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DELEGATION OF THE EUROPEAN UNION TO THE REPUBLIC OF MAURITIUS AND TO THE REPUBLIC OF SEYCHELLES

SOLID WASTE MASTERPLAN FOR SEYCHELLES (2020-2035)

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This project is implemented by COWI A/S

Member of the COWI Consortium

ADDRESS COWI A/S
Parallelvej 2
2800 Kongens Lyngby
Denmark

TEL +45 56 40 00 00

FAX +45 56 40 99 99

WWW cowi.com

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EXECUTIVE SUMMARY

This Solid Waste Masterplan for Seychelles has been prepared under a project financed by the European Commission. It provides for the direction of waste management in the Seychelles until 2035 and establishes the foundation for transforming the current waste management system, in line with the waste management policy 2018-2023. The Masterplan focuses primarily on municipal solid waste (MSW) from the three main islands (Mahé, Praslin and La Digue), as well as certain "priority waste streams".

Solid Waste Management (SWM) poses a significant challenge to Seychelles that, as a Small Island Developing State (SIDS), suffers from the scarcity of land and other issues associated with small and fragile environments. Therefore, it is crucial to implement waste reduction and recovery strategies, strengthen the institutional and legal framework and upgrade the overall waste infrastructure & operations.

The Masterplan estimates, under a medium development scenario, the current waste generation at around 90,000 tons per year, increasing to 130.000 tons in 2035. The amount of waste for final disposal/treatment is currently estimated at 40.000 tons and will be reduced to around 36.000 tons in 2035 due to the expected increase in recycling/bio-treatment. The compostable fraction of the waste accounts for up to 40% and separated treatment of the organic fraction would have a significant positive impact on the remaining landfill volume.

Key challenges

The key challenges of the current waste management system in Seychelles are related to the following:

Geographic isolation: Waste management on small, isolated islands like Seychelles is expensive and complicated. The limited availability of land space makes the siting of waste treatment facilities challenging and it is hard to create economies of scale for disposal and treatment.

Waste infrastructure: The current waste infrastructure is not able to deal with the increased waste amounts. Design capacities have been (almost) reached and inadequate O&M prevent the facilities from functioning properly.

Import of goods: The massive import of goods, but the lack of export of the related waste products, means an ever-increasing burden. Especially the import of low-quality products, with a short-life span, has become a serious challenge and has already resulted in large stockpiles of (e) waste.

Data: There is only limited information available on waste quantity due to the absence of a comprehensive monitoring & reporting system. Information that does exist is often not accurate and in certain instances contradictory.

Financing: Households are not paying for waste management services and the gate fees at the landfills are low. Therefore, the revenue flows from existing SWM

charges are insufficient to be able to meet the full costs of providing a sustainable system. As a result, waste management is mainly subsidize by the government

Culture: The general public does not have sufficient knowledge on the need for proper waste management and their role therein. Unsustainable behaviour is impacting the environment and will ultimately affect the tourism sector that depends in the country's beauty.

Institutional: Existing responsibilities for SWM are not clearly defined between the various ministries and departments (e.g. between MACCE and the LWMA)and available capacity is limited. This has resulted in outdated waste management plans, unaligned policies and responsibilities and insufficient development of improvements.

Regulatory: Seychelles has not yet adopted waste management framework regulation (i.e. a dedicated "Waste Management Act") that fully regulates the management of waste. Resources and procedures for monitoring and enforcement are insufficient.

This Masterplan

Establishing an effective waste management system requires an agreed, long-term and stable policy framework within which the necessary facilities and infrastructure for proper MSW management can be provided. The Solid Waste Masterplan describes specific activities required to realize this, ranging from increasing technical and managerial capacity and strengthening the policy & legal framework to developing financial sustainability and upgrade current facilities.

The Masterplan identifies 4 actions for potential investments to improve the system, which should be accompanied by "softer" supporting measures such as policy & regulatory development and education and public awareness campaigns. These actions are:

Action 1: Reduction of final disposal;
Action 2: Improvement of final disposal sites;
Action 3: Addressing priority waste streams;
Action 4: Careful examination of new SWM technologies.

The total initial investment costs for these 4 actions are estimated at around EUR 14M.The investments would increase the costs of waste management from 800 to 1,160 SCR per tonne. Thus, the full cost recovery bill per person would amount to 580 SCR per year, or 48 SCR per month.

List of Abbreviations

AD	Anaerobic Digestion
CEO	Chief Executive Officer
DG	Director General
EDF	European Development Fund
EEE	Electric and Electronic Equipment
EIA	Environmental Impact Assessment
EIC	Education, Information and Communication
ELV	End of Life vehicle
EMPS	Environment Management Plan of Seychelles
EoI	Expression of Interest
EPA	Environmental Protection Act
EPR	Extended Producer's Responsibility
ETF	Environmental Trust Fund
EU	European Union
EUD	European Delegation
FCA	Full cost accounting
GDP	Gross Domestic Product
GoS	Government of Seychelles
IFC	International Finance Cooperation
LTP	Leachate Treatment Plant
LWMA	Landscape and Waste Management Agency
MACCE	Ministry of Agriculture, Climate Change and Environment
MoF	Ministry of Finance
MRF	Materials Recycling Facility
MSW	municipal solid waste
NBGF	National Botanic Gardens Foundation
NBS	National Bureau of Statistics
NGO	Non-Governmental Organization
NMS	National Meteorological Service
NSWMP	National Solid Waste Masterplan
O&M	Operation and Maintenance
PET	Polyethylene terephthalate
PPP	Polluter Pays Principle
PPP	Public Private Partnership
PS	Principal Secretary
PUC	Public Utilities Cooperation
SCR	Seychelles Rupee
CSR	Corporate Social Responsibility
SEC	Seychelles Energy Commission
SIDS	Small Island Developing State
SNPA	Seychelles National Parks Authority
SRC	Seychelles Revenue Commission
SSDS	Seychelles Sustainable Development Strategy
SSTL	Sustainable Tourism Label Seychelles
STAR	Société de Traitement et d'Assainissement Régional
SWM	Solid waste management

UCTS	Upstream Combination Tax/Subsidy
UNFCCC	United Nations Framework Convention on Climate Change
VAT	Value Added Tax
WCS	Waste Characterisation Study
WEEE	Waste Electric and Electronic Equipment
WEPD	Waste, Enforcement and Permit Division
WMTF	Waste Management Trust Fund
WtE	Waste-to-Energy

1 Introduction

1.1 Rationale

The Delegation of the European Union to the Republic of Seychelles (EUD) has appointed the Danish Consulting and Engineering Company COWI A/S (the Consultant) to carry out the project titled *"Preparation of a Solid Waste Masterplan for Seychelles".* The project, financed by the European Union (EU) under the "Services for the Implementation of External Aid 2018" (FWC SIEA 2018), will provide technical assistance to the Government of Seychelles (GoS) to prepare a new National Solid Waste Masterplan (NSWMP), which will translate the recently adopted National Waste Policy 2018-2023 into a detailed plan to guide the development of solid waste management.

1.2 Objectives

This Masterplan provides for the direction of waste management in the Seychelles until 2035 and establishes the foundation for transforming the current waste management system, in line with the Waste Management Policy 2018-2023.

The objectives of the Masterplan are: (i) to guide the development of waste management by identifying options for interventions that are cost-effective, sustainable and appropriate for the Seychelles; (ii) and to create a stable framework that will provide confidence, within which the necessary investments in waste collection systems and treatment infrastructure can be provided.

1.3 Validation Workshop

On 9th October 2019 a Validation Workshop was held at STC Conference Room Latanier Road, Mahé, Seychelles, during which the draft Masterplan was presented and discussed in the presence of a wide range of stakeholders. Comments and suggestions raised during the workshop have been incorporated in this Final Masterplan.

1.4 Background

Solid Waste Management (SWM) poses a significant challenge to Seychelles that suffers from many of the usual issues associated with managing waste within a Small Island Developing State (SIDS), such as lack of funding & capacity, high costs of transportation, insufficient number of engineered landfills[1] and scarcity of land (see furtherBox 1).

[1] Currently, there are 2 engineered, sanitary landfills in Seychelles, one on Mahé (Providence II) and one on La Digue (L'Union)

Box 1SWM in a small-island context

There are several challenges in managing solid waste that are typically associated with small-island environments. These include the following:

- Limited availability of land space on islands makes siting of waste treatment facilities challenging. It is difficult to find suitable and accepted locations and valuable land (e.g. land suitable for agriculture, tourism, etc.) needs to be sacrificed for waste management.
- Islands are characterized by a relatively small amount of waste which varies seasonally due to tourism and climate. Thus, waste disposal and treatment facilities shall be capable to accommodate these variations.
- If waste cannot be managed locally on the island, there is a need to transport it to another location (island/mainland). This comes with substantial transport costs.
- Total waste amounts are often limited, which makes it less interesting for Contractors to invest in waste management facilities as they cannot be made financially viable to operate.
- The size of the local economy and industrial/agricultural base often cannot sustain consistently high levels of material reuse.

Therefore, GoS is committed to improving the existing waste management system, by implementing waste reduction and recovery strategies, strengthening its institutional and legal framework, upgrading waste operations in line with international practices and other measures that are defined in the recently adopted National Waste Policy 2018-2023.

1.5 Objectives and Scope

This Solid Waste Masterplan will help GoS in the implementation of the objectives of the National Waste Policy 2018-2023 and will translate the broad long-term strategies contained in the policy into detailed plans to guide the development of solid waste management in Seychelles. The Masterplan will provide a clear strategic direction and will help creating a transparent, stable and predictable business environment, which is a prerequisite for increased private sector involvement in the waste sector and for realizing the related benefits.

Definition

Due to the waste quantities generated, and the associated challenges, this Masterplan focuses primarily on Municipal Solid Waste (MSW). Whilst there is a broad understanding of what is generally meant by MSW, for the purpose of this Masterplan, the following definition, as used in the EU Waste Policy Framework, is used:

"Municipal solid waste covers household waste and waste similar in nature and composition to household waste".

In Seychelles, the definition of waste as described in the Environmental Protection Act 2016 is:

"Waste means garbage, refuse, sludges, construction debris and other discarded substances or materials resulting from industrial and commercial operations or from domestic, individual and community activity"

Waste from households includes e.g. paper and cardboard, glass, metals, plastics, bio-waste, wood, textiles, packaging, waste electrical and electronic equipment,

waste batteries and accumulators, and bulky waste, including mattresses and furniture.

Waste from other sources, where such waste is similar in nature and composition to waste from households, may come from commercial sources (such as hotels, wholesale business establishments and retail shops), industrial sources[2]and institutional sources (such as schools, hospitals and government buildings).

In addition, this Master plan addresses specific waste streams that pose particular challenges to Seychelles if not dealt with in a sustainable manner. These so-called "priority waste streams" are the following:

Waste stream	Marked as priority stream because
Waste Electric and Electronic Equipment (WEEE)	Increasing waste stream due to large import quantities of products and their short life span. Currently completely unmanaged and disposed at dumpsites. Poses a specific threat to the environment because they contain hazardous substances. Large appliances take up considerable landfill space and is very suitable for targeting under an Extended Producer's Responsibility (EPR) scheme.
End of Life Vehicles (ELVs)	Large waste fraction both in volume and weight that is currently unmanaged and disposed partly at the dumpsites and partly on scattered (illegal) locations around the islands. Takes up considerable disposal space. Very suitable for targeting under an Extended Producer's Responsibility (EPR) scheme.
Organic Waste	Almost half of the total generated waste is of organic nature. Without separately handling this fraction it puts an enormous pressure on the capacity of the landfills. As such, it also contributes to increased environmental impacts. Relatively easy to treat (low-tech solutions available) within the country.
Hazardous waste	Small fraction with larger amounts generated by some types of industry. Severe impacts on environment if not properly managed. Requires separate infrastructure and a dedicated policy, strategy and regulatory framework.

Area covered

Geographically, the Masterplan will focus on the 3 main islands (Mahé, Praslin and La Digue), where the majority of waste is generated. For the management of waste on the other (inner and outer) islands, it is proposed to adhere as much as possible to the "principle of self-sufficiency", meaning that waste is dealt with on-site unless this pose severe impacts to the environment/health (e.g. hazardous waste), in which case it needs to be transported to one of the 3 main islands.

[2] Industry is assumed to manage itself its waste in an environmentally sound manner.

2 Current state of waste management

2.1 Geographic and demographic data

Seychelles is an archipelago of 155 islands[3]in the Indian Ocean, about 1,500 km east of the mainland of Africa (Kenya) and northeast of Madagascar (see Figure1).The population of Seychelles stood at 98,055 at 31st December 2019[4]. The majority of the population lives on the 3 main islands: Mahé (88% /85,276), Praslin (9% /8,586) and La Digue (3%/ 2,900). Less than 1% (562) lives on one of the other small (outer) islands (see Table 1). According to World Bank estimates[5], about 56% of the population is considered to live in urban areas, whereas 44% is considered rural.

Figure1 Location of Seychelles

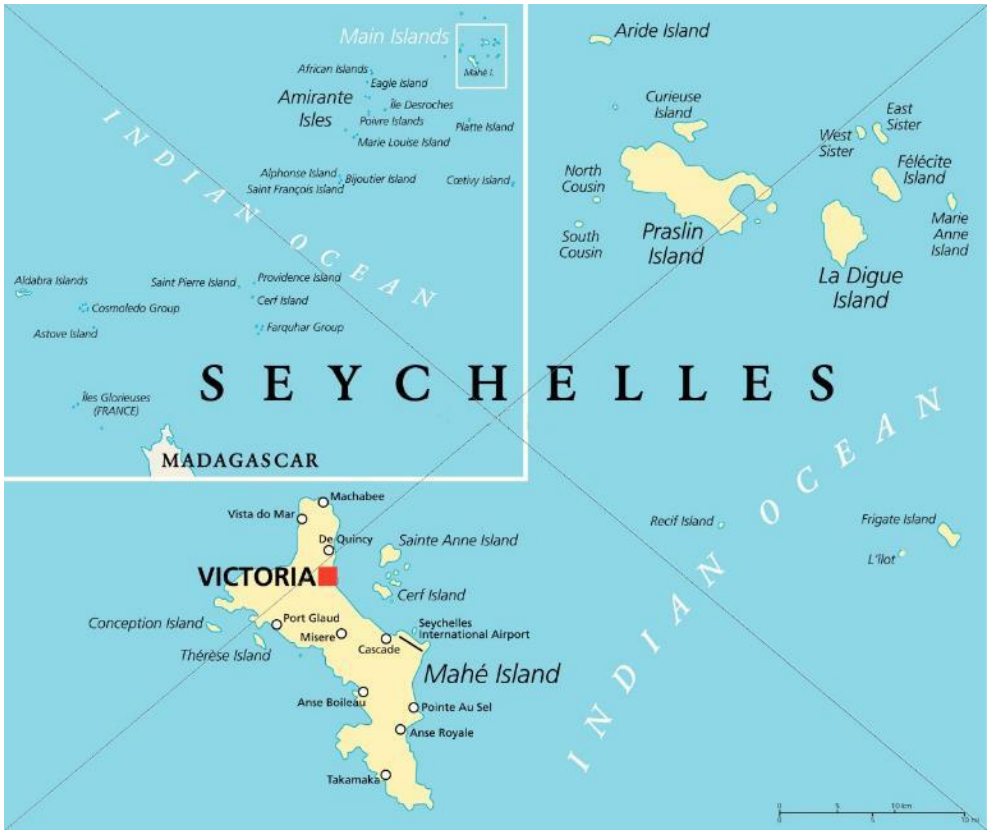


Table 1 District population estimates 2010, 2018 (mid-year)

District	2010	2018
Anse Aux Pins	3,850	4,198
Anse Boileau	4,011	4,057
Au Cap	4,233	4,274
Anse Etoile	4,717	4,891
Anse Royale	4,168	4,624

[3] Although other sources cite the number as 115

[4] National Bureau of Statistics, Bulletin, released 31 March 2020

[5] Based on the United Nations Population Division's World Urbanization Prospects: 2018 Revision.

District	2010	2018
Bel Air	2,857	2,936
Baie Lazare	3,608	3,917
Bel ombre	3,708	3,961
Baie Saint Anne	4,876	4,744
Beau Vallon	4,120	3,985
Cascade	4,267	3,776
English River	4,196	3,704
Glacis	3,833	3,981
Grand Anse Mahe	3,106	3,536
Grand Anse Praslin	3,727	3,842
La Digue	2,761	2,900
Les Mamelles	2,667	2,696
Mont Buxton	3,089	3,141
Mont Fleuri	3,419	3,388
Other Islands	1,042	569
Plaisance	3,781	3,939
Port Glaud	2,572	3,055
Pointe Larue	3,071	3,186
Perseverance		4,545
Roche Caiman	3,232	2,880
Saint Louis	3,209	3,212
Takamaka	2,825	2,825
Total	**90,945**	**96,762**
Island	**2010**	**2018**
Mahé	78,539	84,707
Praslin	8,603	8,586
La Digue	2,761	2,900
Other islands	1,042	569
Total	**90,945**	**96,762**

* Source: National Bureau of Statistics

Tourists

In 2018, a total number of 349,861 visitors set foot in Seychelles[6], which makes tourism an important contributor to waste generation and calls for effective waste management measures.

2.2 Waste quantity and composition

2.2.1 Current municipal waste generation

Reported waste generation

There are no reliable figures for waste generation in Seychelles due to the absence of a proper registration and monitoring system.The most recent estimates report an average municipal waste generation rate for Mahé of 2.45 kg/cap/day (Darmstadt, 2017). In its latest global outlook (2018), the World Bank uses a daily municipal waste generation rate of 1.57kg/cap/day (World Bank, What a Waste 2.0, 2018).

[6] National Bureau of Statistics from disembarkation cards

Low, middle and high scenario

In Table 2 these waste generation rates are included, where the World Bank rate is assumed to represent a medium scenario and the Darmstadt figure the high scenario. A low scenario figure has been added as well, but this is not based on any prior study. As the waste generation rate in rural area is typically lower than on urban areas, it is assumed that rural generation rates are 50% of urban rates.

Under Section 2.2.3 these per capita rates are used to develop three scenarios for future waste generation and disposal/treatment for Seychelles.

Table 2Assumed waste generation rates for low, medium and high-level scenarios

	Low	Medium	High
Unit waste generation - urban (kg/cap/day)	0.50	1.57	2.45
Unit waste generation - rural (kg/cap/day)	0.25	0.79	1.23

2.2.2 Other waste streams

Waste Electric and Electronic Equipment (WEEE)

2017 data show an estimated amount of 879 tons of WEEE being discarded, collected and brought to the scrap yard, landfill Providence 2 or to the scrap dealer[7]. Overall, just over half of the e-waste generated is small equipment (55%), while the second largest share is taken up by temperature exchange equipment such as fridges, freezers, ACs etc. (17%). Further analysis shows that there are total about 1,500 registered importers of Electric and Electronic Equipment (EEE) in 2017, with a small number (70) who make up for most of the amount of EEE being imported (70%).

