WD	Public: LWUA, Govt Banks Private: Self funded, commercial banks	WD; May be contracted out	Rare: Examples: None (Puerto Princesa- Pending)
	Private Co. (BOT)	Commercial bank, government bank, self funded	Private Co	Common Examples: Lapu Lapu, Mactan ,and Laguna (Bacolod City- Pending)
Private Sector	Private sector	Commercial bank, government bank, self funded	Private sector; May be contracted out	Common in Manila, Rare elsewhere Example: Manila Water (2 plants) and Maynilad Water (3 plants)

## Under a BOT model, WDs are willing to pay a private operator to collect and treat their septage.

### Metro Cebu

Metro Cebu Water District (MCWD) has entered into a 5-year concession agreement with EviroKonsult for the collection, transport and treatment of 150 m<sup>3</sup>/day of septage in Lapu-Lapu. MSWD has agreed to pay the company P800 (USD 16)/m<sup>3</sup> of septage processed. Service fees paid to the concessionaire are funded through the collection of a household environmental fee assessed on each cubic meter of potable water consumed [P2.20 (USD 0.04)/m<sup>3</sup>].

### Bacolod

The Bacolod City Water District (BCWD) is preparing to solicit proposals from private service providers to collect, transport, and treat 60 m<sup>3</sup>/day of septage from Bacolod City. The proposal includes the expansion of the facility to 120 m<sup>3</sup>/day over the 5-year concession period. After that time, the BCWD will either assume ownership of the plant or extend the concessionaires contract. The BCWD is willing to pay up to P1,500 (USD 30)/m<sup>3</sup>, funded by an environmental fee of P2.50 (0.05)/m<sup>3</sup> of potable water consumed, paid by households. The water district also expected to pay the LGU a percentage of the total revenues generated by the environmental service fee. Based on the findings of the feasibility assessment, the revenue share can reach 15% and still render an economically sustainable project.

Photo: EnviroKonsult's new septage treatment plant in Metro Cebu





# LGUs, WDs, and private-sector concessionaires are bound by the Government Procurement Reform Act.

The [Government Procurement Reform Act](#) requires transparency, competitiveness and accountability when sourcing services and equipment. Procurement in the Philippines follows the following steps: advertisement, pre-bid conference, eligibility screening of prospective bidders, receipt and opening of bids, evaluation of bids, post-qualification, and award of contract.

Sole source contracting is possible if:

- the goods are proprietary in nature and can only be obtained only from a single source (i.e., when patents, trade secrets, and copyrights prohibit others from manufacturing the same item);
- when the procurement of critical components from a specific supplier are necessary for a contractor to achieve the guaranteed performance of a project; and
- the goods are sold by an exclusive dealer or manufacturer and no suitable substitute can be obtained at more advantageous terms.

Government Procurement Reform Act can be found here: <http://www.bsp.gov.ph/downloads/procurement/ra9184.pdf>

Technologies are not always selected on the basis of the lowest bid but rather on the technology's ability to meet certain standards. These might be related to technology performance or cost or involve other skills required to operate the technology, environmental benefits (e.g., GHG reductions). Of the stakeholders interviewed, criteria common to a terms of reference (TOR) for the development of a septage management system include the following:

Requirements placed on Interested service providers:

- Fully registered and certified in the Philippines
- Undertaken one contract similar in nature to the project for bid in the past 3 years
- Proven experience operating vacuum trucks plus drivers with at least 3 years of desludging experience

Requirements placed on processing technology:

- Track record of at least 3 years in the Philippines or in other countries with similar septage characteristics
- Fully mechanized and should fit the allotted footprint
- Dewatered solids must achieve 20% TS content and can be used as a soil conditioner, effluent treated to DENR Class C or better.





## TABLE OF CONTENTS

Introduction

Philippines Market Strategy

Philippines Market Analysis

Policy and Regulatory Landscape

Market Landscape

Commercial Landscape

**Financial Landscape**

# Low interest loans are available for sanitation projects in the Philippines through national development banks.

## Land Bank of the Philippines

**Funding Source:** In 2012, the World Bank extended a USD 275-million loan package to Land Bank of the Philippines to finance sewerage projects under the Metro Manila Wastewater Management Project (MWMP) to be split equally between Maynilad Water and Manila Water.

**APR:** 6%–7%

**Tenor:** 7–10 years

**Prospective Borrowers:** WDs, LGUs, and private companies

**Conditions:** Used for infrastructure Capex; feasibility studies, environmental compliance certificates from DENR, DOH clearance, and local septage ordinance required.

## Veterans Bank

**Funding Source:** Unknown

**APR:** 6%–7%

**Tenor:** 7–10 year

**Prospective Borrowers:** WDs, LGUs, and private companies

**Conditions:** Used for infrastructure Capex; feasibility studies, environmental compliance certificates from DENR, DOH clearance, and local septage ordinance required

## Development Bank of the Philippines

**Funding Source:** Unknown

**APR:** 4.25%

**Tenor:** 15 years

**Prospective Borrowers:** WDs, LGUs, and private companies

**Conditions:** Used for infrastructure capex; feasibility studies, environmental compliance certificates from DENR, DOH clearance, and local septage ordinance required

## Local Water Utilities

### Administration (The Water District Development Sector Project)

**Funding Source:** ADB. In 2016, ADB extended a USD 73-million loan to distribute to water districts for the improvement of water and sanitation infrastructure.

**APR:** 12%

**Tenor:** Unknown

**Prospective Borrowers:** WDs

**Conditions:** Used for infrastructure capex; feasibility studies, environmental compliance certificates from DENR, DOH clearance, and local septage ordinance required

## Oxfam

**Funding Source:** Revolving Fund

**APR:** 0%

**Tenor:** 5 Years

**Prospective Borrowers:** LGUs

**Conditions:** Required septage ordinance and tariff structure in place

**NOTE:** There are also more than 20 commercial banks active in the Philippines that lend to private companies for local infrastructure projects including Rizal Commercial Bank, China Bank, and Bank of the Philippines.

## LGUs and WDs rely heavily on grants to advance and, in some cases, construct septage project development.

### Department of Public Works and Highways (via the NSSMP)

**Type:** Cash grant; grant facility funded by the national government  
**Prospective Applicant/s:** LGUs  
**Conditions:** Good for up to 40% of the total capital cost of the project. The DPWH offers assistance to the LGU in identifying financing for the remaining 60%. Project qualifications include septage ordinance, feasibility study demonstrating economic viability, detailed design plans, and plans on how to institutionalize operations and oversight. Grants have historically been restricted to HUCs but are reportedly being extended to other cities in the Philippines now. To date, not a single HUC has accessed this grant. Suggested reasons are that the application process is too onerous and that LGUs lack the funds to undertake the necessary project planning steps.

### USAID

**Type:** Provided in the form of in-kind services  
**Prospective Applicant/s:** LGUs and WDs  
**Conditions:** Technical assistance grant for planning of septage or wastewater treatment plant. City must have a good history of working with foreign government, have successfully completed a prior project, and be selected by USAID. Grant is not awarded through an application process, USAID selects grant recipients.

### JICA

**Type:** Provided in the form of processing equipment manufactured in Japan  
**Prospective Applicant/s:** LGUs and WDs  
**Conditions:** JICA selects treatment technology; LGU or WD is responsible for ongoing operations and related costs. Application process required.