End-of-Life Vehicles (ELVs)

Each year between 2,000-4,000 vehicles are imported to Seychelles[8], which at their end of life become waste. In 2019, there were around 50 vehicles importing companies and individuals. Data on ELVs is currently not available.

Organic waste

There is no separate collection of organic waste, so amounts have to be estimated on the basis of analyzed waste composition. Data show that around 50% of the total amount of generated municipal solid waste is of organic nature. Based on the earlier mentioned waste generation rate per capita, this would mean that around 24,000 tons of organic waste is generated each year (see also Section 2.2.3 on the waste forecast).

7 E-Waste Flows in the Seychelles Confidential internship report, 2017

8 Data from Seychelles Revenue Commission (SRC), 2015-2019

Hazardous waste

Hazardous waste includes various materials either disposed of in relatively small quantities together with the municipal solid waste (e.g. batteries, small amounts of oils and paints, smaller electronic equipment etc.) or larger amounts from industrial and commercial enterprises (e.g. chemicals, pesticides, waste oils. medical waste etc.). The total quantities of hazardous waste are not known. According to STAR weighbridge data, 41 tons of hazardous waste (Class 11) entered Providence landfill in 2018.

2.2.3 Forecasted municipal waste generation

The Consultant has prepared a 15-year (2020-2035) municipal waste forecast for 3 different scenarios for the future waste generation, namely a low-growth, a medium-growth and a high-growth scenario. For this, the following factors have been taken into consideration:

Population growth

The average population increase in the period 2010-2018 is 0.7% per year (NBS data) and this has been set as the medium-growth scenario. For the low-growth and high-growth scenarios, a population increase of resp. 0.3% and 1% is assumed.

Waste generation growth

While there is no official correlation rate, international experience indicates that the growth in unit waste generation (kg/person/day) is around 30% of the real growth rate of the GDP. The average GDP Annual Growth Rate in Seychelles from 2013-2017 has been 2.8% (World Bank, Global Economic Prospects – Forecasts) and this is taken as basis for the medium-growth scenario. As such, this is expected to result in a growth of 0.85% yearly of the unit waste generation (kg/cap/day). For the low-growth and high-growth scenarios, a GDP increase of resp. 1% and 8% is assumed, resulting in a yearly increase in unit waste generation of resp. 0.3% and 2.4%.

Collection efficiency

There are no official figures on collection efficiency, but nowadays all 3 main islands seem adequately covered by the bring system for municipal waste and the pick-up system for commercial waste. For the purpose of the forecast, it is therefore assumed that collection efficiency is currently 90% and that this will be further increased during the planning period to100%.

Tourist waste

It is assumed that the per capita waste generation rate for tourists will follow the rate for the urban population. The average stay of tourists in Seychelles is 10 days

(NBS) and it is assumed that this will remain unchanged. The yearly increase of tourists over the period 2014-2018has been 11% (NBS), which has been set as the medium-growth scenario. For the low-growth and high-growth scenarios, rates have been set at 5% and 15% respectively.

Recycling capacity

Current recycling efforts are limited to the redeem systems (see next chapter) for PET bottles and beverage cans. Although positive results have been reached, its contribution (in weight) compared to the total waste generation is negligible. However, in line with the National Waste Policy and the Waste Masterplan, it is expected that over the next 15 years efforts on recycling, and bio-treatment (composting and anaerobic digestion), will increase, in line with the global trend of minimizing waste for final disposal/treatment. It is not possible to accurately predict this, but for the purpose if the forecast the following baselines and targets have been assumed:

- Current recycling efficiency (dry fraction): 5%
- Recycling efficiency at end of planning period: 15%
- Current bio-treatment (wet fraction): 1%
- Bio-treatment at end of planning period:25%

Based on the above, the forecasts for waste generation and waste disposal/treatment amounts in the period 2020-2035are presented in the Figures below for low, medium and high-level development scenarios. The detailed Forecast is included under Appendix B.

Under the medium development scenario, current waste generation is estimated at around 48,000 tons per year, increasing to 60,000 tons in 2035. The amount of waste for final disposal/treatment is currently estimated at 40,000 tons and will be reduced to around 36,000 tons in 2035 due to the expected increase in recycling/bio-treatment.

Figure2: Forecasted waste generation amounts in the period 2020-2035 for low, medium and high-level development scenarios

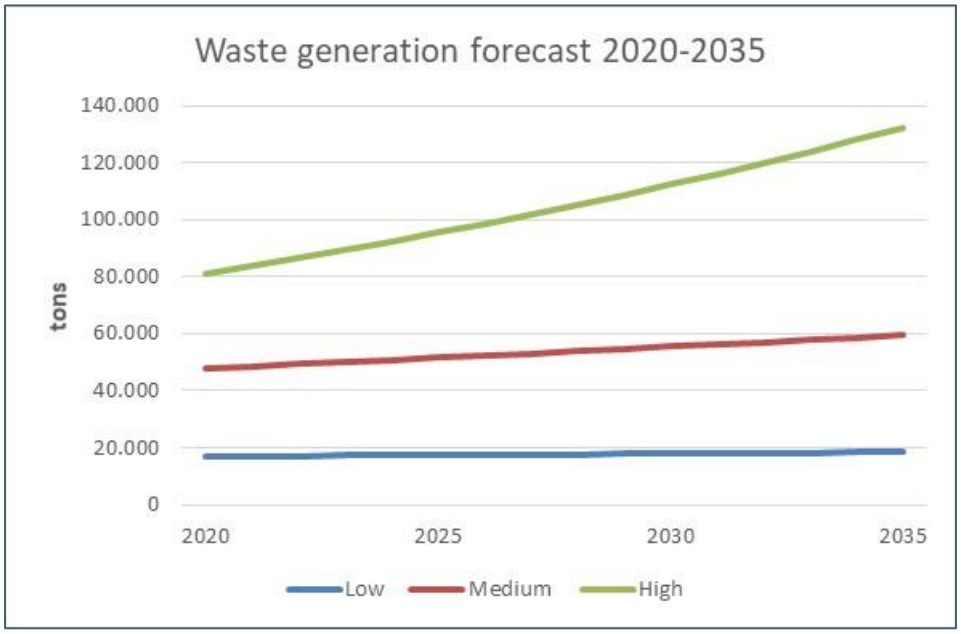
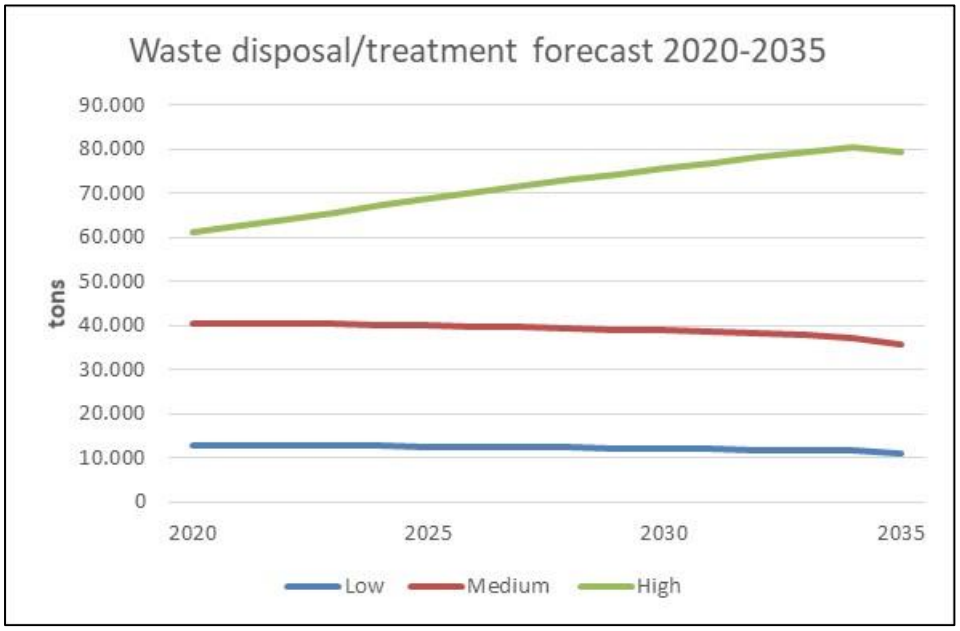


Figure3: Forecasted waste amounts for disposal/treatment in the period 2020-2035 for low, medium and high-level development scenarios



2.2.4 Waste composition

A recent Waste Characterisation Study (WCS) was carried out by Darmstadt University in 2017 and shows the composition of the waste in 20 fractions (Figure 4). For planning purposes, a categorization in 6 fractions (organic, paper, plastic, glass, metals and 'other') is usually sufficient. The reduction of these 6 fractions is depicted in Figure 5.

It can be noted that around 50% of the solid waste produced in Seychelles is compostable. For one thing, this means that separation of the organic fraction would substantially contribute to diversion of waste from landfills, which is the primary policy objective of the government.

Figure 4: Waste composition in 20 fractions (Darmstadt, 2017)

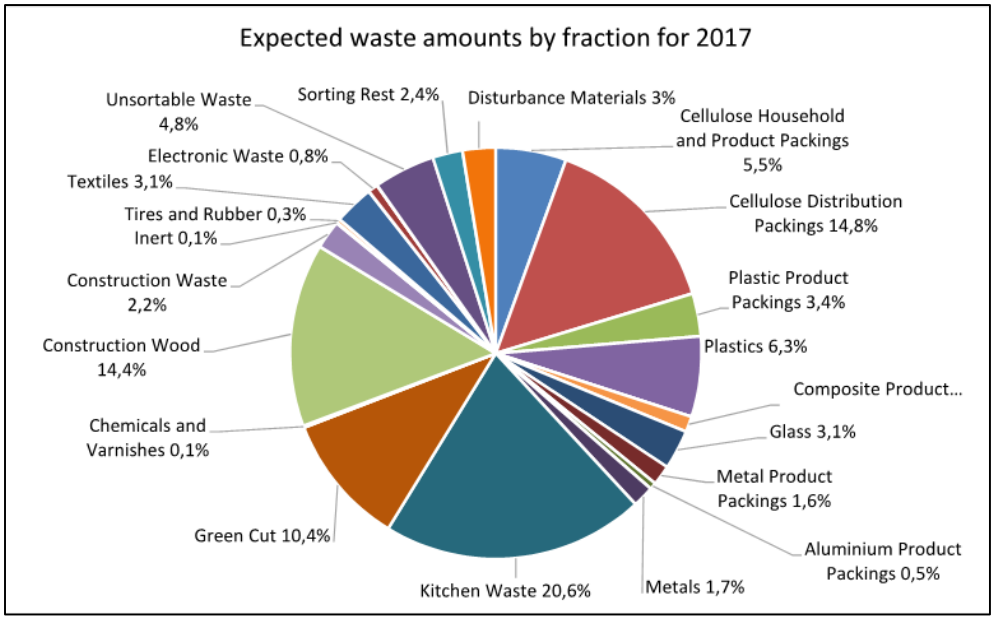
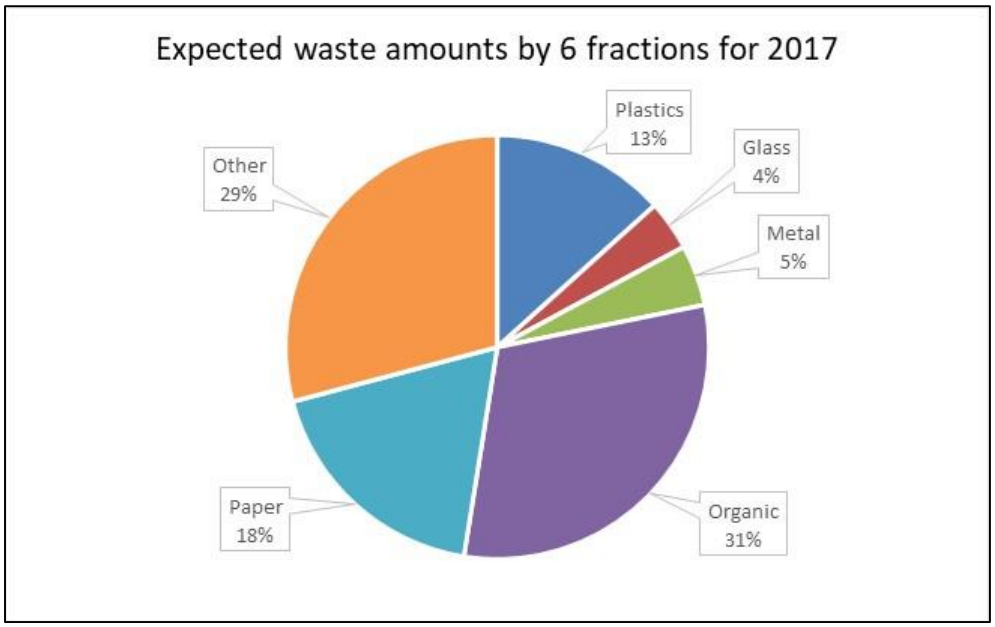


Figure 5: Waste composition in 6 fractions (Darmstadt, 2017)



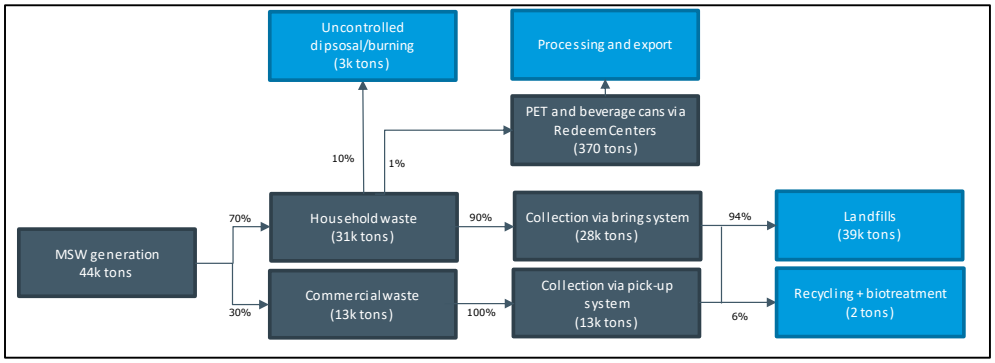
2.3 Waste management operations

2.3.1 Waste flow

In the below Figure, the overall flow for municipal solid waste is presented, from generation to collection (bring and pick-up) and disposal. Included amounts are based on the Consultant's forecast (as included in Section 2.2.3) and further assumptions, as follows:

- Household/commercial waste: 70/30% (STAR weighbridge data 2018)
- Collection efficiency household waste (bring system): 90%
- Collection efficiency commercial waste (pick-up system): 100%
- Extracted before disposal for recycling/bio-treatment: 6%

Figure 6: Waste flow



2.3.2 Waste storage

Household waste

Household waste is stored in communal bin sites situated along the roadside. According to the latest bin audit[9], there are currently a total of 981 bin sites on the 3 main islands. Each bin site generally houses between one to eight 240 liter bins and serves a number of households in the area. In addition, there are 194 small litter bins located on the streets in Victoria and other built up areas. They are also found at most bus stops. Waste from litter bins is collected with the waste from household bin sites.

[9] MACCE, May 2018

Figure7: Collection bins for communal waste (January 2019)

Table 3: Distribution of wheeled 240 litres bins

Island	Region	# of CPs	# of waste bins	# of litter bins
Mahé	North	152	659	72
	Central	128	645	34
	Central/East	95	465	30
	East	120	558	69
	South	130	469	42
	West	104	423	54
	Victoria	101	111	23
Praslin	Baie Ste. Anne Praslin	60	245	15
	Grand Anse Praslin	38	174	23
La Digue	La Digue	53	95	-
	Total	**981**	**3.844**	**362**

Mahé regions: South = Anse Royale, Takamaka, Baie Lazare; North = Beau Vallon, Bel Ombre, Glacis, Anse Etoile; West = Anse Boileau, Grand Anse Mahe, Port Glaud; East = Cascade, Pointe Larue, Anse Aux Pins, Au Cap; Central = St Louis, Bel Air, Mont Buxton, Ile Persévérance, English River; Central/East = Mont Fleuri, Les Mamelles, Plaisance, Roche Caïman.

Commercial waste

Commercial enterprises and other institutions keep their waste stored on their premises until it is being collected through a private commercial contract. However, some (smaller) enterprises dispose their waste in the communal bins.

2.3.3 Waste collection and treatment

Waste collection and treatment is the responsibility of the Landscape and Waste Management Agency (LWMA), who has outsourced operations to the private sector. For the last 20 years the main contractor for collection has been STAR Seychelles, but in April 2019, 8 contractors[10] signed a six-year contract to undertake waste collection from households, and clean bin sites, in various regions of Mahe, Praslin and La Digue.

For the collection of commercial waste, LWMA acts as a middle man. Businesses and establishments are under contract with the Agency that in turn uses private

[10] Initially 10 regions were on tender for municipal waste collection services. The Victoria/Providence Industrial Estate region has been recommended for re-tendering while the Baie St Anne Praslin region is still in the appeal process stage.

waste collection contractors. At the moment, there are 19 contractors for the collection of commercial waste. However, this system is set to change as of mid-2019, and all private commercial institutions and entities will be obliged to have a contract for waste collection directly with an approved private contractor. LWMA will then only provide the general oversight.

2.3.4 Prevention and recycling efforts

The current consumption patterns, with a high consumption of single-use plastic items and low-quality products that are not designed to last or to be recycled, lead to increasing amounts of waste. Life-time extension activities (Re-use, Maintain/Repair, Refurbishment, Re-manufacturing) are conducted in a very limited manner. Recently bans have been established on the import of certain types of single-use plastic items (e.g. plastic bags, Styrofoam boxes, plastic utensils, cups, plates and straws).

PET and beverage cans

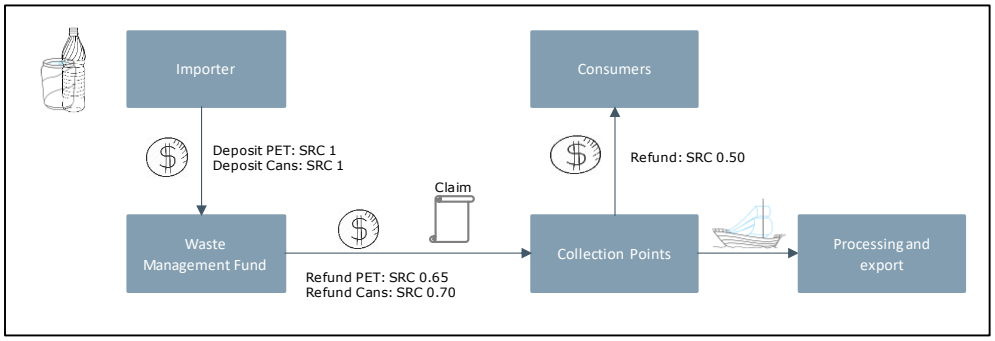
Large-scale waste recycling has yet to be developed. Today, only 2 waste streams (PET bottles and beverage cans) are collected and exported for recycling through a regulated "deposit system"[11], with a 3rd one (alcoholic glass bottles), to be launched in 2020.The schemes include a network of Redeem Centres (there are four on Mahé, one on Praslin and one on La Digue) where people can return their PET bottles and cans for the equivalent to 0.50 Seychelles rupees which represents 0.03 dollars. After processing (shredding/baling), the recyclable materials are exported overseas. Recently, it has become increasingly more difficult to find an outlet for the processed waste due to the closure of international markets such as the closure in China. There is an increased demand for "clean" recyclables, meaning the processing facilities need to ensure a higher and more homogenic quality of the materials to be exported.

Other recyclable streams, such as other plastics[12], glass, paper and organic waste are sent to landfills. The "deposit systems" are functioning reasonably well, but some people find it too cumbersome and not worth the small refund to go to the limited number of Redeem Centres. Therefore, the Ministry of Agriculture, Climate Change and Environment (MACCE) should review the recycling system to ease the consumer's convenience such as adding recycling receptacles where the consumers can deposit the recyclable materials. Nevertheless, since the establishment of the redeeming system for PET bottles and beverage cans, 109 million cans and 259 million PET bottles have been collected and recycled (MACCE, 2019).

[11] A deposit is surcharge on a product when purchased and a rebate when it is re-turned. But in Seychelles, consumers do not pay a surcharge on the bottles. The system is funded from an import levy. Consumers are paid a fee for returning PET bottles and beverage cans.

[12] A ban on single use plastic bags came into force in 2017 and has reduced the amount of plastic waste disposed at the landfills.

Figure 8: Redeem systems for PET and beverage cans



Reuse within the beverage sector

Drinking water

Voluntary reuse schemes are implemented by bottled water manufacturers and hotels, which allow users to bring their own bottles for re-filling. Although the system is not regulated, it is preventing the generation of packaging materials.

Locally made beer

The local beverage company "Seybrew" has established a deposit-return system, to encourage consumers to return their empty beer bottles back to retailers. The system is very effective, with about 90% of the bottles being returned.

Alcoholic drinks

The local rum company "Takamaka Bay" collects its used bottles for re-use. It did not establish a deposit-return system but is encouraging consumers in its advertisements to return their bottles for re-use. The consumer can return empty bottles to any store or vendor that sells Takamaka Bay bottles.

Scrap metal

In 2008, a lease agreement was signed between MACCE and the private company "Samlo and Sons" to scrap metal of the country. However, due to an insufficient processing rate by Samlo and Sons, scrap metals have been piling up at Providence landfill. The situation is now alarming in view that scrap metals have been stockpiled (amount unknown) along the earth access leading to the scrap metal yard. The amount of scrap metal generated each year is estimated of around 6,200 tons (ETH, 2017). In 2017 an amount of 1,118 tons of scrap metals has been exported (MACCE).

Figure 9: Piles of scrap metal on Providence landfill (March 2019)

Paper and Cardboard

There is only one company in Seychelles (Navin recycling) dealing with paper and cardboard. The setup involves machinery that saturates and separates out the paper fibres, which are then used to make egg trays and other similar items. The end product could not compete with cheaper plastic trays and the company has resorted to exporting the cartons to India. Although not a financially viable operation, it is beneficial due to the positive impacts on landfill space.

Car batteries

There exist companies that are collecting and shipping used lead acid batteries coming from the automotive sector including electric buggies that are increasingly being used in the hotel industry. At the moment this activity is not being regulated and it is not known how the batteries are being "processed" with regards to removal and treatment of used concentrated sulphuric acid. Since the acid is corrosive and contains dissolved lead ions and other contaminants, it is hazardous waste. The MACCE knows who is involved in this business in view that they have to obtain permission for export of their containers.

2.3.5 Waste disposal

There are 4 disposal sites in operation in Seychelles, 2 on Mahé (Providence and Anse Royale), 1 on Praslin (Amitié) and 1 on La Digue (L'Union). All landfills are government-owned. The sites on La Digue and Mahé are (partly) engineered sites and have been designed with some environmental protection measures such as bottom liner and leachate collection. However, currently all sites are more or less operated as open dumps (see Figures below).

Providence I & II (Mahé)

The Providence landfill is divided in an old (I) and new (II) part. The old part has been in operation since around 1996 and does not have a bottom liner. Leachate is impacting the ocean, which borders the site on two sides. In 2016, landfilling

at Providence I officially stopped and moved to a new, adjacent site (Providence II). However, small amounts of (liquid) waste are still disposed and the site has never been properly rehabilitated. The area of Providence II covers 7.9 ha with a void capacity 710,000 m^3. A recent study estimated that Providence II sanitary landfill has a remaining lifespan of 15 years[13]. The new site is constructed as a sanitary landfill, funded by the EU, and it includes drainage channels for the collection of leachate, as well as a pre-treatment facility.

The leachate pre-treatment facility is currently out of function because the blower system (that supplies air to the plant) requires corrective work and there are some structural problems (cracks). Originally, the idea was that the effluent would be treated by the Water Treatment Plant of PUC and when designing the pre-treatment facility, it was merely assumed that PUC would accept for treatment. However, this was never looked into in sufficient detail And PUC has always refused to accept the effluent, stating that effluent contains too much residues from the pre-treatment chemicals and would kill their bacteria.

Anse Royale (Mahé)

The Anse Royale landfill was funded by an EU grant under the 8th European Development Fund (EDF) and includes a plastic bottom liner. The facility was commissioned in the year 2000 and designed for a 20-years lifetime. However, the site has rarely been used due to public opposition and today it only accepts small amounts of inert waste (glass and asbestos).

Amitié (Praslin)

Amitié is a non-engineered (no liner, no leachate collection, no LFG management) dumping site on Praslin that has been in operation for more than 20 years. The site was initially being used for extraction and sale of coral sand for the construction industry. There is a simple registration and payment system at the gate, but no weighbridge. There are separate zones for various waste streams (e.g. organic, metals, mixed waste), but in practice this is not fully adhered to. A separate part at the back of the site is used to dispose liquid waste. The site is managed by LWMA, "BS Excavation" subcontracted to manage the daily operation of the landfill

In 2005 Consultants from Carl Bro prepared a feasibility study for the construction of a sanitary landfill on Praslin. However, the government could not invest in such facility at that time and concentrated its investment on Mahé. It was mentioned by LWMA that there are plans to extend the disposal site in the future and such an extension should be sanitary.

Gate fee

Waste delivered by contractors that have collected the waste directly (and thus not under contract with the LWMA) pay SCR 50/ton, for all types of waste. Waste delivered by contractors and collected under contract with the LWMA (either MSW

[13] Seychelles Solid Waste Assessment Report, Cliff J.J. Gonzalves, 2017

from the daily collection or commercial waste collected from businesses that have contracted LWMA) do not have to pay a gate fee.

Quantities of waste

As there is no weighbridge, contractors that deliver waste for which a gate fee must be paid declare the estimated amount themselves. The estimates quantities are recorded, for the purpose of the gate fee only (not for statistical purposes). Due to the lack of a proper registration system, the total quantity of waste that is disposed at Amitié cannot be estimated. Moreover, as the contractors that collect under contract with the LWMA can deliver waste at any time, also at times when the landfill is closed to other operators.

L'Union (La Digue)

The L'Union landfill on La Digue was Seychelles' first operational sanitary landfill, built in 1998 with assistance from the EU. It has a leachate collection and evaporation/recirculation facility, but this is currently out of function. There are 3 areas on the site for different waste streams: (1) Mixed waste; (2) Metal waste (including e-waste); and (3) Green waste. The site is only open 2 days/week and there is no registration at the gate.

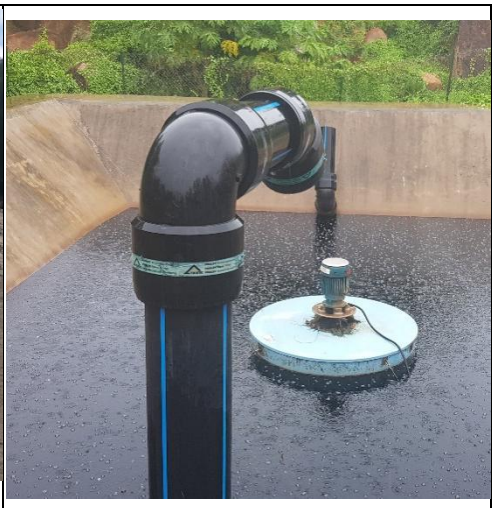
Figure 10: Providence landfill, Mahé (March 2019))

Pile of scrap metal

Area where composting plant was installed

Figure 11 : L'Union landfill, La Digue (March 2019)

Active tipping front



LTP currently out of function

Figure 12: Amitié landfill, Praslin (March 2019)

Storage area for mixed waste

Dumping pit for liquid waste

2.3.6 Treatment of organic waste

There is a central composting plant on Providence landfill that was built and initially operated by STAR Seychelles as part of its long-term (20 years) solid waste management concession in Seychelles. The plant was designed to also function as a Materials Recycling Facility (MRF) to sort municipal waste into its various components for recycling. The plant was opened in 2000 and has a capacity of 3,000 tons of compost per year. The plant only operated for a short time but due to the lack of a market to sell the produced compost, it could not function in a financial sustainable way and it is currently out of function. Furthermore, there are some small-scale initiatives on home composting of green (garden) and kitchen waste, amongst others in hotels, but this is not widespread.

2.3.7 Incineration

Waste-to-Energy (WtE) is not yet looked at on a national/integrated scale. There are a few small solid waste incinerators spread across different islands and operated by hotels. There is also one for medical waste located and run by the Seychelles hospital and two incinerators at the port of entry (seaport and airport). However, the latter two incinerators are not operational. Some commercial enterprises have applied for a permit for on-site incineration, but this has been rejected by MACCE.

GoS also regularly receives unsolicited proposals for treatment of waste by incineration. In response to the growing interest, MACCE has recently (February 2019) prepared a (draft) Request for an Expression of Interest (EoI) for the design, build, operate and finance of a Waste-to-Energy (WtE) facility. Furthermore, MACCE has been liaising with IFC, the private arms of the World Bank Group, to look at the development of WtE plant in Seychelles in a more structured approach.

2.4 Institutional aspects

2.4.1 General

Waste management in Seychelles is managed at the national level. The 26 districts, which are governed by government-appointed administrators, do not have any environmental responsibilities. The institutional set-up for waste management is thus relatively simple.

The direct responsibility for waste management is distributed between two national organizations: Ministry of Agriculture, Climate Change and Environment (MACCE) and the Landscape and Waste Management Agency (LWMA).

2.4.2 Ministry of Agriculture, Climate Change and Environment

Ministry of Agriculture, Climate Change and Environment (MACCE) is charged with ensuring the constitutional right of every person to live in and enjoy a clean, healthy and ecologically balanced environment, the provision of a reliable, affordable and safe water and energy supply and build resilience against climate change and disaster. MACCE is the Regulatory Authority for waste management and formulates policies and strategies for the sector.

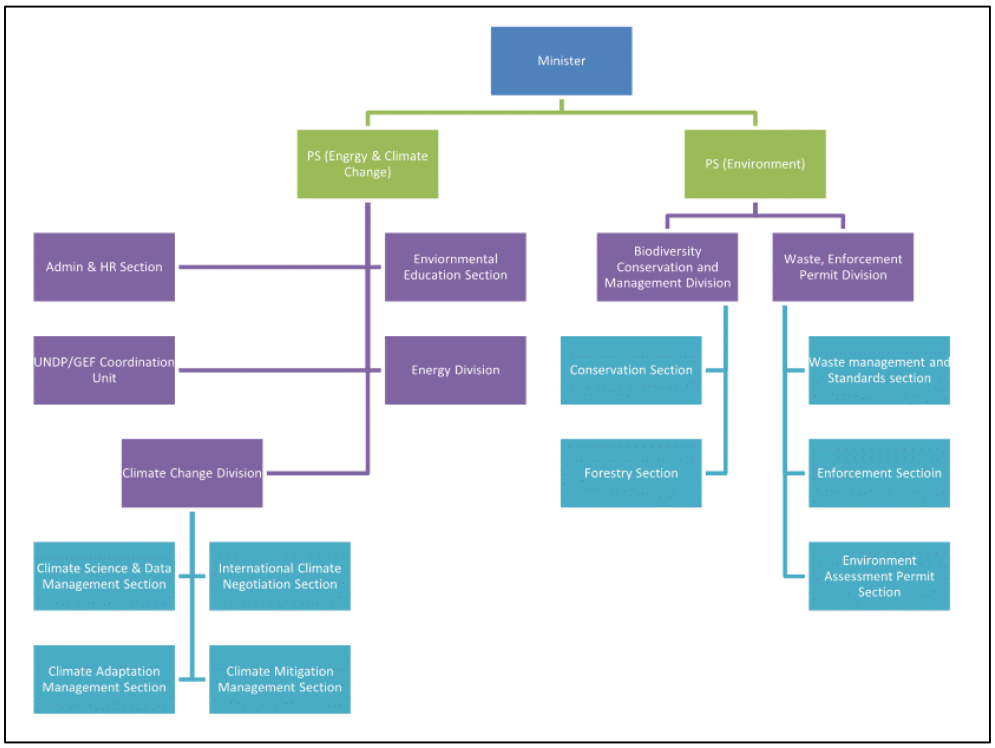
Furthermore, MACCE is divided into three Departments: Agriculture, Environment and Climate Change, each led by a Principal Secretary (PS). The Departments are responsible for the development of policy and regulatory frameworks whilst the Authorities and Agencies (i.e. NBGF, LWMA, PUC, SNPA, SEC and NMS) are the arm length of the Ministry with the responsibility to put these policies into practice.

Environment Department

The Environment Department has 52 staffs in total, including 8 posts on Praslin. It consists of two Divisions, each headed by a Director General the Waste, Enforcement and Permit Division (WEP) and the Biodiversity and Conservation Management Division (BCM)

WEP consists of 3 Sections. The Waste Management and Standards Section is responsible for waste policy formulation, supervision and enforcement. It also assures the alignment of these regulations with international Conventions such as Basel, Rotterdam and Stockholm and the Minamata Convention. The Environmental Assessment Permit Section assess planning applications for various types of developments (residential, commercial or tourism following environmental guidelines. Both sections work alongside the Enforcement Unit by responding to any environmental pollutions and issues enforcement under the Environment Protection Act 2016.

Figure 13: Structure of MACCE (source: E-Waste Flows in the Seychelles, internship report, 2018)



Climate Change Department

The Climate Change Department consists of two Divisions. The Climate Change Division has the responsibility to coordinate climate change issues, implement the National Climate Change Strategy, the Seychelles Sustainable Development Strategy and the international climate change cooperation and global negotiations.

2.4.3 LWMA

The Landscape and Waste Management Agency (LWMA) was established under the Environment Protection (Landscape and Waste Management Agency) Regulations 2009. These Regulations define the responsibilities of the LWMA and also

provide with respect to internal matters of the Agency. LWMA is a budget independent agency, operating under the MACCE.

The key responsibility of the LWMA is to implement the waste policy by ensuring that appropriate facilities and operational activities are provided in an environmentally sound manner, and in particular:

- Waste collection (contracted out to private operators);
- Operation and monitoring of landfills;
- Cleaning of roads, beach and drains (contracted out to private operators);
- Landscaping
- Enforcement of legislation

Their second responsibility is to supervise roads and beach cleaning as well as beautification of Victoria.

Staffing

The LWMA is composed of four sections being Admin, Procurement, Waste Management and Landscaping. The Agency has a presence on Praslin and La Digue in the form of offices and staff, which deal with both landscaping and waste management. LWMA is managed by the Board, appointed by the Minister, consisting of 7 members. There are three senior positions at LWMA: CEO, Deputy CEO and Waste Department Manager. LWMA has 7 inspectors on Mahé, 2 on Praslin and 1 on La Digue. In addition, there is an inspector at the STAR weighbridge on Providence Landfill.

The inspectors check that the bins sites are being emptied, identify waste spillage and also investigate allegations of illegal dumping, open burning etc. They have powers of entry onto private land and can even require householders to remove small accumulations of waste and scrap from their own gardens if there are complaints of unsightliness by neighbours.

LWMA inspectors do not have the mandate to issue enforcement notices. Furthermore, inspectors from MACCE and also from Local District Authorities undertake inspection activities.

2.5 Policy and legislation

2.5.1 General policy framework

The first Environmental Management Plan of Seychelles 1990-2000 was the country's first leading strategy document for the realisation of sustainable development objectives. It was followed by the second Environment Management Plan of Seychelles (EMPS 2000-2010), which aimed to integrate environment management concerns into other development sectors while addressing core concerns. Both programs also covered waste management.

The Seychelles Sustainable Development Strategy 2012-2020 (SSDS) is the current overarching policy framework for sustainable development in the country and contains a thematic on "water sanitation and waste". The National Development Strategy 2018-2020, developed by the Department of Economic Planning, provides a framework for sustainable development, contributing to Vision 2032. The visioning exercise originally aimed at updating the SSDS to cover the horizon up to 2032.

2.5.2 Waste management policy

Since 1990, Seychelles has adopted several policies, strategies and plans, aiming at sustainable development, improved environmental and waste management. Specifically, for waste management, Seychelles developed its first Solid Waste Management Plan, which covered only Mahé, in 1995, with support of the 7th European Development Fund (EDF). This first plan was subsequently updated for the period 2003 to 2010[14].

The next document adopted by the GoS was the Waste Management Policy 2014-2018, which provided for actions for a range of waste streams, including Packaging waste; Bio waste; Scrap metal; Construction and Demolition waste; Waste Electronic and Electrical Equipment; Waste batteries and accumulators; and Waste oil and Hazardous waste.

Also relevant for waste management, is the Seychelles National Climate Change Strategy (2009), which identified the reduction of greenhouse gas emissions as one of its five priority objectives, and the Seychelles Intended Nationally Determined Contribution (2015), prepared under the United Nations Framework Convention on Climate Change (UNFCCC), reiterated the greenhouse gas emission reductions targets including via a reduction in methane emission from the landfill sites.

The Government of Seychelles (GoS) has recently strengthened its commitment to improve the existing waste management system by adopting a new National Waste Policy 2018-2023, which outlines the priority objectives and provides direction as to how these objectives should be met. The Policy has been officially adopted by the Cabinet in December 2018.