**NOTE:** Of the cities visited, all (except Manila) had accessed grants

## Appendix A: HUCs, Cities, and Metro Areas in the Philippines

There are 33 HUCs in the Philippines with populations >200,000 and annual incomes of at least USD 1 million.



There are an additional **18** cities with populations greater than 150,000 people.

Rodriguez (Montalban)

Cainta

Taytay

Binangonan

Santa Maria

San Mateo

Silang

Tanza

Marilao

Santo Tomas

Lubao

Gen. Mariano Alvarez

Pikit

Concepcion

San Miguel

Polomolok — Metro Iloilo-Guimaras

Midsayap

Mexico

## Twelve metro areas comprise multiple cities and, in many cases, are managed by the same water district. (1/2)

### Metro Manila

Total Pop: 12,877,253  
Density: 18,000p/km<sup>2</sup>  
Water District/s: Manila Water; Maynilad Water

#### Cities

Caloocan  
Las Piñas  
Makati  
Malabon  
Mandaluyong  
Manila  
Marikina  
Muntinlupa  
Navotas  
Parañaque  
Pasay  
Pasig  
Pateros  
Quezon City  
San Juan  
Taguig  
Valenzuela

### Metro Cebu

Total Pop: 2,849,213  
Density: 2,300p/km<sup>2</sup>  
Water District/s: Cebu City Water District

#### Cities

Carcar  
Cebu City  
Compostela  
Consolacion  
Cordova  
Danao City  
Lapu-Lapu  
Liloan  
Mandaue  
Minglanilla  
City of Naga  
San Fernando  
City of Talisay

### Metro Davao

Total Pop: 2,516,216  
Density: 540p/km<sup>2</sup>  
Water District/s: Davao City Water District

#### Cities

Carmen  
Davao City  
Digos  
Panabo  
Island Garden City of Samal  
Santa Cruz  
Tagum

### Metro Cagayan de Oro

Total Pop: 1,376,343  
Density: 260p/km<sup>2</sup>  
Water District/s: Cagayan de Oro City Water District

#### Cities

Alubijid  
Baungon  
Cagayan de Oro  
Claveria  
El Salvador City  
Gitagum  
Jasaan  
Laguindingan  
Libona  
Malitbog  
Manolo Fortich  
Opol  
Sumilao  
Tagoloan  
Talakag  
Villanueva

### Metro Angeles

Total Pop: 1,132,933  
Density: 1,600p/km<sup>2</sup>  
Water District/s: Angeles City Water District

#### Cities

Angeles  
Bacolor  
Mabalacat  
Porac  
City of San Fernando



## Metro areas continued (2/2)

### Metro Iloilo-Guimaras

**Total Pop:** 946,146

**Density:** 790p/km<sup>2</sup>

**Water District/s:** Metro Iloilo-Guimaras Water District

#### Cities

Buenavista  
Cabatuan  
Iloilo City  
Jordan  
Leganes  
Nueva Valencia  
Oton  
Pavia  
San Lorenzo  
San Miguel  
Santa Barbara  
Sibunag

### Metro Naga

**Total Pop:** 799,955

**Density:** 650 p/km<sup>2</sup>

**Water District/s:** Metropolitan Naga Water District

#### Cities

Bombon  
Bula  
Calabanga  
Camaligan  
Canaman  
Gainza  
Magarao  
Milaor  
Minalabac  
Naga City  
Ocampo  
Pamplona  
Pasacao  
Pili  
San Fernando

### Metro Bacolod

**Total Pop:** 791,019

**Density:** 960p/km<sup>2</sup>

**Water District/s:** Bacolod City Water District

#### Cities

Bacolod City  
Silay City  
City of Talisay

### Metro Olongapo

**Total Pop:** 604,786

**Density:** 650p/km<sup>2</sup>

**Water District/s:**

#### Cities

Olongapo City  
Subic  
Castillejos  
Dinalupihan  
Hermosa  
Morong

### Metro Baguio

**Total Pop:** 611,316

**Density:** 500p/km<sup>2</sup>

**Water District/s:** Baguio Water District

#### Cities

Baguio  
Itogon  
La Trinidad  
Sablan  
Tuba  
Tublay

### Metro Dagupan

**Total Pop:** 372,756

**Density:** 2,400p/km<sup>2</sup>

**Water District/s:**

#### Cities

Calasiao  
Dagupan  
Mangaldan

### Metro Batangas

**Total Pop:** 550,725

**Density:** 1,100p/km<sup>2</sup>

**Water District/s:** Batangas City Water District

#### Cities

Batangas City  
Bauan  
San Pascual  
Mabini  
Tingloy

## Appendix B: City Snapshots

# Metro Manila is the Philippines' largest population center.



**City, Province:** Metro Manila is comprised of 17 municipalities.

**Total population:** 12.9 million (2015)

**Of note:** Manila is the largest urban area in the Philippines and the 15th densest city in the world.

**Water Concessionaire/s:** Metro Manila is divided into East and West Districts and serviced by private water companies under a 25 year concession agreement, ending in 2037. Western Manila is serviced by Maynilad Water while Eastern Manila is serviced by Manila Water.

## Key sanitation statistics:

- Percentage of population with access to piped sewer / WWTP: 39%\*
- Percentage of serviced population with septic tanks: 85%
- Percentage of population with access to septage collection services: 34%\*
- Percentage of septic tanks regularly emptied: Unknown, although septage collection regularly occurs every 5 years
- Quantity of septage collected daily (m<sup>3</sup>/d): Unknown
- Septage collection fee (USD/service or USD/m<sup>3</sup>): Unknown
- Fee collection method: Paid with water bill
- Septage collection company: Maynilad Water and Manila Water (and their contracted service providers, including EnviroKonsult)
- Current disposal practice(s): Treatment at dedicated septage treatment plants or at combined septage and sewerage treatment plants

## Manila's concessionaires are making significant investments in sewage and septage infrastructure.

**Initiatives Underway:** With access to multi-lateral development bank (MDB) funding and a mandate to expand water and wastewater/septage treatment services to 100% of Manila by the end of their concession period in 2037, Manila Water and Maynilad Water are actively engaged in infrastructure development. While the majority of this activity involves underground sewers and traditional STPs, both concessionaires recognize the continued role that septage collection and treatment will play in reaching their overall service objectives. In 2016, Maynilad earmarked more than P6 billion (USD 120 million) for wastewater programs in Valenzuela, Pasay, Muntinlupa, Paranaque and Cavite City while Manila Water is expected to complete construction of one of the largest wastewater treatment plants in the Country in December 2016—the Ilugin STP, with 100 MLD capacity.

**Technologies/Services Under Consideration:** Of the septage treatment plants that have been constructed in Manila in recent years, mechanical systems that require a small physical footprint are the most prevalent. In the facilities that treat both sewage and septage, septage is typically mechanically dewatered using a volute or screw press, with solids being transported for composting, and effluent treated through sequencing batch reactor or activated sludge.

**Municipal Priorities:** Land is extremely scarce in Metro Manila (evidenced by high population density), and transport is very slow. As a result, the concessionaires have adopted a decentralized treatment system to reduce transport costs. They have also selected treatment technologies that minimize land requirements and built their systems either underground or vertically elevated to maximize space. Transport of biosolids to distant locations for composting is a cost driver for the concessionaires, as are high electricity costs to operate their treatment plants, and the J-OP would therefore help to offset existing expenses.