2.5.3 Implementation efforts

Despite this strong history of commitment to sustainable development and improving waste management, a 'gap' can be observed between what was planned and what actually was implemented. In an earlier assessment[15], the average implementation of all policies and strategies was estimated at 15%.

[14] Scott Wilson Kirkpatrick & Co Ltd was appointed to provide "technical assistance for the updating of the 1995 Solid Waste Master Plan for the Seychelles for the period 2003 to 2010" by the Delegation of the European Commission, Port Louis, Mauritius on 25th September 2003.

[15] Seychelles Solid Waste Assessment Report, Cliff J.J. Gonzalves, 2017

In an effort to address this, GoS has, early 2017,approved an investment plan for waste management (Cabinet Paper).The main objective of this investment plan is to minimize the amount of waste from going to the landfill. The following implementation measures were proposed:

- Crusher Procurement: This will enable a rapid decrease of the volume of waste disposed at the landfill and will require minimal technical knowledge and outside assistance.

- Bio waste recycling value chain development: A recent study has shown that approximately 50% of the total waste disposed of at the landfill are bio waste. The above- named crusher can be utilized to convert green waste into wood chips and, through a decomposition process, compost can be produced for sale to the public.

- Waste Sorting Platform: The government is proposing that private sectors invest in a sorting and recycling waste platform.

- Waste to Energy implementation: Explore the possibility of installing a state-of-the-art waste to energy facility.

- New waste classification: Develop a new waste classification according to the composition of waste.

- Different tipping fees: Develop new tipping fees according to the polluter pay principle. The fees will be adjusted according to the type of waste.

- E-waste and Metal waste: Conducting studies to determine the feasibility of creating a system for the management of e-waste.

- Hazardous waste: Develop a storage or disposal facility.

- Manpower & Training: The lack of qualified manpower in the waste management sector remain a major challenge. A Capacity building program will have to be developed and implemented.

- Innovative fund raising: Develop a new system to raise fund for waste management and there was a proposal to impose a tax of 10 euros per tourist. This tax should generate sufficient funds to finance the sustainable management of waste in the country.

2.5.4 Regulatory framework

Environment Protection Act (EPA)

The Seychelles has not yet adopted a dedicated "Waste Management Act" that fully regulates the management of waste, although the process of preparing such framework legislation is currently underway. The Environmental Protection Act

(EPA, 2016) is the only environmental Act that regulates waste management, but in a very general and incomprehensive manner (in 11 sections, namely section 19, 20, 32-36 and 38-41).The first EPA was enacted in 1988. However, this was repealed and replaced by a more comprehensive act, the EPA of 1994, which came into effect on 1st March 1995, but was significantly revised in 2016.

The EPA is umbrella legislation covering a range of environmental areas, including air, water and waste and providing a general policy framework for environmental protection enabling the introduction of detailed regulations. However, many of the detailed regulations have not been adopted. The legal framework for waste management is thus very basic.

The EPA provides that waste can only be disposed of if authorized by the MACCE, empowers the Minister to adopt regulations: to control waste management that may establish minimum requirements; to specify product requirements related to the content of specific substances or recycled materials and to impose a fee on importers or manufacturers of specified materials, products or goods, to cover their disposal costs. As for definitions, the only waste term that is defined, is "hazardous waste".

Furthermore, Seychelles ratified the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal, the implementation of which is provided for by the EPA.

Regulations under the Environment Protection Act

The Environment Protection (Landscape & Waste Management Agency (Amendment) Regulations 2016 provide for the establishment of the Landscape and Waste Management Agency (LWMA) and assigns to it the responsibility for the management of waste.

The Environment Protection (Impact Assessment) Regulations of 1996 subjects the following waste management activities to an Environment Impact Assessment (EIA): 11-1 Dumping sites; 11-2 Treatment plant; 11-3 Collecting equipment.

The Environment Protection (Standards) Regulations specify the standard for the discharge of effluents to a recipient system from any industry, operation or process, which includes those for waste management. It also specifies methods for sampling and analysis.

Furthermore, under the EPA, 4 statutory instruments were adopted, which ban the importation of the following items:

1 Beverage containers that are not made of PET or glass (2013);
2 Plastic bags (2017);
3 Plastic utensils and polystyrene boxes (2017); and
4 Single-use plastic straws (2019).

Other waste legislation

Several acts, and their implementing regulations, provide for the possibility of the introduction of economic instruments that could be applied to waste management, including the Customs Management Act (2011), The Value Added Tax Act (2010) and the Corporate Social Responsibility Tax Act (2013).

Under the Customs Management Act, three statutory instruments were adopted, which establish an import levy and a collection system for PET bottles (2008), beverage cans (2012) and glass bottles for alcoholic drinks (2018). The VAT Act allows for applying differentiated VAT rates for environmental purposes. The CSR Tax Act obliges business to pay a contribution but gives full flexibility as to which activities their CSR contributions could go, provided that these fall within the Government guidelines. In principle, the contributions could support waste management objectives.

The Waste Management Fund Notice (2007) foresees in the establishment of a Fund with the objective to make funds available for: (a) refunding deposits made by the consumer; (b) the management of a recycling scheme;(c) to assist in the sensitisation of the public in waste management issues; and (d) to fund other waste management initiatives in line with the policy of the Department of Environment.

Other relevant legislation

Besides the EPA, the other key act in terms of planning for sustainable development, is the Town and Country Planning Act (1972), providing the basis for land use planning. Both Acts were adopted in different periods and their provisions are not readily compatible. Under the Act, any major project is obliged to obtain approval in principle from Cabinet prior to the submission of a planning application. For most development projects, which would include most waste infrastructure development projects, the next step is to obtain a permit from the Planning Authority (comprising representatives from various ministries). This permit includes an Environmental Authorisation, which is granted by the MACCE, with the approval of the EIA, which is required for the development of waste management facilities

All persons engaging in any business activity, must register their business with Registrar (under the Companies Act 1972), and have the appropriate license, issued by the Seychelles Licensing Authority (under the Licenses Act 1986). A specific license for the different types of waste management services and activities, with related conditions, does not exist.

The Derelict Motor Vehicles (Disposal) Act (1976), is a rather old piece of legislation that foresees in the removal of abandoned or disused vehicles in public places in on private property. It does not specify a designated collection point, or further waste management (e.g. dismantling, export) processes.

2.6 Financial aspects

2.6.1 Financial system

The main actors of the waste financial system are the following governmental bodies that are directly involved in the planning, financing and implementation of waste management measures, and private actors in charge of the waste collection and management:

- Ministry of Finance (MoF);
- Ministry of Agriculture, Climate Change and Environment (MACCE);
- Landscape and Waste Management Agency (LWMA);
- Waste management contractors;
- Seychelles Revenue Commission (SRC);
- Redeem Centres; and
- Exporters.

Ministry of Finance (MoF)

MoF is responsible of providing funding for the two main cost centres for waste management, the MACCE and the LWMA. It appears that MoF receives income from commercial waste collection and tipping fees. These revenues are not ear-marked, and they do not cover the full cost. The Ministry receives levies on PET bottles and beverage cans, charged by the Seychelles Revenue Commission (SRC), and transfers these levies to the Waste Management Fund (WMF).

Ministry of Agriculture, Climate Change and Environment (MACCE)

The MACCE is mandated with developing waste policies and obtaining the financial resources for their implementation. The MACCE is in charge of the administration of two funds: The Environmental Trust Fund (ETF) and the Waste Management Fund (WMF).

The *ETF* is in charge of financing projects and programs related to the preservation and improvement of the environment. It is funded by mainly by grants for capacity building, education and awareness, community projects, and other initiatives. The ETF has two income sources related to waste: The Environmental Fee charged in water bills of households (15 SCR per household per month); and Fines for littering.

The *WMF* is in charge of coordinating the levy system for PET bottles and aluminum and tin beverage cans. The levy is collected by the SRC and transferred to the WMF via the Ministry of Finance. The WMF pays the Redeem Centers according to the quantities of collected bottles and cans. The structure of the levy system is described below, in the section PET bottles and beverage cans.

Landscape and Waste Management Agency (LMWA)

LWMA is an agency operating under the MACCE. The LWMA is in charge of organizing the cleaning of public spaces and the waste collection. Currently, LWMA administrates two sets of agreements, which include financial flows: 1) Agreements with commercial establishments, and 2) agreements with contractors for waste collection and treatment.

Contractors

After 21 years with a single main operator, Société de Traitement et d'Assainissement Régionale (STAR), which was entrusted with most of the waste collection and operation of the landfill on Mahé on a BOT basis, in 2019 the system has been changed. As from 2019, the municipal waste collection on the three main islands is divided into 10 zones, 7 on Mahé, 2 on Praslin and 1 on La Digue. There are separate concessions with the operators, per zone.

Seychelles Revenue Commission (SRC)

The SRC is in charge of the levy collection of PET bottles and beverage cans at the port of entry. This money collection normally happens at entry of the products into the country, but the products may be stored in bonded warehouses, awaiting customs clearance. There are cases where no such clearance takes place, and the bottles and cans are transported directly to the landfill. In such cases, no levy is charged, i.e. no revenue is generated. If bottles and cans are taken from the landfill and presented to Redeem Centres, they generate a cost, and an imbalance in the WMF. Such imbalances are captured within the redeem system, through the "reserves" built into it.

Redeem Centres

Redeem Centres are the establishments in charge of receiving PET bottles and aluminum and tin cans from citizens. In this process, they receive money from the WMF, retain a part, and pay a fee to citizens that return the containers. Currently, there are 6 Redeem Centres, 4 on Mahé, 1 on Praslin, and 1 on La Digue.

Importers

There is a large number of importers of products that once discard, end up as waste. The SRC maintains a detailed register of all importers

Exporters

Exporters take the recyclable material collected and sell it on the international markets. Currently no such exporters receive financial support. Apparently, only the materials whose value is higher than the shipping costs are being exported. Other materials are left on the islands and end up at the landfills.

2.6.2 Agreements

Municipal and commercial waste

LWMA has tendered 10 concessions for collection of municipal waste for 10 different zones: 7 on Mahé, 2 on Praslin, and 1 on La Digue. Commercial waste is currently collected by contractors who either have or do not have a contract with LWMA. Those who have a contract with LWMA, are paid by LWMA and do not pay any tipping fee. The other group of contractors do pay a tipping fee, according to the estimated quantity and composition of the waste. Currently, the contractors for collection of municipal waste are having 6-year contracts with LWMA and are paid on a monthly basis.

With respect to commercial waste, the commercial establishments must pay to LWMA according to the quantity and composition of their waste, as set out in a list of tariffs. The collectors of commercial waste who have agreements with LWMA are paid by LWMA and are not charged any tipping fee at the landfill. Others bringing commercial waste to the landfill are paying a tipping fee.

The present system for contracting of municipal and commercial waste collection seems to be in the process of changing, although it is not clear when such change may occur. It seems that it is the intention that LWMA would no longer be involved directly in the cash flow between commercial establishments and the collectors of commercial waste. This will be the consequence of a change in the system so that commercial establishments enter into direct agreements with waste collectors, while the role of LWMA will be that of the regulator and supervisor only.

PET bottles and beverage cans

There is a return system for PET bottles and cans that is financed from import levies[16]. The levies are:

- PET levy = SCR 0.70 (since 2008). As from Oct 2018 the levy was increased to 1 SCR;
- Cans levy = SCR 1.00 (since 2012).

Levies are paid by importers via the Customs Division of the Seychelles Revenue Commission (SRC) and then transferred to the Treasury (MoF).The Treasury (MoF) then transfers the proceeds to the Waste Management Fund (WMF), on a monthly basis.

There are discrepancies between the revenues from levies, as paid by the importers to the Seychelles Revenue Commission (SRC), and the transfer made by Treasury to the WMF. Some of it is caused by bottles and cans which are not taken out of the bonded warehouses and sold before their dates of expiry. In such cases, no levy is paid. The PET bottles and cans will reach the landfills, and if they

[16] MACCE considers including other types of plastic bottles, such as PP or PS bottles, in the recycling system.

are taken out and brought to the Redeem Centres, they will be included in the redeem mechanism, whereby the Redeem Centres pay the collectors and claim the refund. Thus, such bottles and cans will not generate any revenue as they escape the levy but will generate expenses when presented to the Redeem Centres for refund. The imbalances are captured by "reserves" in the system.

The WMTF distributes the levy as follows:

- PET bottle: levy SCR 1
  - SCR 0.35 is retained by the WMF to pay for transport and administration costs;
  - SCR 0.65 is paid by MEEC from WMF to the Redeem Centres, based on completed delivery notes/collection receipts/invoices;
  - From the SCR 0.65, an amount of SCR 0.50 is paid by the Redeem Centre to the person that returns the bottle;
  - The Redeem Centre thus retains SCR 0.15 per bottle. This amount acts as a "reserve" which captures imbalances between the number of "revenue bottles" and the number of "cost bottles".

- Cans: levy SCR 1.00
  - SCR 0.30 (30cts) is retained by the WMF to pay for transport and administration costs;
  - SCR 0.70 is paid by MEEC from WMTF to the Redeem Centers, based on completed delivery notes/collection receipts/invoices;
  - From the SCR 0.70, an amount of SCR 0.50 is paid by the Redeem Centre to the person that returns the can;
  - The Redeem Centre thus retains SCR 0.20 per can. This amount acts as a "reserve" against imbalances between "revenue cans" and "cost cans".

Thus, the PET bottle and cans levies are used fully to keep the redeem system operating.

Environmental Trust Fund

The Environmental Trust Fund (ETF) was established as a special Fund in 1994 under the Public Finance Management Act with the objectives of reducing pollution, protecting the environment, beautifying Seychelles and promoting environment education. The ETF is operated by the MACCE under a Board and is used to finance environmental projects. It is open for government bodies and NGOs. The revenues come from levies on household water bills (SCR 15 per household per month), but also from waste water discharge levies (mostly hotels, but also the PUC), levy on bird eggs, royalties from export of Coco du Mer, export of tortoises , fines etc. Total revenues are approximately SCR 5 million per year.

Examples of financing provided by the ETF in the waste sector are:

- Co-financing of investment in glass recycling system;
- Co-financing of LWMA purchasing of crusher for landfill;
- Provision of 240-liter collection bins;

- Payment for transportation of scrap metal from islands to Mahé;
- Provision of equipment for beach cleaning and cleaning of Victoria (high water pressures, trimming machines).

The household levy provides the main part of the revenues of SCR 5 million for the ETF, with 180 SCR per household per year. The revenues are used, partly for procurement of equipment, partly for operating costs, and partly for administration at the ETF.

2.6.3 Costs/Expenses

Information about the costs of the waste management system is incomplete, as primary sources were not available. Therefore, the Consultant has had to rely on secondary sources to provide an overview of the costs. According to the Transdisciplinary Case Study 2018 (ETH), the costs of the waste management system, paid by the Ministry of Finance, are:

- Total: 303 million SCR;
- MACCE: 87 million SCR;
- LWMA: 216 million SCR.

MACCE spends 7.3 million SCR on environmental protection, as follows:

- Salaries: 4.8 million SCR;
- Goods and services: 2.4 million SCR.

LWMA spends 173 million SCR on waste management in a broad sense, with the following allocation:

- Salaries: 4.1 million SCR;
- Office travel and material: 7.1 million SCR;
- Cleaning of beaches, roads, toilets: 88.5 million SCR;
- Waste management in Praslin and La Digue: 17.1 million SCR;
- Waste management in Mahé: 55 million SCR.

The 55 million SCR spent on waste management in Mahé is distributed as follows:

- Landfill management: 18.8 million SCR;
- Collection of commercial waste: 15.3 million SCR;
- Collection of municipal waste: 14 million SCR;
- Budget discrepancy: 6.9 million SCR.

Total expenses for management of municipal and commercial waste: 82.1 million SCR.

2.6.4 Revenues

The revenues from waste management operations are:

- Municipal waste: None;
- Commercial waste: 17.8 million SCR;
- ETF: 15.1% of fee in water bill: 1.4 million SCR;
- ETF: Fees for littering: 0.3 million SCR;
- WMTF: Levy share (administrative): 2.4 million SCR.

Total waste management revenues: 29.3 million SCR, of which 17.8 million SCR directly related to municipal and commercial waste management. Based on these figures, the cost recovery percentage for municipal and commercial waste is 21.7%. This is for operation and maintenance – no capital expenses are covered.

2.6.5 Fees and tariffs

User charges

Households are not paying any user charges specifically for waste management services. There is only an environmental levy of 15 SCR on the monthly water bill. Thus, households have no incentive to reduce and to sort their waste.

Commercial establishments must have their waste collected by a private contractor, either by agreement with the LWMA, or by agreement with a private contractor directly.

Landfill tipping fees

At the Providence and l'Amitié (Praslin) landfill private companies that bring waste pay a small gate fee of around 50 SCR/ton. On La Digue no tipping fee is applied.

2.6.6 Conclusion

A financially sustainable system, which allows to maintain and grow the delivery of services under economic stability, is key to successful waste management. Quality of services are to a large extent determined by the amount of funding available.

The financing of waste management remains a challenge as there is no full-cost recovery due to the absence of, and resistance to, a Polluter-Pays-Principle. Decision-makers depend on the willingness of consumers (i.e. the voting public) and enterprises to pay for higher waste management standards in (fixed) investments and (variable) running costs of managing their wastes. Therefore, the availability of financial resources depends upon environmental awareness, the level of incomes, systems for enforcement etc.

Only a combination of internalized costs ("true prices") and reliance on the Polluter-Pays-Principle, implementing a Circular Economy approach, will lead to environmentally and socially responsible sound management. This in turn leads to reduced consumption of resources, fewer environmentally harmful emissions and economic growth.

2.7 Summary of existing situation

The Table below provides a summary assessment of the existing situation.

Table 4 summary assessment of the existing situation – key challenges

Area	Key challenges	Principal causes	Main effects
Waste generation	▪ Increasing quantities of municipal solid waste ▪ Increase of problematic waste streams, such as used batteries, waste tyres and electronic waste, and no concrete intervention measures.	▪ Economic and population growth and increased tourism. ▪ With the higher standard of living, there comes a greater range of problematic waste streams, e.g. electronics items, some of which contain harmful chemicals.	▪ Increased pressure on current waste management system, which is reaching its limits.
Policy framework	▪ A historic lack of urgency among the politicians. However, with the landfills reaching full capacity, a sense of urgency has emerged. ▪ Many policy documents, master plans and technical studies and assessments available, but implementation is lacking. ▪ Existing policy documents do not accurately reflect the existing situation on waste management. ▪ Uncertain legal status of the existing waste management policy, reducing the degree of adherence to the policy	▪ The latest waste policy seemed developed without sufficient stakeholder involvement and publication. It also lacks a legal basis.	▪ No clear and formal basis is available for determining waste management priorities or targets.
Legislative framework	▪ Environmental legislation is not adequate for the control and regulation of waste management. Lack of waste framework legislation and implementing regulations, with for example, technical waste management standards. ▪ Compliance is not effectively assured, through adequate promotion, monitoring and enforcement.	▪ Lack of capacity/knowledge in preparing relevant legislation. ▪ Resources/procedures for monitoring and enforcement are insufficient and ineffective.	▪ Waste management is not adequately regulated and as such best practices and techniques are not applied. ▪ Littering and fly tipping in some areas.

Area	Key challenges	Principal causes	Main effects
	▪ Penalties for littering and fly-tipping are not sufficiently high to be effective.		
Institutional framework& capacity	▪ Dominant role of the government, and limited involvement of other relevant stakeholders in waste management. ▪ Existing institutional/organisational responsibilities are not clearly defined between the various governmental organisations. ▪ Contractual arrangements for service provision are not achieving the intended results (e.g. a single waste management operator for the past 20 years: no competition, no drive for improvements). ▪ Increased involvement of a large number of contractors in waste collection will be challenging to control. ▪ LWMA and MACCE lack appropriate capacity (human resources and updated knowledge) to address the existing waste crisis and related challenges[17].	▪ The legal framework which assigns waste management responsibilities to the MACCE and the LWMA is not clear ▪ The organisation of the LWMA has not yet been fully carried through and rationalised. Conditions of contract are not being adhered to by either party. ▪ Staff not sufficiently trained in order for them to carry out their duties. ▪ Low attractiveness for working for the government: challenging to hire/retain qualified staff.	▪ Confusion/overlap of functions and responsibilities, leading to inefficient allocation of resources. ▪ Insufficient control on maintenance and improvement of the waste management system.
Knowledge	▪ No reliable qualitative and quantitative waste data. Hardly any data readily available on priority waste streams. ▪ No structured/periodic reporting	▪ No weighbridges at landfills on Praslin and La Digue. ▪ Lack of a waste management information system. ▪ Lack of systematic reporting to the LWMA by the contractors of the amounts of waste collected, recycled and disposed of.	▪ Comprehensive and reliable statistical basis for evidence-based policy development, planning, management and control of waste and waste facilities is not available. ▪ Systematic underestimation of the volumes generated in different policy documents (with also different figures).
Financing	▪ Lack of understanding that waste management is not a revenue-generating sector.	▪ The Polluter Pays Principle is not being applied. ▪ The gate fees at the landfills are low and not properly regulated (e.g. on Praslin and La Digue it	▪ Without full cost recovery, waste generators will not be aware of the cost of managing their own wastes.

[17] Technical advisors have recently joined LWMA to strengthen its capacity. MACCE remains understaffed and is occupied with daily (permitting) routines that prevent it from developing the strategic framework.

Area	Key challenges	Principal causes	Main effects
	▪ Users of municipal waste collection services are not paying for the service. Accountability for waste generation is thus not encouraged. ▪ The revenue flows from existing charges for commercial waste are insufficient for meeting the full costs of providing a sustainable system.	is left to the contractor the estimate the quantities of waste that he is delivering and for which he should pay a gate fee).	▪ The existing waste management system is financially not sustainable. ▪ Necessary investments in the waste management sector are not taking place.
Stakeholder inclusivity	▪ Attitude: general public does not have a sufficient awareness of the need for, and benefit of, sustainable waste management (including segregation, reduction etc.) ▪ There is a limited number of environmental NGOs and community groups involved in waste management.	▪ Lack of effective communications campaigns. ▪ Penalties are inadequate and often not imposed.	▪ Littering in public places is widespread and uncontrolled, which will affect tourism (littering is small in volume but big in impact). ▪ Unsustainable waste management system continues (no change).
Waste prevention	▪ The potential for waste avoidance and reduction is not being exploited (waste hierarchy is not adhered to). ▪ Low quality of imported products (such as electronic and electric equipment) and lack of an after-sales repair service for these goods.	▪ Waste management is (nearly) a free service. ▪ The current financial costs of managing and disposing of wastes provide little or no incentive to avoid/reduce waste generation. ▪ Product suppliers, consumers and other waste generators are not aware of the potential opportunities for, and benefits of, avoiding and/or reducing wastes. ▪ No regulation on import of unsustainable products and lack of local repairing skills and services.	▪ Resources are not used efficiently, and are thus waste, with economic and environmental consequences. ▪ Waste generation, and the related waste management costs, are higher than need be. ▪ Increasing problem with the disposal of electronic waste.
Collection	▪ Waste is not separated at source ▪ 240 litres bins too small for cost-efficient collection.	▪ Systems for the separate collection at source of certain waste types do not exist, except on a trial basis.	▪ Huge burden on existing landfill capacity ▪ Reduced recycling potential

Area	Key challenges	Principal causes	Main effects
Storage	▪ Intermediate storage of waste until critical masses for export have accumulated, is not systematically organised. ▪ Existing facilities/practices, e.g. for scrap metal, do not comply with appropriate EHS standards.	▪ Lack of technical and financial capacity. ▪ Initially, no sense of urgency as disposal at landfills was easy and cheap	▪ Potentially hazardous wastes are ending up at final disposal sites and deplete remaining lifetime.
Recycling	▪ Government-organized/supported recycling schemes exist only for a limited number of waste products (PET bottles and aluminium cans): the full potential for recycling is not being realised. ▪ The informal sector plays an important role in the collection of recyclables. ▪ There are no domestic processing facilities due to lack of economies of scale.	▪ Lack of awareness on Circular Economy principles and limited Government policy and support for recycling. ▪ Domestic stable, long-term market outlets for most types/grades of recyclable materials do not exist. At the same time, costs incurred for collection, segregation and shipment inhibit the export of recyclable materials.	▪ Many types of potentially recyclable materials is disposed on landfills. ▪ The volumes of waste requiring final disposal, and the related costs, are higher than need be.
Organic treatment	▪ The potential of composting is underutilised: a high share of the municipal waste is biodegradable but is nevertheless sent to dumpsites. ▪ A composting plant was built at Providence but failed.	▪ Proper feasibility assessment has never been made. ▪ Previously installed technology was too complex and not cost-effective (lack of market for compost).	▪ Large amounts of organic waste are landfilled, depleting remaining landfill volume and impacting the environment (greenhouse gases, leachate).
Incineration	▪ Small-scale incinerators operated by hotels, private enterprise, the hospital etc. are a cause of concern. ▪ Development of WtE plans mainly on the basis of unsolicited proposals.	▪ Lack of strategy, policy and regulation on incineration ▪ Existing waste incinerators do not comply with appropriate environmental standards. ▪ Standards governing the incineration of waste are not yet developed.	▪ Some wastes are burnt in inadequate/inappropriate facilities and cause environmental (air) pollution. ▪ Development of inadequate (i.e. non-proven) technologies.
Hazardous waste	▪ Hazardous waste is mixed with general wastes, which all are dumped together.	▪ Lack of technical and financial capacity to establish proper facilities.	▪ Hazardous materials are being landfilled and pose threats to human health and environment.

Area	Key challenges	Principal causes	Main effects
	▪ Hazardous waste management facilities do not exist.	▪ Current collection system not suited for source segregation of hazardous waste.	
Final disposal	▪ Existing landfills are in poor status and rapidly reaching full capacity. ▪ Although some are constructed as sanitary facilities, they are not properly operated. ▪ Leachate treatment plants at Providence II and La Digue landfills are out of function.	▪ Few landfill diversion measures implemented. ▪ Inadequate technical capacity to operate and maintain the landfills. ▪ Insufficient available funds to invest in improvement measures. ▪ Lack of formal/legal technical standards.	▪ Waste disposal poses severe threats to the environment, especially to the ocean, and groundwater. ▪ Health and safety risks to operatives handling wastes, and to other people entering waste disposal sites.

3 Way forward

The National Waste Policy 2018-2023 includes 11 thematic areas to improve the management of solid waste[18]. Each thematic refers to general objectives and provides suggestions for concrete measures, but without translating them into detailed plans. In this Masterplan, the most important measures are further described and detailed.

3.1 Key challenges- the necessity for change

Many of Seychelles' solid waste management challenges are related to its status as a Small Island Development State (SIDS). However, this should not be an excuse to avoid addressing them in a comprehensive and integrated manner.

Geographic isolation: Waste management is costly on the main land, but waste management on remote, isolated islands like Seychelles is even more expensive and complicated. Being located (too) far from other island countries it is difficult to justify joint initiatives, such as stockpiling processed recyclables until critical quantities are reached that can be marketed. Also, a part of the waste cannot be managed locally on the island due to the current lack of treatment capacity and the limited opportunities to develop cost-efficient treatment facilities. These waste types need to be exported. Finding recipient countries and recycling facilities that accept the waste is challenging and freight costs are high. However, if it is not too costly to import products, then it should also not be too costly, with the support of the producers/importers, to get these products of the islands once they have reached the end of their life. The cost of managing a selection of these end-of-life products could be borne by the producers/importers, implementing the Extended Producers Responsibility (EPR) principle.

Waste infrastructure: The current waste infrastructure is not able to deal with the increased waste amounts. Systems for the separate collection at source of certain waste types, do not exist and disposal sites are reaching full capacity and do not comply with appropriate EHS standards. Much of the existing infrastructure has been donor-financed and when commissioned complied with the latest international guidelines. But due to a lack of operating capacity and maintenance, these facilities are not functioning properly anymore.

Land area: Seychelles is composed of 115 islands with a total land area of only 455 km^2. Almost the entire population is living on the 3 main islands, where thus by far most of the waste is being generated. However, some of the other, islands are also populated, have tourist facilities and/or are open to day-time visitors and are thus presented with waste management challenges. Furthermore, the limited availability of land space makes the siting of waste treatment facilities challenging

[18] The 11 areas are: legal and institutional framework, infrastructures, financing and cost recovery, capacity building, public education and awareness, non-state actors, waste prevention n and minimization, waste recovery and recycling, waste segregation, storage, transport and collection, waste treatment and processing and final disposal

as it is difficult to find suitable and accepted locations and valuable land (e.g. land suitable for agriculture or tourism) must be sacrificed for waste management.

Population: Seychelles has an estimated population of 98,055 at 31st December 2019, which is comparable to a small-sized European city. There is therefore little capital available to support SWM projects, particularly to stimulate recycling initiatives or advanced waste treatment. Additionally, the low volume of total waste generated provides insufficient quantities to have technically feasible treatment systems. The small economies of scale prevent waste businesses from generating revenues to overcome operation and investment costs. Consequently, landfilling presents a seemingly cheaper option for waste treatment, but this poses long term sustainability issues. On the positive side, given the low number of inhabitants, it is relatively easy to target them. It also makes that the number of waste generators that should change behaviour, is limited.

Import of goods: The import of low-quality products, with a relatively short-life time before they become waste, has become a serious challenge and has already resulted in large stockpiles of broken refrigerators and other Waste Electric and Electronic Equipment (WEEE). However, it appears that the bulk of these goods are imported by a limited number of companies and there is only one main entry point to the country (the harbour). It should thus be relatively easy to control imports.

Tourism: Seychelles has a large tourist sector, with visitors drawn by its beaches and biodiversity. The tourism sector is the economic pillar of the country. On one hand, the tourism sector aggravates the waste management problem, as tourists generate large amounts of wastes. However, the prevalence of this sector of the economy makes that an important group of stakeholders that must be encouraged to change behaviour, can be easily identified and targeted. Furthermore, the economic importance of the tourist sector, which direct contribution to GDP has been estimated at 50%, depends on the country's natural beauty. This should be a strong incentive to improve the existing waste management system.

Data: Understanding the actual quantities of municipal waste being produced is central to any decision-making process. At the moment, there is only very limited information available on waste amounts. Moreover, the information that does exist is unreliable and in certain instances contradictory. This causes that planners face a significant challenge in determining both scale of the problem and current needs.

Financing: Households are not paying for waste management services and the gate fees at the landfills are low. Therefore, the revenue flows from existing SWM charges are insufficient to be able to meet the full costs of providing a sustainable system. As a result, waste management is mainly a government burden.

Culture: The general public does not have a sufficient awareness on the need for proper waste management and their role therein. Many households do not place enough value on collection and environmentally sound management to be willing

to pay a fee for the service, when the alternatives of dumping or burning is culturally acceptable and poorly regulated. Product reuse, repair, and recycling are not adequately valued due to complex social and political dynamics that stem from often closely-knit societies

Institutional: Existing institutional/organizational responsibilities for SWM are not clearly defined between the various ministries and departments (e.g. between MACCE and LWMA). Institutional weaknesses have resulted in outdated waste management plans, unaligned policies and responsibilities and roles that are not always well-defined and clearly assigned. Furthermore, limited institutional and human resources capacity at government level make that insufficient attention can be paid to improvements.

Regulatory: Seychelles has not yet adopted waste management framework regulation (i.e. a dedicated "Waste Management Act") that fully regulates the management of waste. Resources and procedures for monitoring and enforcement are insufficient.

3.2 Vision and goals

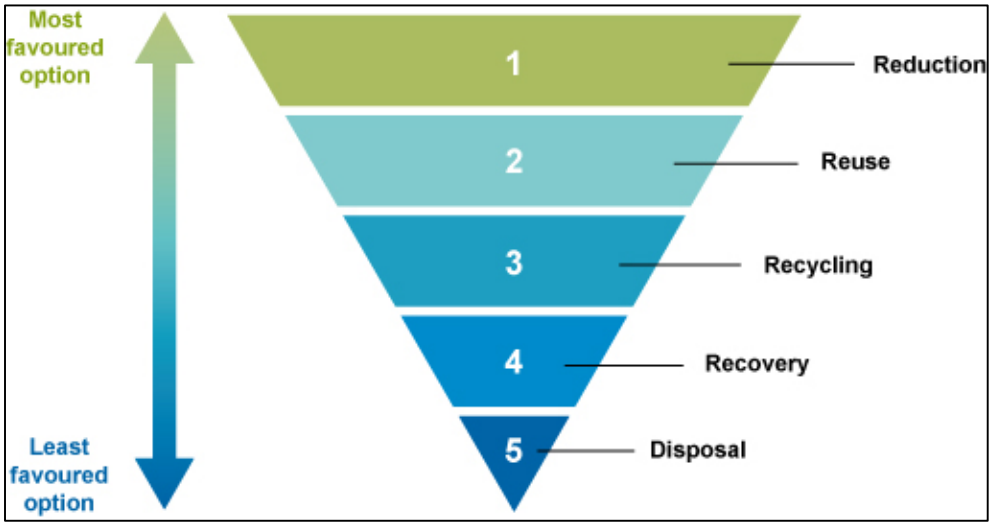
3.2.1 Vision

The vision of the GoS, as confirmed by the 2018 National Waste Policy, is that where waste that cannot be avoided is managed in a sustainable manner, resulting in an improved quality of life for the population, protection of the environment and increased economic activity. This requires strong controls from the generation of waste to its collection, transport, storage, recovery and disposal.

This vision implies that waste is seen as a resource that can be recycled and reintegrated to achieve a Circular Economy[19], giving full effect to the Waste Hierarchy (see Figure14).Applying the waste hierarchy principle means that actors should show a preference to the 'most favoured' option (reduction) at the top of the hierarchy rather than to the 'least favoured' option (disposal) at the bottom of the hierarchy.

[19] A Circular Economy implies maintaining the value of products, materials and resources in the economy for as long as possible. A Circular Economy is the pillar of sustainable development as it enables decoupling of economic development from the natural resources' consumption.

Figure14Waste hierarchy



3.2.2 Goal

The main goal is to reduce to a maximum extent the quantities of waste sent to landfill, with a visionary goal of zero waste (and zero greenhouse gas emissions from the waste sector).

Reaching this goal will require changing the perspectives, values and habits and how the people of Seychelles think about waste. It needs a change in production, import, consumption and waste management patterns, including first and foremost applying the Waste Hierarchy. This means moving waste management away from sole reliance on final disposal to a situation where waste is prevented, and recyclable waste is collected separately and recycled, either in-country or abroad.

Applying the Waste Hierarchy, including diverting waste from landfills to recycling, will come at a significant cost, which should be borne by those that are responsible for the generation of the waste. Therefore, the cost of managing the waste from a product, should be incorporated in the product cost and waste management services should not be free.

3.3 Guiding principles

To achieve its vision and objectives, a set of principles should be adhered to that work together to ensure a high level of environmental protection. These principles guide decision-making and are used when developing, interpreting and implementing policies and legislation. They are used in a range of government and public authority decisions on waste management, including planning applications, license applications. These guiding principles and values are the following, in no specific order of priority:

Waste Hierarchy. The "waste hierarchy" ranks waste management options according to what is best for the environment. It gives top priority to preventing

waste in the first place. When waste is generated, it gives priority to preparing it for re-use, then recycling, then recovery, and last of all disposal.

Precautionary Principle. Where evidence of environmental or human health risk exists, appropriate precautionary action should be taken even in the absence of certain scientific evidence and conclusive proof of causes.

Prevention principle. This principle requires preventive measures be taken to anticipate and avoid environmental damage before it occurs .It means in short terms: it is better to prevent than repair. This principle is not as far-reaching as the precautionary principle. In the context of waste management, it means preventing the generation of waste, where this is avoidable, minimize the amount of waste generated and reducing the hazardous content of that waste, where this is practicable, by changing the current production and consumption patterns.

Rectification at source principle. Environmental pollution and damage should be rectified at source. Working alongside the prevention principle, this ensures damage or pollution is dealt with where it occurs.

Environmental Integration Principle.This principle requires that environmental protection, and waste management concerns, are integrated into other priority development areas, such as climate change, biodiversity conservation, agricultural development and tourism development. It means that all government departments have responsibilities to protect the environment; it will improve cross-sectorial and multi-stakeholder engagement in waste management, open up new funding avenues and enhance the sustainability of outcomes.

Principle of Sustainable Development. Sustainable development means development that meets the needs of the present without compromising the ability of future generations to meet their own needs. Consisting of three pillars, sustainable development seeks to achieve, in a balanced manner, economic development, social development and environmental protection. Application of the principle when taking waste management decisions requires that the overall environmental, human health, economic and social impacts are considered.

Polluter Pays Principle. The cost of pollution, i.e. of the damage caused and any remedy required, should be allocated correctly to and should be borne by the person who causes the pollution, rather than by society at large. This principle plays a significant role in environmental management, acting as a deterrent and directing accountability for damage. In the context of MSW management, it means that waste generators should pay the cost of managing their waste and remediating associated environmental damage, and that thus the spending for waste management should be recovered from the generators.