**Facility Siting:** Because of a general lack of space, STPs and septage treatment plants are embedded within neighborhoods. Project 7, the only treatment plant visited in Manila, is a completely enclosed building with subterranean treatment tanks, which reduce odors and makes the plant more appealing to the surrounding community.

**Local Partners:** Project development in Metro Manila will require the participation of either Manila Water or Maynilad Water.

**Expectations for Project Finance:** Projects developed by Manila Water and Maynilad Water are financed with MDB funds vis-à-vis the Metro Manila Wastewater Management Project.

# Subject to high electricity prices, Manila Water and Maynilad Water would both benefit from on-site electricity generation.

**Initiatives Underway: Availability of Biomass Sources:** In 2011, Metro Manila produced between 8,400 and 8,600 MTPD of MSW, or one-quarter of the country's garbage. Approximately half of the MSW generated is biodegradable waste, such as food and animal carcasses. A 2015 report estimates that the Philippines was the third largest contributor of plastic waste to the marine environment in the world, next to only China and Indonesia (Jambeck, 2015). Although the Philippines has a thriving biomass-to-energy industry because of an abundance of rice husk, rice straw, coconut husk, shells, and bagasse, agricultural regions are quite distance from Metro Manila making MSW the most likely supplemental fuel for a J-OP.

## Markets for End Products

**Ultrapure Water:** Stakeholder interviews did not suggest that either of the concessionaires were selling treated effluent. Metro Manila does, however, appear to have semiconductor and electronics manufacturing, and several power plants, that could be potential end users of J-OP water.

**Electricity and Heat:** Electricity rates in Metro Manila are high. For industrial customers in the very-large category (between 750kW and 10,000kW), per kWh rates are P4.98 (US 0.10), including P497 (USD 9.99)/kW for transmission, P12,726 (USD 256)/customer/month for supply and 33.96% VAT.

## Bacolod City is the fourth largest city in the Philippines and a center for sugar cane production and fishing.



**City, Province:** Bacolod City,  
Negros Occidental

**Total population:** 561,875  
(2015)

**Of note:** Bacolod is the fourth largest city in the Philippines. Capitalizing on the proximity of the sugar cane fields, PepsiCo has a beverage production facility in Bacolod.

**Water District:** Bacolod City Water District (BCWD)

**Current Services Provided:** Water treatment and distribution

**Other cities served by Water District:** None

**Other Key Stakeholders:** LGU will likely provide land for new septage treatment facility.

### Key sanitation statistics:

- Percentage of population with access to piped sewer / WWTP: 0%
- Percentage of population with septic tanks: 100%
- Percentage of population with access to septage collection services: 0% at present; proposed 52%
- Percentage of septic tanks regularly emptied: 0%
- Quantity of septage collected daily: 0 m<sup>3</sup>/day at present
- Environmental Service Fee: P0.0/m<sup>3</sup> at present; proposed P2.50 (USD 0.05)/m<sup>3</sup> of water consumed
- Fee Collection Method: Not applicable at present; proposed to be paid with water bill
- Septage Collection Company: None at present; proposed private operator
- Current Disposal Practice(s): Overflow travels by gravity to the ocean

## Bacolod City Water District is preparing to issue a TOR for the collection and treatment of the 60 m<sup>3</sup>/day of septage.

**Initiatives Underway:** The BCWD has developed a TOR for a private company to construct and operate a new septage treatment plant in Bacolod City. The plant is expected to treat 60 m<sup>3</sup>/day with an eventual expansion to 120 m<sup>3</sup>/day after 5 years. Whether the BCWD or the LGU will lead procurement and project development is still uncertain, as a new mayor was recently elected and roles/responsibilities are still being defined; however, the issuance of the TOR was reported to be imminent in July 2016.

**Technologies/Services Under Consideration:** According to the city representative, the TOR places a series of requirements on proposers:

- The technology must be fully mechanized, utilize little land, and produce minimal odors
- The technology must currently be operational in the Philippines
- The developer must have 3–5 years of experience operating a septage management facility and must be experienced providing desludging services
- Effluent must meet Class-C standards and solids must be dewatered to 20% total solids

**Municipal Priorities:** The BCWD favors a private sector model whereby they do not have to secure capital, operate the plant or provide desludging services in the near term. The interviewed representative indicated that the BCWD was in communications with EnviroKonsult.

**Facility Siting:** Based on the BCWD's current plan, the LGU will be responsible for identifying a plot of land on which to locate the new septage treatment plant and has selected a site 20 km away from Bacolod City. The site is located near a new peri-urban development and a light industrial zone. Zoning is reportedly very relaxed. Numerous vacant lots were observed throughout the city and along the coastline, making the selection of this distant site not well understood.

**Local Partners:** The LGU and BCWD appear to be collaborating on the development of this project. In exchange for the land and the implementation of several packaged wastewater treatment systems in public settings around the city (markets, schools, etc.), the BCWD will share a percentage of the revenues from the septage collection fee (between 5% and 15%). It is expected that dewatered fecal sludge will be used as a soil amendment in nearby sugar cane fields.



## Unexpected load shedding and periodic brownouts mean the BCWD would benefit from a reliable source of electricity.

**Expectations for Project Finance:** The private operator will fund or finance the project. In exchange for their services, the BCWD will compensate them P1,500 (USD 30) /m<sup>3</sup> of septage collected and treated over the 5 year contract life. At the end of the contract life, the BCWD will determine whether to assume control of the plant and vehicles or extend the contract period. No revenues are currently anticipated from the sale of effluent or dewatered fecal sludge. The service fee paid to the operator will be funded entirely through the collection of the environmental service fee.

**Availability of Biomass Sources:** Bacolod City produces approximately ~280 MTPD of MSW\*, which is disposed of in a poorly managed landfill. Other sources of biomass (namely agricultural waste from sugar cane) are produced nearby; however, they are reportedly burned despite national laws prohibiting this practice. Biomass quantities at a scale required for the J-OP would be easily obtainable.

### Markets for End Products

**Ultrapure Water:** Markets for ultrapure water were not apparent.

**Electricity and Heat:** Like many cities in the Philippines, Bacolod City experiences scheduled and unscheduled brownouts. As a result the BCWD relies on diesel generators to provide back-up power. The district currently spends P7 million (USD 145,000)/month on grid supplied energy to power its water extraction, treatment, and distribution equipment for 52,000 households. In addition to this, generators are used frequently. It is common for the NPC to require unexpected load shedding in 15–30 minute increments. When this occurs, pumping operations are disrupted, often requiring back up power for 2+ hours as systems are restarted. Retail industrial electricity prices are reportedly P10 (USD 0.21)/kWh.

Bacolod City has several areas zoned for industrial and light industrial activities. It is also home to a Pepsi beverage production facility. According to the Bureau of Renewable Energy, another Pepsi plant on Luzon Island is utilizing waste heat from a local biomass to energy facility. No other applications for heat were identified.