Pay-for-Service Principle. This principle (sometimes referred to as the "user pays principle) works alongside the Polluter Pays Principle and must be applied to apply that principle in practice. Those who generate waste, should pay for having their waste managed. The user pays principle requires that the charges applied for waste management services reflect full cost recovery for those services. In its

purest form, the application of this principle would mean that consumers would pay for household waste management services on a 'pay-by-weight' basis.

Extended Producer Responsibility Principle. This principle also works alongside the Polluter Pays principle and must be applied to apply that principle in practice. The Extended Producer Responsibility principle means that producers and/or importers of products, who are most responsible the marketing of products and packaging, bear financial responsibility or financial and organisational responsibility for the management of their products and packaging at the end of their useful lie.

Proximity Principle.Waste generated should be treated in one of the nearest appropriate facilities. It is recognised that as a small island state, Seychelles may have to transfer waste to distant, international facilities to ensure the environmentally sound management of waste. Waste should be recycled domestically when technically and economically feasible. However, most recyclable commodities will have to be shipped off the island to environmentally sound recycling facilities in other countries, in recognition of the fact that physically establishing such recycling facilities may not be technically or economically feasible for the Seychelles. Similarly, hazardous waste must be shipped off the island. Recycling initiatives, including those resulting in a substantial volume of materials taken offshore, which will relieve the pressure of limited landfill space in the Seychelles.

Principle of Self-Sufficiency. An integrated and adequate network of waste installations should be established to enable the country to move towards being self-sufficient in waste disposal, subject to the Best Available Techniques principle. It is recognised that as a small island state, Seychelles will have to establish this network in cooperation with other countries

Best Available Techniques. 'Best Available Techniques', meaning the most effective and advanced techniques, will provide the basis for emission limit values and other permit conditions designed to prevent and, where that is not practicable, to reduce emissions and the impact on the environment as a whole, and for planning waste treatment capacity.

3.4 Prevention

Prevention means measures taken before a substance, material or product has become waste. Prevention is the most efficient way to improve resource efficiency, to reduce the volume of waste for disposal and thus to extend the life-time of landfills, to reduce the adverse impacts of waste and to reduce the costs for collection and treatment.

Therefore, the Government should take a mix of appropriate prevention measures and monitor and assess progress in the implementation of such measures. The measures will target all materials and products, but in particular the priority waste streams that have been identified. Generally, the measures will promote sustainability in production and consumption, which can contribute significantly to waste prevention. To this end, it is required to take steps to make consumers aware of

that contribution and encourage them to participate more actively in order to improve resource efficiency. Continuous information, education and communication initiatives to raise awareness on the issues surrounding waste prevention and littering will therefore be an essential component of the prevention strategy.

Another essential component of the prevention strategy will be to reduce the presence in the Seychelles of those materials and products that are difficult to re-use, are "waste intensive" and of which the waste is difficult to manage. As Seychelles is dependent on the import of many goods, this generates an environment with far more potential than most countries to control the import of difficult products.

Mechanisms that may be employed to reduce the presence of difficult products could include:

- Tariffs and charges on selected products (if allowed under WTO regulation);
- Environmental levies and taxes;
- Legal restrictions on the import of potentially polluting imports.

To reduce the quantity of waste, prevention measures will encourage the design, manufacturing, import and use of sustainable products (i.e. products that are resource-efficient, durable, repairable, re-usable and/or upgradable). Also, the import of products with less packaging should be encouraged.

Furthermore, life-time extension activities could be intensified. The useful lifetime of many consumer products (i.e. the amount of time between buying and discarding them) is getting shorter. It is thus important to promote life-time-extension activities by re-use, repair, refurbishment or upgrade or remanufacturing[20].

A focus of the prevention efforts should be, besides the mentioned priority waste streams, on products that are the main sources of littering, notably in natural and marine environments, and products with a high content of hazardous substances.

3.5 Future waste management operations

The Government must enable the development of the necessary infrastructure for the collection, recovery and disposal of waste, which requires among others the selection of appropriate technologies. The selection of waste management technologies must take into account the prevailing socio-economic conditions and capacity of the Seychelles and prioritize public health and environmental protection, sustainability and compliance with international and regional treaties. In this section potentially practicable options for the handling, processing and disposal/treatment of wastes in the Seychelles are identified and described.

[20] Remanufacturing a product goes one step further than repair. By disassembling a product and returning it to an 'as-good-as-new' state, it can be sold again on the market as a new product, thereby extending the lifetime of most of its parts. Re-manufacturing is currently working in Business-to-Business markets, but it can, and should be, scaled up to consumer products.

3.5.1 Source segregated waste collection

With over 30% of the waste being of organic/compostable nature, a major achievement in diverting waste from landfills could be made by introducing a source separation concept. Under such a system waste shall, as a start, be separated at source in 2 fractions, namely one fraction with dry waste and one fraction with wet (organic) waste. Both waste fractions will be delivered to the existing municipal waste collection (bring) system[21]. For this, new/additional receptacles must be placed at all the current communal bin sites. Once collected, the wet fraction should be processed by a suitable technology, such as composting or Anaerobic Digestion (AD). The dry materials could be further sorted and refined at a Material Recovery Facility (MRF).

Experience shows that it is difficult to successfully introduce a source separation system in full scale from the beginning. The success of the system depends widely on people's awareness and willingness to use the system etc. Therefore, it is recommended first to test the system in pilot areas for at least half a year and then use the results to adjust and possibly improve the system as needed including information and awareness raising before the dual collection concept is introduced in the entire project area.

Waste collectors should be allowed to refuse to empty wet waste bins if they are contaminated with unacceptable materials. Householders should be liable to fixed penalty notices for breaches of obligations to use the prescribed bin system. However, this is difficult in Seychelles with the communal bin system.

Hazardous household wastes

With the 2 bin-system, there is still the challenge of hazardous household waste ending up at the landfills as it will be co-collected with the dry fraction. While the amount of hazardous waste from households is low compared to the main (mixed) waste stream[22], it is still recommended to set-up a combination of mobile collection (e.g. monthly collection service to all households)and free delivery points at Redeem Centres and retailer shops.

3.5.2 Increase recycling

The efficiency of the PET and beverage can recycling systems can be increased by offering citizens more bring-points than only the Redeem Centres. In the EU for instance, it is common to have bring points for this type of recyclables in all supermarkets (so-called "reverse vending machines") and this could also be an option for Seychelles. In addition, special containers could be installed at strategic/busy locations to collect the bottles and cans.

[21] Collection on a household by household basis (pick-up) is unlikely to be feasible in Seychelles because not all households can easily be accessed by a collection vehicle. Also, collection costs would increase significantly because each household would need to be provided with a container.

[22] There is no accurate data on amounts of hazardous waste form households, but STAR weighbridge data from Providence landfill indicate a total of 40 tons of hazardous waste in 2018, which is 0.1% of the disposed municipal waste.

Figure15 Reverse vending machines for beverage cans

Reverse vending machine for cartons, plastic and aluminum beverage containers in Australia

Reverse vending machine for PET and beverage cans in Sweden

Other options to increase the collection of recyclables, also expanding to other waste types, are the following:

- ***Via recycling centres (also called drop-off centres),*** which are dedicated fenced sites for collection of recyclables. In EU, these centres generally receive also garden waste, bulky waste and household hazardous waste. Inhabitants and commercial entities will bring recyclables and waste to the recycling centre by own means of transport;
- ***Via buy-back centres,*** i.e. a facility located in strategic locations where citizens, waste pickers etc. can deliver recyclables and be paid in cash for the materials, similar to the current Redeem Centres. Recyclables are refined and stored at the buy-back centres and sold to the processing industry. The buy-back centres could be operated as public centres or private owned centres operated under licence;
- ***Via bring banks,*** i.e. sets of containers located in the collection districts for different types of recyclables (usually dedicated containers for paper and cardboard, glass, plastics and metals). Bring-banks are located in strategic locations (e.g. at commercial centres, shops, multi-storey houses etc.) serving about 1,000-2,000 inhabitants each. Citizens will bring the recyclables to the bring banks;
- ***Via collection points or door-to-door recyclables collection,*** generally in specific containers for mixed recyclables. The system can be established with a number of containers for different recyclables or as a simple system, as described before, where waste shall be separated into two main fractions; one for recyclables ("dry fraction") and one for the residual fraction ("wet fraction"). The recyclable materials collected in the dry fraction must be sorted and prepared for transport before they can be sold to the recycling industry. The sorting and refinement could be carried out in a material recovery facility (MRF);

- ***Via direct collection at shops, institutions, private and governmental offices etc.***, i.e. establishment of agreements with the shops, institutions etc. for collection of recyclables (paper (including confidential papers), cardboard, bottled, cans, glass, plastics etc.). The system will provide high quality products and is suitable for private sector participation as recyclables are high in quantity (per point of generation) and clean. The collection of source-separated recyclables is usually organised as part of a general waste removal agreement covering also collection of residual waste.

3.5.3 Treatment capacity for organic waste

In relation to biological treatment of the organic fraction of the source-segregated MSW stream, for the initial period, it is proposed that the focus will be on decentralized home composting of household organic waste (suburban and rural areas) and centralizedwindrow composting of green wastes (e.g. waste from gardens and parks).

Home composting

While composting is defined as a recycling activity, home composting may be considered as a waste prevention action since it is applicable on a home basis, prior to the material in question entering the MSW stream. Home composting typically involves the use of dedicated bins or vessels into which the user gradually adds organic matter over a period of time. All green wastes, such as yard wastes (e.g. fallen leaves, grass clippings, weeds and the remains of garden plants, also food waste, make excellent compost. This material naturally decomposes to form compost. The high temperature will kill most weed seeds and speed up the decomposition process so that the compost may be ready in about 3 months. Home composting can be practiced in most backyards in a variety of manufactured composting bins, which differ in shape, size and price. Home composting can be implemented in the individual households in the suburban and rural areas in Seychelles. A high degree of effort and commitment is required on the part of participants because home composting requires households to separate and compost their own kitchen and green waste and to handle the compost produced in their own garden.

Windrow composting

A central, basic windrow compost centre should be established, comprising of a surfaced area on which green waste is shredded and then piled into rows. The simple compost process includes the following:

- Shredding of the green waste using a mobile tub grinder
- Piling the shredded green waste into long rows (i.e. windrows)
- Turning the windrows with the loading shovel on a weekly basis to improve porosity and oxygen content, and to redistribute the cooler and hotter parts of the windrows;
- Once the temperatures within the windrows have reduced, screening the windrow material using a star screener; and
- Stockpiling the resulting compost/mulch and allowing the material

The main objective of the composting facility is to divert the organic waste stream away from the landfills. Even if the marketing of compost might not appear feasible for a number of reasons, the end-product from the composting process could be used for basic applications such as road filling and will not take up landfill capacity.

Figure16 Examples various composting technologies

Example of a home composting unit

Windrow composting of green waste

3.5.4 Treatment capacity for dry waste

Dry recyclables can be retrieved from the waste stream by manual or mechanical separation at a Materials Recovery Facility (MRF).An MRF (pronounced "murf") is a specialized plant that receives, separates and prepares recyclable materials for marketing to processors or end-user manufacturers. Although MRFs do not contain difficult electronic technologies they include mechanical parts and engines that can break down and need professional maintenance.

Generally, there are two different types: "clean" and "dirty" MRFs. A clean MRF accepts recyclable commingled materials that have already been separated at the source from municipal solid waste generated by either residential or commercial sources. Material is sorted to specifications, then baled, shredded, crushed, compacted, or otherwise prepared for shipment to market. A dirty MRF accepts a mixed solid waste stream and then proceeds to separate out designated recyclable materials through a combination of manual and mechanical sorting. The sorted recyclable materials may undergo further processing required to meet technical specifications established by end-markets while the balance of the mixed waste stream is sent to a disposal facility such as a landfill.

When comparing both types, clean MRFs (i.e. MRF in addition to source separation activities) significantly out-perform mixed treatment on both material quality and diversion rate. In the case of manual sorting this type also poses less risk for the workers. Therefore, dirty MRFs are not considered appropriate for Seychelles.

Figure17 Manual sorting of dry recyclables in a facility in Denmark

3.5.5 Interim storage & pre-treatment of certain fractions

Some of the priority waste streams such as End of Life Vehicles (ELV) and Waste Electric and Electronic Equipment (WEEE) cannot be (fully) handled in Seychelles and need an off-island solution. For this, an intermediate storage site (Waste Transfer Station) should be developed on Mahé, where these waste streams are collected and temporarily stored, until sufficient quantities have been generated to allow for export. If assessed feasible, sorting and/or processing capacity could be installed at this site to pre-treat the waste, for instance in the form of a dismantling facility. Alternatively, the waste products are shipped in their entirety off-island for further processing.

As such, a central Waste Transfer Station will play an important role in the country's waste management system, serving as the link between the collection system and the final waste treatment facility, which for several waste streams, will be located overseas. The basic purpose of the transfer station is to consolidate waste over a certain period of time, until sufficient quantity of recyclable material has been generated, for more economical shipment off the island to waste treatment facilities abroad.

The waste will be pre-treated, which will minimally include sorting and compaction, for more economical shipment or to meet the requirements of the final waste treatment, i.e. recovery or disposal, facilities. Pre-treatment can help making it economically viable to get waste off the island. However, the shipment of several waste streams will always come at a cost, given that the low value of some recyclable materials and the high freight costs. Export for recycling, even if not profitable, could be a management option. The cost should be borne by those responsible for the generation of the waste, in line with the Polluter Pays principle, and should thus borne by the producers/importers of the products from which the waste results and/or the producers of the waste.

The central waste transfer station should be located on Mahé; from La Digue and Praslin waste will be shipped to the central transfer station. No long-term storage should occur there, and waste should be quickly consolidated, loaded into a barge and moved off site on a regular basis.

3.5.6 Careful examination of new SWM technologies

Waste-to-Energy (WtE) incineration

Waste-to-Energy (WtE) incineration is a treatment technology which greatly reduces the waste volume (up to 80%) and demand for landfill space. Energy can be recovered for heat/cooling and electricity production. WtE can play a role in the transition to a circular economy provided that the waste hierarchy is used as a guiding principle and that choices made do not prevent higher levels of prevention, reuse and recycling. However, WtE may be not the preferred technology for Seychelles, due to:

- High investment and operational costs;
- Waste composition: high density, wet waste with low amounts of high-calorific value waste.
- Limited volumes for incineration, in particular after the bio-waste and the inert waste, and possibly also other recyclable wastes, have been sorted out.
- Complex to operate: the poor level of operation of landfills and composting facilities, (i.e. relatively simple facilities) hints that the discipline and capacity to operate incinerators remains to be developed. Also, institutional capacity is required, for instance to measure and to analyse the emissions.
- Regulatory: regulations on emission control strategies are still to be adopted (and the necessary effective air-pollution control systems to meet the requirements of such regulations), with a view to prevent any environmental and health impacts of incineration.
- Incineration processes reduce the mass and volume of waste to a large extent, but leave residues, i.e. the bottom and fly ashes, and the materials from the flue-gas cleaning, which must be managed as hazardous waste.
- Competition with recycling: WtE requires high calorific waste such as plastic and cardboard packaging and thus attracts recyclable waste.

On the positive side, WtE can help address the current challenge of expensive electricity production from diesel and limit the pressure on the capacity of the landfills. It can also replace the scattered/decentralized development of small-scale incinerators, including those at industries, hotels and hospitals that are not able to meet stringent environmental standards.

Therefore, the feasibility of WtE in Seychelles should be assessed in detail and in a structured manner (i.e. no piecemeal approach). First study results (ETH, 2018) show that incineration could be an option based on technological, economic and societal feasibility but it is questionable whether or not conditions in the Seychelles are already robust enough to allow for proper and sustainable operation. It should also be noted that first and foremost WtE is a technology to tackle the waste problem and its prime objective should not be the generation of electricity as other, cheaper, technologies are available for this.

Anaerobic Digestion (AD)

Organic ingredients intended for composting can alternatively be used to generate biogas through Anaerobic Digestion (AD). It produces two main outputs: an energy-rich gas called biogas and an effluent. Depending on the system design, biogas can be combusted to run a generator producing electricity and heat (called a co-generation system), burned as a fuel in a boiler or furnace or cleaned and used as a natural gas re-placement. The effluent, which may be a solid as well as liquid with very little dry matter is usually called the digest, which can be used as a soil conditioner to fertilize land.

AD is particularly suited for organic waste with a high moisture content such as kitchen waste and food waste and as such can be complementary to aerobic processing (composting), which is best suited for rough, structured wastes such as shrub cuttings and other yard debris. The technology can also be combined with mechanical sorting systems to process residual mixed municipal waste (mechanical biological treatment or MBT). After recyclable and compostable materials have been separated from the waste stream, MBT is an efficient way to treat the remaining waste in terms of the environment, and in particular climate change.

The feasibility of AD in Seychelles should be assessed in detail. First study results (ETH, 2018) show that AD as a treatment solution for organic waste has great potential to help Seychelles meet its goals of increasing the share of renewable energy. However, its economic feasibility depends on the local demand and the possibility to sell the products that emerge from the process.

3.5.7 Improved disposal facilities

Irrespective of the policy pursued, there will always be the need for landfill capacity in Seychelles. The current situation of active landfills on the 3 main islands is inadequate to cater for sustainable disposal of waste.

Although no detailed assessment has been done, based on feedback from stakeholders such as LWMA and its own experience, the Consultant is of the opinion that transport of (mixed) waste from Praslin and La Digue for final disposal at Providence on Mahé will not be cost-effective. On a small scale, transport of waste takes from some outer islands to Mahé already takes place.

Thus, there remain a need for disposal capacity at all 3 main islands and therefore the current sites need to be improved as follows:

- On Mahé, Providence Landfill I needs to be fully and properly closed and rehabilitated. This implies the establishment of a final (semi) impermeable cover along with a surface water control and leachate collection and treatment system. Also, provisions for the extraction and flaring of landfill gas should be made.

- At the same, options to extend Providence Landfill II, in a engineered manner, should be explored as despite all waste minimization and prevention measures, there is still a need to increase final disposal capacity on the island.

- The leachate pretreatment plant that collects and pre-treats leachate from Providence II is out-of-function and needs to be repaired. Moreover, an agreement with PUC needs to be made to further treat and discharge the leachate from the treatment plant. In view that the leachate is only pretreated, additional treatment steps should be added.

- On Praslin, the disposal site is non-engineered and requires closure/rehabilitation and reconstruction as sanitary landfill. The liquid waste pit requires particular attention and might require full remediation. On the landfill in La Digue, several improvement measures are required, in particular regarding leachate management that is currently not working.

Equally important is the need to improve management and operation of all these landfills by adhering to international best practices, such as proper compaction of the waste, daily covering, leachate and landfill gas treatment etc.