\*Based on a per capita MSW generation rate of 0.5 kg/p/d. World Bank, “What a Waste”

## Puerto Princesa is the country's final frontier and a highly regarded tourist destination.



**City, Province:** Puerto Princesa, Palawan

**Total population:** 255,116 (2015)

**Water District:** Puerto Princesa Water District (PPWD)

**Current Services Provided:** Water supply, septage collection

**Other cities served by Water District:** None

**Other Key Stakeholders:** Puerto Princesa Local Government Unit, Palawan Electric Corporation

### Key sanitation statistics:

- Percentage of population with access to piped sewer / WWTP: 0%
- Percentage of population with access to septage collection services: currently none
- Total Number of Septic tanks: 40,000
- Percentage of serviced population with septic tanks: 100%
- Percentage of septic tanks regularly emptied: currently none
- Quantity of septage collected daily: Currently none; projected 50m<sup>3</sup>/day
- **Environmental Service Fee:** Proposed P2.0 (USD 0.04)/m<sup>3</sup> of potable water consumed up until a maximum payment of P3500 (USD 72) (proposed for new plant)
- **Fee Collection Method:** Fee will be paid with water bill
- **Septage Collection Company:** LGU currently owns one vacuum truck but it is not currently functioning
- **Current Disposal Practice(s):** N/A

## The PPWD has prepared a TOR for the development of a new septage treatment facility.

**Initiatives Underway:** The PPWD is in the process of issuing a public tender for the construction of the city's first and only septage treatment plant. The PPWD initiated this project with the support of USAID and Manila Water, who provide feasibility assessment assistance.

**Technologies/Services Under Consideration:** The PPWD is limiting their evaluation of technologies to those currently operating in the Philippines, given the desire to see a system in operation. SBR is currently seen as the best suited technology for Puerto Princesa.

**Municipal Priorities:** Technology selection will prioritize systems with a small footprint, due to limited land, and low labor requirements. The 50 m<sup>3</sup>/d plant is expected to cost P100 million (USD 2.07 million), including the purchase of three new vacuum collection vehicles (two 5-m<sup>3</sup> trucks, one 10-m<sup>3</sup> truck).

**Facility Siting:** The PPWD Septage Treatment Plant will be sited at the city landfill, approximately 13 km outside of the city center. The land was gifted to the water district by the LGU. Local ordinances require that treatment facilities be located in agricultural areas, away from residential areas. There is a lagoon nearby to store treated effluent.

**Local Partners:** Local partners have not been identified. The

PPWD is still evaluating whether they will contract with a private desludging company or provide collection services themselves. The PPWD will own and operate the new septage treatment plant. Treated septage sludge is expected to be used as a soil amendment in nearby rice fields. Effluent will be stored in the nearby lagoon and used for fire fighting.

**Expectations for Project Finance:** The Development Bank of the Philippines will finance 90% of the total project cost at a rate of 4.25% over 15 years. At this time, cost recovery is expected to be achieved through collection of an environmental service fee—no other revenue streams are anticipated.

## A need for reliable electricity is high with 100% of the supply coming from large-scale diesel generation.

**Availability of Biomass Sources:** Additional biomass sources may not be readily available in Puerto Princesa and, given the small amount of septage available, will be absolutely necessary. This is further compounded by the low solids content of septage in the Philippines, requiring even more biomass feedstock to reach the target 16.2 MTPD for the J-OP. The LGU is currently preparing to enter into contract with a private company, Austworks to cap and close the existing landfill and install a plasma gasification plant to manage 100% of the city's MSW and hospital waste, totaling 90 MTPD. Austworks will reportedly cover 100% of the capital and operating expenses, in addition to gifting 1% of the projects annual revenues back to the LGU. The project is expected to cost P2.1 billion (USD 43 million) and span 25 years. Electricity generated by the plant will be sold back to the Palawan Electric Cooperative (PALECO) via a power supply agreement. Other sources of biomass (namely rice hauls) are produced in nearby agricultural zones, however are reportedly burned despite national laws prohibiting this practice.

### Markets for End Products

**Ultrapure Water:** Being a tourist destination and fishing community, Puerto Princesa is void of industrial users for ultrapure water. The water district suggested use as coolant water for hotels and malls with the ultrapure water likely fetching a price equal to that of potable water.

**Electricity:** The Island of Palawan is not connected to the

National Electricity Grid. Electricity on the island is supplied by PALECO, a private generator and distributor of electricity. The only source of electricity is diesel and bunker fuel, and consumers experience regular brownouts, particularly in the summer months when demand is high and the plant needs to be shut down for cooling. The WD reportedly uses a generator to supply backup power for 30% of their total operating hours during the summer months.

Despite this, electricity rates in Palawan are similar to those in other areas of the Philippines. The last publicly available source (December 2014) cites an industrial retail price of electricity of P8.5 (USD 0.18)/kWh but the price fluctuates with the spot price of diesel.\* In the summer months, the WD spends P3 million (USD 62,000) /month for electricity to extract, treat, and supply potable water to it's 40,000 connected households. Expenses during the rainy season are reduced because of an abundance of groundwater and related reductions in groundwater pumping.

The PPWD would be the desired end user of electricity produced by a J-OP, offsetting their existing and future electricity costs and generating a more reliable supply of energy. With the planned placement of the new septage treatment plant, electricity distribution infrastructure would presumably be installed connecting the J-OP to the district's existing water treatment plant, if justified by the difference between the electricity price paid by the district and the price sold to PEC.

\* <http://www.paleco.net/powerrate/powerrates/December.pdf>

## Metro Cebu is the second largest metropolitan area in the Philippines and a major port of entry with abundant industry.



**City, Province:** Metro Cebu in Cebu Province comprises 13 cities. The Metro Cebu Water District (MCWD) serves eight of them.

**Total population:** 2.8 million in Metro Cebu, 2.2 million served by the MCWD (2015)

**Water District:** Metro Cebu Water District

**Current Services Provided:** Water treatment and supply, desludging services and septage treatment expected to begin in August 2016

**Other cities served by Water District:** Cebu City, Talisay, Mandaue, Lapu Lapu, Consolacion, Liloan, Compostela, Cordova

**Other Key Stakeholders:** Cebu City Government; Metro Cebu Development and Coordinating Board

### Key sanitation statistics:

- **Percentage of population with access to piped sewer / WWTP:** 0%
- **Percentage of serviced population with septic tanks:** 100%
- **Percentage of population with access to septage collection services:** 65% of the population is currently desludged by private companies. The remaining 35% will be serviced by MCWD and their service providers in the future.
- **Percentage of septic tanks regularly emptied:** Unknown
- **Quantity of septage collected daily (m<sup>3</sup>/d):** Unknown
- **Septage Collection Fee:** P3,000–10,000 (USD 62–207)/service (depending on size of the tank). MCWD will enact an environmental service fee of P2.20 (USD 0.05)/m<sup>3</sup> of potable water consumed for customers in Mactan Island once the Cordova Plant is operational
- **Fee Collection Method:** Private desludgers: Fee collected at time of service. MCWD: Fee paid with water bill
- **Septage Collection Company:** Private desludging companies (at present), Metro Cebu Water District and EnviroKonsult will undertake collection service in the future
- **Current Disposal Practice(s):** Most septage is dumped in the local environment. Five desludging companies dispose of septage at a 200 m<sup>3</sup>/day dewatering plant (the Cebu Volute Dewatering Press supplied by JICA), although at the time of visit the plant was not operational.

# The MCWD has just developed its first septage management facility, with plans for three additional plants.

**Initiatives Underway:** The MCWD is currently commissioning the construction of its first septage treatment plant in Lapu-Lapu. At present, the only septage management facility in Metro Cebu is the Volute Dewatering Press, owned and operated by the LGU (with support from JICA). The Lapu-Lapu Septage Treatment Plant will be a privately owned and operated 150 m<sup>3</sup>/day facility that utilizes mechanical dewatering, activated sludge and chlorine disinfection. The service delivery model is Build-Own-Operate-Transfer, with expectations that after 5 years, the facility will be transferred from EnviroKonsult, to the MCWD. During the contract period, the district will pay EnviroKonsult P800 (USD 17)/m<sup>3</sup> to collect and treat the septage. The Water District is also preparing an application to JICA to fully fund the development of three additional septage treatment plants with a total combined capacity of 620 m<sup>3</sup>/day. Facilities will be located in Talisay (230 m<sup>3</sup>/d), Consolacion (150 m<sup>3</sup>/d), and Cebu City (240 m<sup>3</sup>/d) and are expected to cost USD 20 million in total.