3.6 Policy measures

3.6.1 General

Traditional views about waste lead to a policy approach, focused on end-of-life management and on a system that diverts all waste to landfills. This has stalled progress in waste reduction and recycling. This Master Plan is changing the waste management policy of the GoS.

The success of the Integrated Waste Management System (IWMS) that implements the policy, is largely dependent on people factors, i.e. the extent to which people are willing, motivated and able to reduce waste and to participate in source separate collection schemes. A significant change in behavior of all stakeholders is needed. Changing behavior can only be achieved through the adoption of an appropriate mix of policy measures: regulatory, economic information-based (motivational, educational) measures, complemented with logistic measures and with the development of the necessary infrastructure.

Therefore, the key objectives of policy instruments are to:

- Change behaviour towards full application of the Waste Hierarchy, i.e. towards increasing prevention, re-use, collection and recycling, and towards reducing reliance on landfilling

- Raise the financial means that are necessary to improve the performance of the system. Revenues from economic instruments must be earmarked and used to improve the management of the waste streams resulting from the products on which a levy has to be paid.

To change behavior, the government currently relies heavily on command-and-control measures, complemented with information-based and/or voluntary measures (e.g. raising awareness campaigns, Sustainable Tourism Label). However, if the government wants to achieve its policy objectives, it will be important to define an appropriate mix of measures that should also include a wider range of economic policy measures (in particular measures that make the generator pay for waste management, including Extended Producers' Responsibility (EPR) related measures).

In principle, for materials to be recycled and re-integrated into the economy, the cost to recycle must be lower than the cost of sending materials to landfill (which is very low). To this end, landfilling must be made much more expensive, complemented with regulatory instruments (e.g. landfill bans).

To adopt and to implement policy instruments, MACCE will have to coordinate with other governmental institutions, in accordance with their specific mandates and the institutional arrangements defined between them. As such, for the economic instruments, MACCE and LWMA will have to coordinate with the Ministry of Finance.

3.6.2 Revision of existing policy instruments

Regulatory

Import restrictions

With Seychelles being a series of island communities with limited resources, it is necessary for many goods to be imported. The fact that there is only a single point of entry to the country and relatively low number of importers of products, generates an environment with a high potential to control the import of materials that are difficult to reuse, recycle or dispose of.

Seychelles has adopted already 4 statutory instruments, which ban the importation of the certain items[23]. This could be expanded to other products that end up as waste that is difficult to manage and for which there are sustainable alternatives available. Such products could include e.g. cotton bud sticks, packets & wrappers, single-use drinks containers with removable caps/lids, sanitary items

[23] Beverage containers that are not made of PET or glass; Lightweight plastic carrier bags; Plastic utensils (namely plastic spoons, knives, plates, bowls, cups and trays)and polystyrene takeaway boxes; Single-use plastic straws.

(wet wipes, sanitary towels) etc. The objective is to avoid the presence in Seychelles of these products and to promote less harmful alternatives.

Economic

Landfill gate fees

Landfill gate fees currently only exist for commercial waste and should be expanded to also cover municipal waste. The objectives of gate fee will be to cover the full cost of waste management operations (and to provide sufficient revenue to improve the operation) and to encourage recycling, by making landfilling more expensive. Furthermore, it should be considered to raise the gate fees, which are now extremely low and do not cover the full cost, and to apply differentiated gate fees according to types of waste. The gate fee for waste types not wanted to be landfilled, such as recyclable waste, should be made significantly higher than for mixed waste.

Import levies

Under the Customs Management Act (2011), an import levy already exists on PET bottles, beverage cans and alcoholic glass bottles. The revenues from the levies are partly transferred to the Waste Management Trust Fund (WMTF) and are used to fund a recycling scheme, under which the waste is collected and exported for recycling. It should be considered to expand the system to other priority products, based on the polluter pay principle. Such products could include e.g. electric and electronic equipment, batteries and accumulators and vehicles.

By imposing an import levy, the GoS is making the importers financially responsible for the management of the waste that results from their products, which is a form of Extended Producer Responsibility (EPR). Importers shall be exempted from the levy only if they have a sustainable recycling program, under which high collection and recycling rates are achieved. The rates will be determined by the GoS in an implementing regulation that provides for the management of the priority products.

Deposit refund system

The glass bottle reuse scheme currently carried out by Seybrew is very effective. This scheme is viable financially and technically and should be encouraged. The existing system for alcoholic glass bottles (which is maintained by Seybrew, but which has also been introduced by law in 2018) should be expanded to have all reusable glass bottles collected for recycling, and thus not only the alcohol glass bottles or the Seybrew bottles. The expansion is likely to improve the economies of scale.

Fiscal incentives for energy efficiency

An Energy Efficiency Bill, proposed by the Seychelles Energy Commission (SEC) and already approved by the Cabinet of Ministers (March 2019), will make it mandatory for all importers to import electrical appliances that meet the minimum energy efficiency standards, and thus use less energy. This ban is complemented with 2 economic incentives:

- All imported electrical appliances certified energy efficient by the SEC will be exempted from the VAT;
- A soft loan scheme for the purchasing of these appliances and of renewable energy equipment.

These financial incentives are provided by the Ministry of Finance, Trade Investment and Economic Planning offer various financial incentives. The long-term goal is to have only energy-efficient equipment in use in Seychelles.

It should be evaluated for which "waste-friendly" products similar financial incentives can be established and provided.

Public certification of services
The Sustainable Tourism Label Seychelles (SSTL) is a sustainable tourism management and certification programme designed specifically for use in Seychelles. The SSTL is an excellent tool, but there is no sufficient uptake. The Government could therefore consider making certification obligatory for all tourism establishments. The full cost of certification will have to be borne by the establishments. The criteria will be gradually be strengthened, as the environmental management systems develop.

3.6.3 Proposed regulatory policy instruments

Authorization of waste management activities and facilities

Seychelles should control waste management activities through a formal authorisation procedure for the operation of waste management services and facilities, with penalties for non-compliance. Information on authorised companies should be transferred into a central electronic database.

Depending on the level of the control that is needed, the authorities may decide to use registrations instead of licenses, whereby registrations would be required for activities and facilities with a potentially lower impact (due to the amounts or types of waste handled for example). Registration, under a less strict procedure than the one for licensing, may avoid that operators are driven to operate illegally to escape the bureaucracy.

The objectives of the authorisation system include:

- To ensure an environmentally sound operation of the activities and facilities, such that discharges to air, water and land are properly controlled.

- To ensure that all operators are known and report to the government on quantities collected and recycled.

- To allow holders of waste to verify to which operators they can pass on their waste for environmentally sound collection, recycling and disposal. To this

extent, the authorising authorities will provide information on authorized companies on their websites.

As such, anyone holding waste, will have a duty to only hand over the waste to registered or licensed operators and should be able to provide evidence that they have fulfilled this duty.

The authorisations can be tied to environmental standards and may be subject to the fulfilment of specific conditions such as compliance with a code of practice, minimisation of environmental impacts or use of certain types of equipment.

Some of the main elements that will be considered when authorising a particular activity, are summarized in the Box below.

Box 2Elements to consider when authorizing activities

- Site selection.
- Design and construction standards for storage and recycling facilities.
- Authorised waste types.
- Waste acceptance procedures
- Pre-treatment requirements
- Storage requirements
- Closure and aftercare requirements
- Standards:
    - Water and air emission limits; emissions control; emission monitoring.
    - The fate, monitoring and control of residual waste and pollutants
- Employee training.
- Compliance with legal standards.
- Alert system, Emergency and contingency plans.
- Records and record-keeping.
- Offences and penalties; inspections; third-party auditing and certification
- Proof of financial standing; financial guarantee.

Environmental standards

Standards for all aspects of waste management are a basic feature of any regulatory framework for waste management and their establishment is a pre-requisite for the authorisation system. Standards will force facilities to consider the environmental impact of their operations and the cost of meeting the standards. This will bring them to internalise the external environmental costs in their calculations.

The government should consider establishing the following types of standards:

- Emission standards, to combat air and water pollution from industrial facilities, including waste management facilities. Instead of specifying limits applicable to the ambient environment, emission standards, limit the amount or rate of particular pollutants that a facility can release to the air or water bodies in a given period of time. Such standards leave the choice of the technology required to meet the standards to the regulated. Compliance with emission standards is measured by sampling and can be difficult and expensive to monitor. Legislation will however prescribe that a government can recover the cost of compliance control from the controlled facility.

- Technology standards, specifying that the waste treatment must include certain technologies or processes. Technology standards are easy for officials to inspect compliance.

- Practice standards, requiring or prohibiting certain work practices that have significant environmental impacts. For example, a standard will prescribe that certain waste streams must be stored in containers or on concrete floors that meet certain requirements. Mandatory separation of certain types of waste will also be prescribed. Best practice standards are easy for officials to inspect and check for compliance, but it is difficult to ensure ongoing compliance.

Disposal bans

The Government should consider adopting a legal ban on the disposal of waste streams for which landfilling is not an appropriate form of disposal, due to their recyclability or risks, including the following waste streams:

- Biodegradable waste;
- Paper and cardboard;
- Metals;
- Plastic packaging;
- Tyres;
- Batteries;
- Waste electronic and electric equipment.

The disposal bans will help direct materials to reuse and recycling streams where infrastructure is already in place or drive investment in recycling infrastructure. Promotion, education, consumer convenience and accessibility are critical to the success of any disposal ban. Disposal bans can only be effective when consumers are aware of them and have access to means to avoid disposing of the banned materials, such as opportunities to deliver these materials to the collection system.

Mandatory waste management planning

Successful businesses do not happen by accident, but they make plans. A selection of organisations, both businesses and institutions, will be obliged to devise a waste management plan and to submit it for approval to the LWMA and MACCE. A waste

management plan is a written record of an organisation's goals for managing waste and what it will do to achieve those goals.

The following types of organisations (if capacity/size exceeds a certain threshold) could be subjected to mandatory waste management planning:

- Commercial establishments (food, non-food, hospitality etc.)
- Institutional establishments (hospitals, schools and offices)
- Industrial establishments

All businesses must evaluate the wastes they generate and how best to manage it in keeping with the legislation, to best protect the environment and reduce business expenses. The development, the format and the minimal content of such plans will be prescribed by legislation.

Product quality standards

Product standards specify the level of expected performance of a product. The Seychelles Energy Commission (SEC) has already developed minimum energy efficiency standards that will be made mandatory for all importers of electrical appliances. Similarly, product quality standards will be developed for electrical appliances and products will be certified as meeting the standards. The marketing of appliances that do not meet the quality standards will be banned and only the marketing of products that are certified as meeting the standards, will be allowed.

The objective of the product quality standards is to ensure that appliances meet minimum standards and to avoid the marketing of sub-standard products that contribute disproportionally to the amount of waste generated.

Extended warranty

Anew law can prescribe an extended warranty on a selection of new products that are imported, and in any case on electric and electronic equipment, to discourage the importation of low-quality equipment. An extended warranty will be significantly longer than the current, standard warranty, which is sometimes only a few months. It will ensure a minimum product lifetime, with the burden of proof on manufacturers and importers, where appropriate.

An extended warranty will in practice result in a maintenance agreement and oblige importers to establish after-sale services for the maintenance and repair of their products. The law will prescribe the mandatory provision of information to the consumers on the warranty period and on their rights within the period.

3.6.4 Proposed economic instruments

Waste collection charges

It is clear that the costs for an improved waste management system are likely to be significantly higher than for the current system. Right now, industrial and commercial waste generators are not paying the full cost of the waste management services, while households do not pay at all (but bear the cost indirectly through the taxation system). Furthermore, the charges currently being paid do not reflect the need for additional investments in the future. Therefore, as a start, a charge should be placed on waste collection (and disposal) from households, to remind the community that there are costs to reduce the impact to their health and environment from waste disposal and provide an incentive for waste minimization.

Waste collection charges, also referred to as user charges, are directed at recovering the costs associated with the collection, recycling and disposal of waste for which (local) governments are responsible. User charges should, in principle, meet the notion of full-cost recovery, i.e. recovering the full cost of environmentally sound management of the waste. As such, they are similar to gate fees which are applied by operators of a treatment or disposal facility.

User charges require the waste generator to pay a rate to the municipal waste collection service providers. The level of the charges can be based on different assessment units:

- Flat-rate charges, that would be the same for each household
- Variable-rate charges are not related to the service level, but are for example based on: charges on other utilities, such as electricity and/or water supply, which are related to their consumption and sometimes the size of the household or enterprise (whereby the rate can be a percentage of the charges on the other utilities for which a bill is submitted to the households), the size of the building or estate, on the household income or on the number of people living in a household.
- Service-related charges (unit-based pricing, often referred to as PAYT or "Pay-as-You-Throw"), that vary according to the level of service, the volume or weight of waste collected and or the level of segregation at source.

In the vast majority of areas where service-related charges are introduced, the overall cost of the service is funded through a combination of flat rate fees or taxes and a variable element. The flat rate fee is deemed important to give some certainty as to the level of revenue generated, which is a requirement to ensure costs are fully recovered. The variable element is used to stimulate waste prevention and the separate collection of recyclables. Generally, the variable charge rate for residual waste is set at the highest possible level, while the charge rate for recyclables is set a lower or zero level.

Service-related rates are preferable, as they provide for an economic incentive and thus have the greatest potential to influence the behaviour of households. For example, households can be rewarded for their prevention efforts (the less waste they offer for collection, the lower the charges are) and/or their segregation efforts (through a higher rate for mixed waste than for source segregated dry recyclable materials).

However, the introduction of service-related charges would require door-to-door collection, whereby a pre-paid bag system would be the cheapest option. Such a system is not feasible with the current collection system, as it would be difficult to determine who was responsible for not using pre-paid bags and for placing waste loose in the bins. Consequently, such a system would tend to penalise honesty rather than excessive waste generation.

Given that the introduction of service-related charges is not feasible in the short-term, it is proposed to introduce variable-rate charges. One option is to include an entry for waste collection and disposal on the utility bills. Initially this can be set at a very low rate and this could be increased over a period of time to fully reflect the true cost of the service. Charges paid should cover the cost of the present system, and the cost of improving the system. The costs of a sustainable waste management system are likely to be significantly higher. The dependability of a service is of importance. People will be unwilling to pay for an unreliable service.

Any measures that aim to recover the costs of the waste management services provided and that concern imposing charges on consumers and producers are usually very sensitive, especially if imposed for the first time.

Moreover, cost recovery is a political issue that must be tackled at the political level. Politics on an island are very intimate. Politicians are close to the people, and therefore tend to refrain from making difficult and unpopular decisions.

Extended Producer Responsibility

General

Extended Producer Responsibility (EPR) is not a single policy instrument, but a policy approach under which producers/importers are held environmentally accountable and are given a significant responsibility – financial and/or physical – for the management of the waste associated with their products and packaging. Because the application of economic instruments to make producers/importers at least financially responsible, is central to the establishment of an EPR scheme, EPR is sometimes qualified as an economic instrument, even though it is more of a policy approach.

An EPR system (or scheme) consists of an appropriate mix of policy instruments that aim at making producers responsible for the environmental impacts of their products throughout the products' life-cycle, from design to the waste phase. It should ensure the best waste management practices according to the waste management hierarchy, taking into account life-cycle thinking

There are 3 broad categories of policy instruments and they can be used in combination in an EPR system:

1 Regulations. A regulatory instrument applied in many countries that have established EPR systems, are various forms of product take-back requirements, assigning responsibility, for example to producers to take care of the management of their products once they have become waste. This type of requirement is often achieved by establishing collection and recycling targets for a product. Another example of a regulatory instrument are product standards, such as minimum recycled content.

2 Economic instruments provide a financial incentive to change behaviour and to implement EPR policy. They come in several forms, including deposit-refund, Advanced Disposal Fees (ADF) and upstream taxes, such as product taxes on the import of designated products

3 Accompanying information-based instruments aimed to indirectly support EPR programmes by making producers/importers responsible for providing information, for example to the public, for raising public awareness on prevention and improved waste management, or to repair shops, to give them the technical information they need to successfully repair products

Producers are commonly given a range of options in deciding how they will comply with regulatory requirements. A producer may choose to fulfil its obligations individually by finding innovative ways to reduce material use, develop reusable products, or manage materials at their end-of-life by recycling and reintegrating them into the economy without disposal. However, often producers will also decide to work together to meet producer responsibility requirements, including by aligning efforts across multiple provinces.

EPR in the Seychelles

There is no "one-size-fits-all" combination of EPR instruments and the most appropriate combination should be selected for the Seychelles, taking into consideration market size and conditions and the unique characteristics and properties of the products, product categories or waste streams covered.

A typical EPR programme requires that producers/importers of particular goods take back the goods at the end of the use phase and take responsibility for their waste management. However, such a programme does not seem appropriate for Seychelles. The responsibility of importers will be solely financial, while the waste resulting from the imported products will continue to be managed by the LWMA, relying on private waste management contractors.

Given the relatively small quantities of a large number of products, it is better to concentrate the responsibility for management the waste associated with these products, with one organisation, instead of distributing the responsibility over a large number of importers. In addition, by maintaining the responsibility of the LWMA to deliver the system, disruption of services is avoided.

Producers/importers will be given financial responsibility, through a product tax on the import of designated products that aims to cover the full net cost of collection and treatment. The revenues of the EPR tax will be earmarked and could be centralized in the Waste Management Fund and used to finance (i.e. to subsidise) the collection and treatment of the waste from the targeted products. This economic instrument is sometimes referred to as an Upstream Combination Tax/Subsidy (UCTS).The system must ensure producer compliance with regulated requirements and a fair system that discourages non-compliance and prevents free-riders.

As experience is gained and information collected on the full net cost of the improved waste management system, criteria will be defined that will help to determine the rate of the EPR tax and how the rates should vary according to the properties of the product (e.g. its toxic content) and its reparability, recyclability or durability.

To adopt the EPR approach for the Seychelles, for specified products, a combination of two or more of the policy measures listed in the Table below should be selected.

Table 5Mix of policy measures for implementation of the EPR principle in Seychelles

Regulatory instruments	› Product standards: quality requirements, defined by the Seychelles Bureau of Standards, for a selection of products, to avoid the import of low-quality, waste intensive products. › Product bans: banning of products that do not meet product quality standards. › An extended warranty on new products (i.e. a maintenance agreement), significantly longer than the current, standard warranty (which is sometimes only a few months). › Mandatory provision of repair services (after sales service)
Economic instruments	› A tax on the import of designated products, to finance the collection and treatment that is organised by the LWMA. › Deposit-refund systems, to improve the collection rate.
Information-based instruments	› A national EPR plan, developed by the GoS, in consultation with the stakeholders. › A corporate EPR plan, in which importers review all measures that they take for improved management of the waste from their products, in compliance with the Waste Hierarchy and reporting on implementation of the plan (public performance disclosure) › Manuals for reuse and repair: development and making them publicly available. › Public information, education and awareness campaigns, will be financed from the revenues of the import levy. Importers will be required to provide knowledge and to support the implementation of the campaigns.