**Technologies/Services Under Consideration:** In the District's tender for the Lapu-Lapu Plant, the Cebu water district specified two requirements: (1) that technologies have a performance record in the Philippines and (2) that the system produce Class C effluent and dewatered sludge with a 20% total solids content. Based on the existing collection of septage treatment plants throughout the country, this would have limited proposals to

SBRs, activated sludge, and sedimentation ponds.

**Municipal Priorities:** Because of a near absolute lack of septage treatment infrastructure, the MCWD is aggressively pursuing opportunities to develop new plants. The district is actively looking to avoid capital cost expenditures in lieu of paying a management fee to a private company. The district's head of planning indicated that they are not interested in increasing their workforce and may choose to contract for desludging services in the future as well.

**Facility Siting:** Land has been identified for all four treatment plants. The Lapu-Lapu Plant is located on 3,700 m<sup>2</sup> in a residential district. The Cebu City plant is located between a shopping mall and the sea port, while another facility will be located at the landfill site. There was no indication that zoning laws would impeded site selection, although public consultation is required. This was supported by the relative proximity of the planned sites to residential, commercial, and industrial zones.

**Local Partners:** The Lapu-Lapu Plant will produce dewatered sludge with a 20% total solids content and treated effluent. Solids will be given away free of charge to the LGU as a soil amendment. The effluent will be used onsite for irrigation, toilet flushing, and truck washing, with remaining effluent gifted to the LGU for fire fighting.

## The MCWD is locating septage treatment plants in residential, commercial, and industrial areas for greater user access.

**Expectations for Project Finance:** The Lapu-Lapu Plant is being funded solely by EnviroKonsult. If JICA funds the remaining three plants, it will be a grant in the form of no-cost Japanese technology. In the event that JICA funding does not transpire, the Cebu Water District will likely develop the three plants through a similar private sector business model.

**Availability of Biomass Sources:** Metro Cebu generates ~420 MTPD of MSW, 60% of which is organic (predominantly food) waste. The area landfill has been operating over capacity for more than 25 years. According to Mega Cebu, a nonprofit coalition working to promote sustainability initiatives in the metro area, the city is keen to privatize waste management, shred their MSW and sell it to Cemex, a local cement producer, as refuse derived fuel (RDF). Industrial waste from manufacturing processes could also be a good source of biomass feedstock for the J-OP.

### Markets for End Products

**Ultrapure Water:** Metro Cebu is a center of industry with Mactan Island (made up of Cordova and Lapu-Lapu) is home to a robust electronics manufacturing sector and the Cebu International Airport. The majority of the industries are located in the 120-hectare Mactan Export Processing Zone, an industrial tax-free

zone opened in 1979 that includes over 35 business ventures, many of which are Japanese owned.

**Electricity:** Electricity in Metro Cebu is supplied by the Visayan Electric Company. Between August 15 and September 14, 2016, the average retail residential electricity rate was P10.89 (USD 0.23)/kWh while the wholesale price of electricity was P7.98 (USD 0.17)/kWh.\* With brownouts occurring 1–2 times per month, the Cordova Septage Treatment Plant and all future plants will be equipped with a diesel generator. The Cordova Plant only expects to operate their generator 48–72 total hours per year.

Given MCWD's preference for highly mechanized (high-power consuming) technologies, co-location with an existing septage treatment plant could provide an opportunity to offset system costs. Metro Cebu has a demonstrated ability to site facilities in locations that would be considered infeasible in other cities and therefore locating next to a major end user would not be challenged.



## Dumaguete City is recognized for having developed the country's first public septage treatment plant.



**City, Province:** Dumaguete City, Negros Oriental

**Total population:** 131, 377 (2015)

**Of note:** WD and LGU jointed developed the first public septage treatment plant in the Philippines

**Water District:** Dumaguete City Water District (DCWD)

### Key sanitation statistics:

- Percentage of population with access to piped sewer / WWTP: 0%
- Percentage of population with septic tanks: 90%
- Percentage of serviced population with access to septage collection services: 90%
- Quantity of septage collected daily (m<sup>3</sup>/d): 80m<sup>3</sup>
- **Septage Collection Fee:** P2.00 (USD 0.04)/m<sup>3</sup> of potable water consumed
- **Fee Collection Method:** paid with water will
- **Septage Collection Company:** WD
- **Current Disposal Practice(s):** Septage is treated in stabilization ponds. Effluent is discharged to the local environment and dewatered biosolids are given free of charge to local farmers and nursery owners

**Current Services Provided:** Potable water supply, septage collection, septage treatment

**Other cities served by Water District:** Valencia, Bacong, Dauin, Sibulan, San Jose, Zamboangita

**Other Key Stakeholders:** Dumaguete City LGU (co-owner of septage treatment plant), Septage Treatment Facility was developed with support of USAID

# The Dumaguete City LGU is actively seeking solutions to their MSW problem.

**Initiatives Underway:** The Dumaguete Septage System has been collecting and treating septage since mid-2010. Aside from serving the city of Dumaguete, it also provides services to adjacent and distant towns in response to high demand for the service. The P25 million (USD 517,000) plant processes 80 m<sup>3</sup> of septage each day using a settling tank, drying beds, lagoons, and constructed wetland technology. Solids treatment is not currently meeting envisaged coliform destruction targets.

**Technologies/Services Under Consideration:** The Dumaguete City LGU is currently exploring WTE technologies capable of handling their MSW stream and has received numerous unsolicited proposals from technology vendors. LGU staff expressed a significant amount of vendor fatigue and not-unwarranted skepticism towards new technologies, based on their past experience. The WD has no immediate plans to integrate new technologies into the Dumaguete Septage Treatment Plant, although expressed interest in the J-OP in follow-up communications because of low pathogen removal at the existing site, small footprint, and its ability to co-process MSW, which is a priority of the LGU (see below).

**Municipal Priorities:** The LGU is desperate for a scheme to solve

its solid waste disposal problem. The city has been operating an open dumpsite since the 1970s with no viable solution in site and has recently been fined for poor waste management.

**Facility Siting:** The Dumaguete Septage Treatment Plant is located on a 2-hectare piece of public land, 5 km from the city center. The land was provided by the LGU. The operating footprint of the plant is ~ 1 hectare. The neighborhood is a mix of residential and commercial and is in relatively close proximity to the airport and an industrial animal butchery.

**Local Partners:** The Dumaguete Septage Management System was jointly developed by the DCWD and the LGU.

**Expectations for Project Finance:** The Dumaguete Septage Management System is jointly funded and maintained by the LGU and the DCWD. Future expansion and investment would require approval from both parties and financing from government banking institutions.

# The supply of MSW is adequate and would help solve a persistent challenge of the LGUs.

**Availability of Biomass Sources:** Upon arrival, septage is transferred by truck to a settling tank. Each month, ~30 m<sup>3</sup> of sludge from the settling tank is transferred to a drying bed, where it resides for 1–3 months, reducing the volume to 20 m<sup>3</sup>. Two anaerobic ponds produce an additional 30 m<sup>3</sup> of sludge per month which is also transferred to sludge drying beds. Currently, dried sludge is given away free of charge to farmers and nursery owners.

The city's MSW is currently disposed of in an open (unregulated) dump. Based on visual observations of litter and uncollected wastes, waste capture rates are low. The city produces 0.6 kg/cap/day of MSW (78 MTPD total), although informal recyclers extract valuable materials at the curb. The city operates an organic waste processing facility near the dumpsite with compost products sold or given to farmers.

## Markets for End Products

**Ultrapure Water:** No obvious markets for ultrapure water exist. The Ang Tay Golf Course is located nearby, as is an industrial animal butcher, which may require high quality water for cleaning. STeP was not able to reach the butcher for comment.

**Electricity:** Dumaguete is connected to the National Grid Corporation which receives its electricity from geothermal

plants located in the town of Valencia, 10 miles west of the Dumaguete. Electricity is distributed by the Negros Oriental Electric Cooperative (NORECO) with offices in Dumaguete city. There are scheduled brownouts for maintenance but these are rare and infrequent.

Retail residential power rates are P10.00 (USD 0.21)/kWh. The water district spends P2.5 million (USD 51,691) per month on electricity to extract water from 16 deep wells and supply potable water to its 30,504 concessionaires. The septage treatment plant spends an additional P10,000 (USD 207)/month on electricity.

Given the low electricity demand of the septage treatment plant and the distance and distributed nature of the DCWD's pumping network, a J-OP would likely need to sell electricity to a nearby industry or the grid. The Dumaguete Airport is located ~3–4 km away from the septage facility and therefore could also be a potential buyer. The region has vast experience with renewable energy projects. There are three large scale solar plants nearby in addition to geothermal plants in the region.

## Appendix C: Miscellaneous Materials

# Complete List of Stakeholders Interviewed

## Stakeholders Interviewed

- National Department of Energy—Renewable Energy Management Bureau
- National Solid Waste Management Commission
- National Department of Health
- Asian Development Bank
- Negros Oriental Electric Cooperative
- Bank of the Philippine Islands
- Manila Water
- Maynilad Water
- Metro Cebu Water District
- Mega Cebu
- Puerto Princesa Water District
- Puerto Princesa LGU
- Dumaguete City WD
- Dumaguete City LGU
- Bacolod City WD
- EnviroKonsult
- Ecosystem Technologies International, Inc.
- Department of Science and Technology

# Abbreviations

ADB	Asian Development Bank
DENR	Department of Environment and Natural Resources
DOH	Department of Health
HUC	highly-urbanized city
JICA	Japanese International Cooperation Agency
LGU	local government unit
MWCI	Manila Water Company, Inc.
MWSI	Maynilad Water Services, Inc.
NSO	National Statistics Office
NSSMP	National Sewerage and Septage Management Program
DPWH	Department of Public Works and Highways
MWSS	Metropolitan Waterworks and Sewerage System
TOR	terms of reference

Drinking Water Pricing in Manila				
	Average Business II Rates			
Service Provider	Maynilad Water		Manila Water	
Units	PHP/m <sup>3</sup>	USD/m <sup>3</sup>	PHP/m <sup>3</sup>	USD/m <sup>3</sup>
Usage Tier				
First 100 m <sup>3</sup>	7.81	0.16	5.23	0.10
Next 900 m <sup>3</sup>	73.89	1.48	49.72	1.00
Next 1000 m <sup>3</sup>	77.34	1.44	52.03	1.04
10,000 m <sup>3</sup> and above	86.62	1.74	58.32	1.17



# A spectrum of fit was defined for each of the five key areas.

Parameter	Designation	Definition	Parameter	Designation	Definition		
Market	Well-established market	<ul style="list-style-type: none"> <li>Sophisticated septage treatment plants* have and are being developed in large quantity (20+ in operation, 10+ in pipeline)</li> </ul>	Technical	Strong technical fit	<ul style="list-style-type: none"> <li>Low contamination rates, land constrained, meets local emissions criteria, high need for electricity, preference for mechanical technologies</li> </ul>		
	Moderately well established	<ul style="list-style-type: none"> <li>Septage treatment plants have and are being developed in small quantity (10+ in operation, 5+ in pipeline)</li> </ul>			Moderate technical fit	<ul style="list-style-type: none"> <li>Land constrained, meets local emissions criteria, moderate need for electricity (supply is ample and reliability is good), preference for mechanical technologies</li> </ul>	
	Poorly established	<ul style="list-style-type: none"> <li>No septage treatment plants have or are being developed</li> </ul>		Weak technical fit		<ul style="list-style-type: none"> <li>Feedstock contamination is prohibitive, does not meet local emissions criteria, large amount of available land</li> </ul>	
Policy	Strong policy framework	<ul style="list-style-type: none"> <li>Mandatory septage treatment, strong enforcement mechanisms, Combustion permitted</li> </ul>			Financing	High access to capital	<ul style="list-style-type: none"> <li>Projects have successfully been financed, availability of grants and low interest loans, municipalities are credit worthy</li> </ul>
	Moderate policy framework	<ul style="list-style-type: none"> <li>Mandatory septage treatment but poorly implemented and enforced, combustion permitted</li> </ul>					Moderate access to capital
	Weak policy framework	<ul style="list-style-type: none"> <li>Completely absent sanitation policies and/or combustion prohibited</li> </ul>		Low access to capital		<ul style="list-style-type: none"> <li>Rates are high (above 10%), tenor is short, cities must fund projects with their balance sheet</li> </ul>	
Commercial	Unencumbered path to commercial deployment	<ul style="list-style-type: none"> <li>High appetite for technology risk, open to foreign technology, avail of strong local partners, robust markets for end products (high price + sit behind grid or FIT)</li> </ul>	Financing			Low access to capital	<ul style="list-style-type: none"> <li>Rates are high (above 10%), tenor is short, cities must fund projects with their balance sheet</li> </ul>
	Moderately encumbered path	<ul style="list-style-type: none"> <li>Foreign tech must be proven domestically, local partners require the buy-down of risk, robust markets for end products</li> </ul>					
	Encumbered path to commercial deployment	<ul style="list-style-type: none"> <li>Lack of local partners, aversion to foreign technology, no markets for end products (no FIT, must sell to grid, low wholesale prices)</li> </ul>					

\*mechanical systems include: anaerobic filter, mechanical dewatering, activated sludge, or systems that involve thermal treatment or anaerobic digestion.

# Effluent and biosolids reuse standards are set by the DENR and the DOH.

## Class C effluent standards (DENR)

Parameter	Value	Unit
Class	C	
Discharge Point	Inland rivers	
BOD	50	Mg/L
COD	100	Mg/L
TSS	70	Mg/L
pH	6.5-9	
Surfactants (MBAS)	5	Mg/L
Coliform	10,000	MPN

## Specifications for biosolids reuse (DOH)

Parameter	Plain Organic Fertilizer	Compost or Soil Conditioner	Fortified Organic Fertilizer
Total NPK	5-7%	3-4%	Min 8%
Carbon: Nitrogen	12.1	12.1	12.1
Moisture Content	<=35%	<=35%	<=35%
Organic Matter	>=20%	>=20%	>=20%

## Pathogen limits for biosolids reuse (DOH)

Parameter	Limit
Fecal Streptococci	<5 x 10 <sup>3</sup> /g compost
Fecal Coliforms	<5 x 10 <sup>2</sup> /g compost
Salmonella	0
Infective Parasitic	0

# WTE plants must comply with the ambient air quality guidelines set forth in the Clean Air Act 1999.

National Ambient Air Quality Guideline Values

Pollutants	Short term <sup>b</sup>			Long term <sup>b</sup>		
	mg/Ncm	ppm	Averaging Time	mg/Ncm	ppm	Averaging Time
Suspended Particulate Matter <sup>c</sup> - TSP	230 <sup>d</sup>		24 hours	90		1 year <sup>e</sup>
PM-10	150 <sup>f</sup>		24 hours	60		1 year <sup>e</sup>
Sulfur Dioxide <sup>c</sup>	180	0.07	24 hours	80	0.03	1 year
Nitrogen Dioxide	150	0.08	24 hours			
Photochemical oxidants as ozone	140	0.07	1 hour			
	60	0.03	8 hours			
Carbon Monoxide	35	30	1 hour			
	10	9	8 hours			
Lead <sup>g</sup>	1.5		3 months <sup>g</sup>	1.0		1 year

<sup>a</sup> Maximum limits represented by 98% values not to exceed more than once a year.

<sup>b</sup> Arithmetic mean

<sup>c</sup> SO<sub>2</sub> and Suspended Particulate Matter are sampled once every 6 days when using the manual methods. A minimum of 12 sampling days per quarter or 48 sampling days each year is required for these methods. Daily sampling may be done in the future once continuous analyzers are procured and become available.

<sup>d</sup> Limits for Total Suspended Particulate Matter with mass median diameter less than 25–50 mm.

<sup>e</sup> Annual Geometric Mean.

<sup>f</sup> Provisional limits for Suspended Particulate Matter with mass median diameter less than 10 mm and below until sufficient monitoring data are gathered to base a proper guideline

<sup>g</sup> Evaluation of this guideline is carried out for 24-hour averaging time and averaged over 3 moving calendar months. The monitored average value for any three months shall not exceed the guideline value.

# Drinking water quality is regulated through microbial contaminant limits and quality standards.

## Microbiological limits for drinking water

Parameter	PNDWS 2007	WHO Guidelines for Drinking-water quality
Total coliform <sup>1</sup>	<1 Total coliform colonies/100mL	None specified, but should be absent
Fecal coliform <sup>1</sup>	<1 Fecal coliform colonies/100mL	None detected in a 100mL sample
Heterotrophic plate count <sup>1</sup>	<500 CFU/mL	None specified
E. coli	None specified	None detected in a 100mL sample

## Physio-chemical drinking water quality standards

Parameter	PNDWS 2007	WHO Guidelines for Drinking-water quality
pH	6.5 – 8.5	None specified
Turbidity (NTU)	5	< 0.1
Total dissolved solids (mg/l)	500	None specified
Iron (mg/l)	1.0	None specified
Chlorides (mg/l)	250.0	None specified
Nitrate(mg/l)	50	3
Sulfate (mg/l)	250	None specified
Zinc (mg/l)	5.0	None specified
Fluoride (mg/l)	1.0	1.5
Mercury (mg/l)	0.001	0.006
Arsenic (mg/l)	0.05	0.01
Lead (mg/l)	0.01	0.001 <sup>2</sup>

<sup>1</sup>Membrane filter technique

<sup>2</sup>Provisional value. WHO recognizes that it is extremely difficult to reach these levels, and it depends on treatment performance and analytical achievability.

## Forty cities currently have solid waste source separation programs in place, indicating a readiness for WTE.

Angeles City, Pampanga

Baler, Aurora

Cagayan de Oro City, Misamis Oriental

General Santos City

Jagna, Bohol

Kabacan, Cotabato

Lahug, Cebu

Makati City, Metro Manila

Mandaue, Cebu

Puerto Princesa, Palawan

Ronda, Cebu

San Fernando, Cebu

San Juan, Metro Manila

Carmen, Cebu

Asturias, Cebu

Daanbantayan, Cebu

San Francisco, Cebu

Moalboal, Cebu

Naga City, Camarines Sur

Oslob, Cebu

Cordova, Cebu

Argao, Cebu

Mandaue, Cebu

Naga City, Cebu

Topledo, Cebu

Cebu City, Cebu

San Fernando City, La Union

San Fernando City, Pampanga

Quezon City, Metro Manila

Pasig City, Metro Manila

Sorsogon City, Sorsogon

Tuguegarao City, Cagayan

Legaspi City, Albay

Antipolo City, Rizal

Bayawan City, Negros Oriental

Los banos, Laguna

Calanba, Laguna

Cabuyao, Laguna

Marikina, Metro Manila

Mandaluyong City, Metro Manila

## Appendix D: Septage Facility Profiles



## In 2010, Dumaguete City developed the Philippine's first publicly owned and operated septage treatment facility.

**Name:** Dumaguete Septage Treatment Plant

**Date operational:** April, 2010

**Location:** Dumaguete City

**Design capacity:** 80 m<sup>3</sup>/day

**Operating throughput:** 70–100 m<sup>3</sup>/day

**Technology(s) used:** Sludge drying beds, stabilization ponds, gravel filter and wetland

**Number of people served:** 130,000 in Dumaguete, including septage from Valencia, Bacong, Dauin, Sibulan, San Jose, Zamboanguita

**Septage collection system:** 8 vacuum trucks ranging from 3 to 6 m<sup>3</sup> in capacity owned and operated jointly by the LGU and DCWD

**Household collection fee:** P2.00/m<sup>3</sup> of potable water consumed

**Capital costs:** P25 million (USD 500,000)

**Annual operating costs:** P12 million (USD 240,000)

**Other cost-recovery measures:** None, effluent is discharged to the local environment; dewatered solids given away free of charge to farmers and nursery owners

**Financing:** The facility and vacuum trucks were jointly funded by the Dumaguete City WD and the LGU. The program was developed with technical assistance from USAID through the Local Initiatives for Affordable Wastewater Treatment (LINAW) and Philippine Sanitation Alliance (PSA).

**Treatment efficiency:** BOD<15mg/l; TSS<10mg/l

**Footprint:** 10,000 m<sup>2</sup>

**Total land area:** 20,000 m<sup>2</sup>



Clockwise from top left: sludge drying beds, sequential stabilization ponds, gravel filter and wetland.



# In August 2016, EnviroKonsult will begin operations on a 150 m<sup>3</sup>/d mechanized FSTP in Metro Cebu.

**Name:** Lapu-Lapu Cordova Septage Treatment Plant

**Date operational:** (Planned) August, 2016

**Location:** Cordova, Mactan Island, Metro Cebu

**Design capacity:** 150 m<sup>3</sup>/day

**Operating throughput:** anticipated 150 m<sup>3</sup>/day

**Technology(s) used:** Settling tank, coagulation, mechanical dewatering, activated sludge, chlorine disinfection

**Number of people served:** 85,000 households

**Septage collection system:** EnviroKonsult

**Household collection fee:** P2.20 (USD 0.05)/m<sup>3</sup> of potable water consumed

**Capital costs:** P100 million (USD 2.1 million) including the purchase of five new 10m<sup>3</sup> desludging trucks

**Annual operating costs:** Unknown (15 employees). Costs include electricity, labor, coagulant, and maintenance

**Other cost-recovery measures:** None, effluent is used onsite and discharged to the local environment; dewatered solids are expected to be given away free of charge to farmers and nursery owners

**Financing:** Will be funded 100% by EnviroKonsult; MCWD will pay EnviroKonsult P800 (USD 17)/m<sup>3</sup> of septage collected and treated for a 5-year concession period

**Treatment efficiency:** Class C effluent, sludge dewatered to 20% total solids content

**Footprint:** 500 m<sup>2</sup>

**Total land area:** 3,700 m<sup>2</sup>

**Other information:** None



Top: Mechanical dewatering unit

Bottom: Activated sludge tank

## In addition to operating 16 STPs, Maynilad Water owns and operates 3 facilities that also treat septage.

**Name:** Project 7 (Veteran's Village) Water Reclamation Facility (Septage + sewerage treatment plant)

**Date operational:** 2009

**Location:** Quezon City, Metro Manila

**Design capacity:** Septage treatment system is operating at 50% capacity

**Operating throughput:** 2,400m<sup>3</sup>/day sewerage plus 240 m<sup>3</sup>/day septage

**Technology (s) used:** Septage enters a holding tanks and is treated first by coagulation and mechanical dewatering. Sewerage flows in through screens, a grit trap and oil/water separator and then meets the effluent from the septage in an equalization basin before moving on to sequencing batch reactor, media filtration and chlorine disinfection

**Number of people served:** 185,000 people

**Septage collection system:** Maynilad Water

**Household collection fee:** 20% of water bill; P3,000 (USD 62) /septic tank

**Capital cost:** P266 million (USD 5.5 million), 2013

**Annual operating costs:** Unknown. Operator pays to transport solids to Alaminos, Laguna (Southern Luzon) to be made into fertilizer. Two staff per shift.

**Other cost-recovery measures:** None known

**Financing:** World Bank (20% of total capex), remainder unknown

**Treatment efficiency:** Class C effluent, sludge is dewatered to 20% total solids content

**Footprint:** ~1,000 m<sup>3</sup> (treatment occurs largely underground)

**Total land area:** 1,300 m<sup>3</sup>

**Other information:** None



Top: Project 7 Water Reclamation Facility

Bottom: Mechanical dewatering unit

## There are 21 septage treatment plants in the Philippines.

	Plant Name	Owner/Operator	Location	Date Operational	Design Capacity	Technology Used	Capex	Annual Opex	Cost Recovery	Funding	Plant Footprint	Land Footprint
1	Project 7, Quezon City	Maynilad Water	Quezon City, Metro Manila	2013	Septage: 240m <sup>3</sup> /day (facility also accepts 2,400 m <sup>3</sup> /day piped sewerage)	Coagulation, mechanical dewatering, SBR, media filtration and Chlorine	P266 million	--	20% of water bill; P3,000 /septic tank.	Maynilad Water & World Bank (20% of total Capex)	1,000 m <sup>2</sup>	1,300 m <sup>2</sup>
2	Dagat-Dagatan Sewage & Septage Treatment Plant	Maynilad Water	Metro Manila	2009	250 m <sup>3</sup> /day septage, 13 MLD total capacity	Coagulation, filter press, and oxidation pond	--	--	Percentage of water bill; amount unknown	--	--	--
3	Las Pinas	Maynilad Water	Metro Manila	2015	250 m <sup>3</sup> /day	Screw press dewatering	P363 million	--	--	--	--	--
4	San Jose del Monte, Bulacan	San Jose del Monte Water District	City of San Jose del Monte	2015	60 m <sup>3</sup> /day	Flocculation and vacuum press, SBR	P70.55 million	Total O&M: P14.5 Million/year; Septage Collection = P470/m <sup>3</sup> ; Electricity = P20,000	P1.90/m <sup>3</sup> of potable water consumed	--	382 m <sup>2</sup>	4,400 m <sup>2</sup>

## Septage Treatment Plants Continued (2/4)

	Plant Name	Owner/Operator	Location	Date Operational	Design Capacity	Technology Used	Capex	Annual Opex	Cost Recovery	Funding	Plant Footprint	Land Footprint
5	Cebu Volute Dewatering Press	Cebu City LGU	Cebu City	2014 (facility did not appear operational in July 2016)	200 m <sup>3</sup> /day	Dewatering press, lagoon	P15 million	--	Private desludgers pay P200–250/m <sup>3</sup> of septage	Capex grant provided by JICA	--	--
6	FTI Septage Treatment Plant (South)	Manila Water	Metro Manila	--	Combined capacity of 1,400 m <sup>3</sup> /day	--	--	--	--	--	--	--
7	San Mateo Septage Treatment Plant (North)	Manila Water	Metro Manila	--		--	--	--	--	--	--	--
8	Laguna	EnviroKonsult / Maynilad Water	Bay, Laguna	2013	60–100 m <sup>3</sup> /day	Flocculation and Vacuum press plus MBR	P70 million					
9	Baliwag, Bulacan	Baliwag Water District	Baliwag, Bulacan	2013	30–40 m <sup>3</sup> /day	Flocculation and Vacuum press	P35 million	P10.2 million	10% of water bill	Loan from Land Bank	2,800 m <sup>2</sup>	800 m <sup>2</sup>
10	Tacloban City	Tacloban City	Tacloban City	2016	20 m <sup>3</sup> /day	Anaerobic Baffled Reactor; with Lime	P8 million		Funded by LGU	Capex grant provided UNICEF		

## Septage Treatment Plants Continued (3/4)

	Plant Name	Owner/ Operator	Location	Date Operational	Design Capacity	Technology Used	Capex	Annual Opex	Cost Recovery	Funding	Plant Footprint	Land Footprint
11	Lapulapu-Cordova Septage Treatment Plan	Metro Cebu Water District	Cordova	2016	150 m <sup>3</sup> /day	Settler, Mechanical Dewatering, Activated Sludge, Chlorine	P100 million		P2.20/m <sup>3</sup> water consumed	Metro Cebu Water District	500 m <sup>2</sup>	3,700 m <sup>2</sup>
12	Bayawan City	Bayawan City govt.	Bayawan City	2010	--	Anaerobic Baffled reactor; lagoons	--	--	--	LGU	5,000 m <sup>2</sup>	10,000 m <sup>2</sup>
13	Dumaguete City	LGU and Water District	Dumaguete	June 2010	80 m <sup>3</sup> /day	Stabilization ponds	Initial – P25 million; 2015 Assets –P35 million	P11 million	P2.00/m <sup>3</sup> water consumed	LGU and Water District	10,000 m <sup>2</sup>	20,000 m <sup>2</sup>
14 - 20	7 separate STPS in the cities of: Alabel, Glan, Maasim, Malatapan, Malalag, Matium and Kiamba	LGUs	Various locations in Province of Sarangani (Mindanao)	2005–2009	20–25 m <sup>3</sup> /day	Lagoons/ stabilization ponds	--	--	--	All Funded by JICA	Variable	Variable

## Septage Treatment Plants Continued (4/4)

	Plant Name	Owner/ Operator	Location	Date Operational	Design Capacity	Technology Used	Capex	Annual Opex	Cost Recovery	Funding	Plant Footprint	Land Footprint
21	San Fernando Septage Treatment Plant		San Fernando, La Union Province	2012	30 m <sup>3</sup> /day (?)	Hybrid system using anaerobic baffled reactor, up-flow anaerobic sludge blanket, facultative lagoon, maturation pond	USD 800K		P600 per house per year attached to property tax	USAID, Rotary International.		1.2 ha