Framework legislation must be developed to empower the government to designate materials under the producer responsibility regulations. In line with EU prac-

tices, at least the importers/producers of electric and electronic equipment, batteries and accumulators and vehicles should be made responsible for the financing of the management of the waste from these products.

Tourist tax

The introduction of a tourist environmental tax, raised on tourists for environmental purposes, and more in particular, could be used to fund improvements in the waste management system. Some Governments in various parts of the world have introduced such a tourist tax, which may include environmental improvements, or for specific environmental purposes. Such a tax will not have a direct impact on the behaviour of tourists but will raise revenues that that can be exclusively used for environmental purposes, in which case they could have a positive impact on the environment.

Tourists may be ready to pay if it can be demonstrated to them that the revenues are exclusively and directly used for environmental purposes, such as improving local waste management. The revenues should therefore be earmarked and should not be spent on other areas than environmental management. The levy can be collected in different ways; it could for instance be added to an airline ticket price or paid on arrival at the airport or paid to the accommodation upon check-out.

Tourist tax is common across Europe. However, mostly the tax is not labelled as an environmental tax and the revenues are not used exclusively for environmental purposes but are used to maintain tourism-related infrastructure. A tourism tax (sometimes referred to as a city tax) is a small fee charged to visitors by the municipality. This goes towards financing and maintaining facilities in the area, producing brochures, tourist activities and modernising tourist attractions including museums and castles. It is however, usually up to each municipality to decide how much they charge, which can change annually.

A recent study has made the following calculation: "With a low fee (tourist – tax), about 1 – 3 € per day and person, more money would be available for a sustainable waste management concept. If one tourist stays in average one to two weeks (10 days) and 300,000 tourists are visiting the Seychelles every year, 3 – 9 Mio. € would be available for the waste management."[24]

3.6.5 Proposed information-based instruments

An Education, Information and Communication (EIC) programme

The active engagement of all actors - government, importers, waste management service providers and users (industries, commercial establishments, institutions

[24] Developing Waste Management Concept for Mahé – Next steps, Darmstadt University, 19??

and households) is important for the delivery of efficient and effective waste management services. This engagement should be encouraged by information, communication and education.

Informed politicians and decision-makers are more likely to prioritise funding for waste management, while an informed population is more likely to support relevant initiatives and to adopt waste management practices that minimise the quantity and cost associated with waste management.

As confirmed during the Validation Workshop, people need to take more responsibility for dealing with their own waste and a behavioural change is required.

Recognizing the low level of awareness, a comprehensive Education, Information and Communication (EIC) programme in waste management will be an on-going action required to sustain progress. The programme will cover the following areas:

- The opportunities for waste prevention;
- Littering, back-yard burning;
- Collection, recovery and disposal schemes;
- Separate collection;
- Hazardous waste management;
- The benefits (for both the community and the environment) of adopting environmentally sound management practices and of operating and maintaining environmentally sound waste management facilities.

Technical Assistance

A range of measures can be implemented to provide technical advice to operators of waste collection and treatment facilities. This technical capacity is required to ensure the designed lifetime of the facilities/equipment is met and their environmental protection measures are adhered to. Such technical advice can include among others:

- Training for government officials of current international policy, practises and technologies.
- Training for companies involved in the management of waste, including a dedicated, practical training on the operation of sanitary landfills.
- Development of practical guidelines for the prevention and the environmentally sound management - storage, collection, transport recycling and disposal- of municipal waste and of specific waste streams.

Curriculum development

To build up future capacity in solid waste management on a high/academic level, a formal academic plan should be developed for the learning experiences of students that wish to develop that waste management capacity. The plan can be developed in cooperation with, and delivered by, the University of Seychelles, in cooperation with external lecturers.

Pilot projects

Small pilot projects, targeting different sources of waste and different categories of waste, are also a means to increase awareness of proper SWM and to test the introduction of new technologies. A pilot project is a small-scale preliminary project, conducted in order to evaluate feasibility, time, cost, adverse events, and improve upon the project design prior to implementation of a full-scale project or prior to replication of the project to other organisations. Pilot projects could be developed for improving:

- The collection of waste through source separated collection;
- The management of waste at accommodation establishments;
- Introduce decentralised small-scale home/regional composting;
- Waste management at schools.

Public recognition

Good performance of the organisations can be encouraged by recognising it publicly. The following categories of organisations will be considered:

- Commercial establishments, including tourism and distributors/retailers;
- Institutions, including schools;
- Importers, that take action to extend the lifetime of their products;
- Waste management companies.

Public recognition gives them positive social visibility and an improved reputation which creates motivation for them to continue or for others to follow suit.

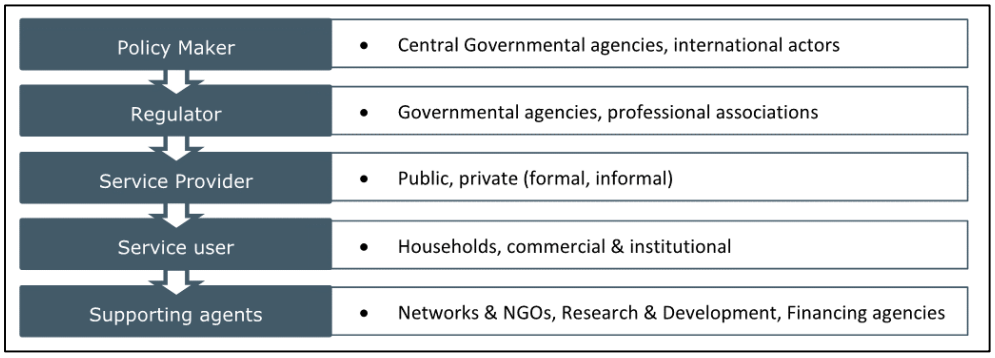
Public recognition can be given by establishing a system of "Waste Awards" that will be periodically granted to the best performing organisations in each of the different categories. Such a system will have to be widely publicised, not only to inform potentially interested organisations, but also to make it known to the wider public, potential clients of the rewarded companies. Good environmental performance can then become part of the companies' marketing strategy and corporate social responsibility (CSR).

3.7 Proposed institutional setup

3.7.1 Introduction

Although systems for delivering and managing SWM services vary around the globe, there are some distinct roles and responsibilities which are common to all – and which must be addressed for the sector to perform adequately. One fundamental point, irrespective of the country of operation, is that the role of policy maker, "regulator" and "service provider" must be separated and conducted by different organizations.

Figure 18:Key roles and actors within the SWM Sector



Regardless of how SWM services are delivered, all of them require oversight from the public sector, the 'client' function. It is the job of elected political representatives and civil servants to protect both public health and environmental conditions - and to ensure that services are carried out at a level of quality required, and at a cost that is affordable. However, presently this separation of roles is not fully implemented in Seychelles, where LWMA fulfils both roles of regulator (e.g. development of own strategies, outreach campaigns etc.) and service provider – and as a consequence, transparency, accountability and enforcement are all seriously compromised.

3.7.2 Future institutional arrangements

In order for SWM activities within Seychelles to achieve desired levels of service there is a pressing need to undertake institutional and organizational changes from that which presently pertains. Being already legally established and possessing considerable operational and regulatory experience, LWMA is, in principle, well-placed to act in a central role to oversee, administer and regulate the new SWM system – in conjunction with MACCE undertaking the key environmental monitoring and strategy development role.

The roles and responsibilities of the various governmental organisations must be clarified, in order to minimise conflicts and overlaps. Environmental integration must be encouraged, and the establishment of an inter-ministerial working group should be considered. As an example, in this way MACCE and LWMA will coordinate with the Ministry of Finance for the development of economic instruments. Also, some ministries will develop plans, which should include a waste management chapter, requiring the involvement of the MACCE. An example could be the development of a Sustainable Tourism Plan for Seychelles, which includes a waste management chapter that could be developed in more detail.

Key functions of MACCE include the development (and partly implementation) of regulation and policy, environmental monitoring and enforcement. LWMA is responsible for the implementation of the waste management system, including general oversight. However, there is substantial overlap in activities, which should be removed. Therefore, a detailed institutional assessment is required to identify duplications (and deficiencies) between MACCE and LWMA agree on a clear division of tasks and responsibilities.

As such, LWMA must be organised internally to focus on the various components of waste management, particularly the aspects of waste storage, collection and transport and into waste treatment and disposal. It should not be the leading actor in the development of legislation and policy.

Regarding the outsourcing of waste collection and operation services to the private sector, clear lines and procedures for communication between the private operators and the government need to be established and implemented. This should include provision for frequent meetings to review the status of services; recommendations for changes in operations and/or procedures due to underperformance and/or mutually agreed amendments and/or improvements.

3.7.3 Capacity development

Capacity development programmes include technical as well as managerial aspects, such as project/programme planning, financial management and monitoring and evaluation.

LWMA seems to have sufficient human resources already in place to undertake their contractual tasks – particularly with the re-focusing of its core activities away from managing commercial waste, for which commercial establishments are now obliged to conclude directly a contract with a waste management service provider.

MACCE should consider increasing the staff involved in waste management, as currently only 5 posts are assigned, of which only one (Director) at senior MSc level. In parallel it needs to develop a training programme for its waste management staff and hire experienced consultants to assist with training, policy and strategic development and implementation.

3.7.4 Waste Information System

To address the major challenge of the lack of available and reliable waste data to guide the planning process, a nation-wide Waste Information System (WIS) needs to be developed. A WIS captures routine data on the tonnages of waste generated, recycled and disposed of on a monthly and annual basis. As such it supports the improvement of integrated waste management policies and actions. It can also be used as basis for user charges.

3.8 A WIS requires each waste facility in Seychelles to implement measures to collect, capture, verify, and submit their waste data, for instance by installing weighbridges to accurately record tonnages of waste received.Recommended regulatory changes

3.8.1 General

The Environmental Protection Act (NEPA) 2016, the environmental framework law, regulates waste management in a very general manner. The scope of the legislation that covers waste management should be broadened and the level of detail should be increased, to support the implementation of the National Waste Policy. Also, the waste management situation has evolved since the adoption of the EPA, which no longer reflects the existing situation. The legislation should thus be updated, such that it can drive improved waste management.

It is proposed that the regulatory framework will comprise the two common layers of legislation. The first of these is so-called framework legislation, which, as the term suggests, defines a 'framework' that sets the stage. The second layer of legislation comprises the subsequent subsidiary detailed regulations that serve to transpose the broad goals of the framework legislation into specific measurable obligations. Without the introduction of detailed regulations, the framework legislation would remain without the desired effect.

The introduction of two layers of waste legislation allows for implementation in stages, with progressively more stringent standards, and also allows the actors in the system to develop expertise and raise the necessary financial resources.

To keep the regulatory framework as simple as possible, the GoS should:

- Adopt a risk-based approach, to simplify legal requirements for activities that are lower risk, less complex or have standard requirements, while continuing to protect the environment and human health. This increases the efficient and effective use of the government's resources while also providing better services and transparency to businesses and the public.

- Keep the number of detailed regulations to a minimum, by adopting comprehensive regulations, covering all aspects, as needed to give full effect to the waste framework act.

- Review existing legislation and identify overlaps and inconsistencies with newly proposed legislation, which will also help to identify the cumulative impact of legislation. For example, certain obligations that are currently provided for by the Regulation on the LWMA, may be moved to the framework Act or to implementing regulations. Certain provisions of the LWMA Regulation should also be supported by framework legislation or regulations, such

as the power that is given to the LWMA to charge fees for the collection of disposal and treatment of waste.

3.8.2 Framework Act

The waste framework act will provide at least the following critical elements.

Table 6: Waste Framework Act: critical elements

Element	Decription
Scope	Definitions of among other waste, waste types, waste management operations and operators. Definitions are a cornerstone in the development of legislation, and must therefore be clear, certain and precise.
	The types of waste that are within and outside the scope of the law.
	The categories of waste (municipal, industrial, commercial, non-hazardous/ hazardous etc.)
	The priority waste streams.
Priorities	The strategic objectives and the guiding waste management principles that have been outlined in the national waste policy and Master Plan.
Responsibilities of key stakeholders	Definition and clear allocation of the responsibilities and obligations of the competent authorities. It is particularly important that each government authority has clear responsibilities and duties and that overlaps among them are avoided.
	Definition and clear allocation of the responsibilities and obligations of the private sector and civil society, including waste generators, waste managements and the broader society. Such obligations will include among other mandatory source separation of priority waste streams.
Changing behaviour	Key policy measures, to provide incentives to stakeholders to meet their responsibilities and obligations.
Prevention	Specific objectives and key measures.
Organisational and technical requirements	Best practice standards for waste management activities, including for collection and transport, handling, treatment and disposal, requiring or prohibiting certain work practices that have significant environmental impacts, and thus requiring particular waste management performance from waste management operators. For example, a standard might prescribe that certain waste streams must be stored in containers or on concrete floors that meet certain requirements or standards for landfill construction and incinerator operations.
	Minimal environmental standards for discharges to air and water from waste management facilities
Health and safety standards	To help control safety and health risks during waste management activities, not only to protect those at work in waste and recycling activities, but also anyone who might be affected by that work, including members of the public.
Procedures	Procedures for: › Planning and consultation. › Tendering. › Licensing of facilities that generate or manage waste. › Certification schemes (e.g. of re-use centres)

Element	Decription
	› Performance monitoring and reporting.
Targets	Concrete targets, such as collection and recycling targets for the different priority waste streams.
Financing	The legal basis for a sustainable mechanism allowing for continued funding of waste management, including among other: › The setting of taxes and charges › The provision of subsidies › The adoption of Extended Producer Responsibility measures, i.e. empowering the MACCE to require EPR measures on a product-by-product-basis.
International obligations	Giving effect to international obligations, especially for trans boundary movement of waste (under the Basel Convention, to which the Seychelles is a party).
Compliance	Key principles of compliance promotion (while the key measures can be included in the Master Plan), such as transparency, publicity and dissemination of guidance on how to comply.
	The legal basis for monitoring (i.e. using inspections and other checks to collect information about levels of compliance and provide evidence for enforcement)
	The legal basis for enforcement (i.e. stopping businesses and individuals who disregard the regulations, sanctioning them and obliging them to rectify the damage, e.g. cleaning-up of illegally dumped waste).
	Provision of authority for enforcement bodies to impose administrative, civil and criminal sanctions. Penalties should be sufficient to serve as a deterrent. The consequences of non-compliance should be clear, with clearly defined penalties for non-compliance (sanctions) for non-compliance and violation.
	Environmental liability and insurance, including among other legal liability for environmental legacy problems, e.g. for contaminated sites or dumpsites, to prevent that responsibilities that should be private are turned into problems for the community at large.
Reporting	Reporting requirements for collecting and regular reporting of timely and reliable data on the generation, collection and treatment of waste, to allow for evidence-based policy making and implementation.
Access to information	Access to information by the public.
Institutional cooperation	Mechanisms for communication, coordination and cooperation between various national authorities that may have a role to play in implementing the legal provisions e.g. ministry responsible for waste, customs officials, prosecutors, environmental inspectorates.

3.8.3 Implementing regulations

The framework act should be supported by regulations dealing with particular waste streams and activities, detailing how the various waste streams should be managed and how the facilities should be operated in an environmentally sound manner. As such, the regulations should include the operational standards that all

waste contractors should minimally meet, and that should be included in the licenses.

Legislation could be complemented with technical instructions and guidance, issued by the LWMA, for example regarding the operation of landfills (e.g. the prescribed compaction rate to be achieved, amount of cover materials use etc.)

The regulations should as a minimum cover the management of the following types of waste:

- Municipal solid waste[25] (incl. bio-waste);
- End of Life Vehicles;
- Waste Electric and Electronic Equipment;
- Hazardous waste.

Waste disposal facilities

The country lacks binding standards on the operation of landfills. To ensure that all landfills are operated according to the regulations and best practices, a regulation on waste disposal must be developed. The regulation should apply in full to any new landfills that will be constructed in the near future, while selected provisions should apply to existing landfills. The regulation should address at least the following concerns:

- Rules on the authorisation of waste disposal facilities
- Technical standards for the designation, design, development, operation and control of waste disposal sites.
- Preventive and protective measures to be taken against any threat to the environment in the short as well as long term, and more especially against the pollution of groundwater by leachate infiltration into the soil.
- Definitions on when and how a landfill must be closed, including the obligations and responsibility of the operator of the site during the after-care period.

Compliance assurance

The enactment of appropriate laws and regulations is just the beginning to creating an effective legal system on waste management and should not be regarded as an end in itself. For laws and regulations to be effective and to be beneficial to society, they must be implemented and complied with. Assuring compliance is also critical for creating a 'level playing field' for environmentally sound waste management, so that compliant, high-standard facilities get a chance to become economically viable. If no legal pressure would be applied, waste generators may be inclined to take their waste to (existing) facilities operating at (much) lower environmental standards and therefore able to offer a lower price than the (new)

[25] If the management of municipal waste were to be improved, such improvements should be supported by a regulation. The regulation could provide among other collecting times, frequency of collection, places where to put the waste, use of closed containers or sorting obligations for households, bin sizes and colours etc.

compliant facilities. Businesses should only work with legally compliant suppliers and service providers.

A compliance assurance strategy is required to ensure that legal requirements are being met by waste management operations and that they are achieving environmentally sound management. This strategy should include the following elements:

Table 7: Compliance strategy for sustainable waste management

Area	Measures
Promotion	Compliance promotion measures aims: › To make all stakeholders (i.e. the regulated) fully aware of the requirements of the waste legislation, by raising their awareness on waste management legislation, trough appropriate IEC campaigns or by publicising the regulations. › To support and help businesses, both waste management companies and waste generators, to comply by improving their knowledge and understanding, for example by disseminating: o Plain-language guidelines on how to interpret and implement the regulations in practice will be issued twelve weeks before they take effect. o Codes of good practice on environmentally sound management. Compliance promotion measures could be taken jointly with industry associations or other representative bodies.
Monitoring	Monitoring involves regular inspections and other checks to collect information about levels of compliance and provide evidence for enforcement
Enforcement	Enforcement involves: › Prosecuting and stopping businesses and individuals who disregard the regulations › Application of penalties that are significant enough to provide effective deterrence to other potential. Offenders, including closing non-compliant facilities. › Obliging offenders to rectify the damage, e.g. cleaning-up of illegally dumped waste.

Enforcement agencies should get a clear mandate and related responsibilities. They should not only be duly authorized by the law, but should also be strong, independent and well-resourced. Their capacity - skills, knowledge and awareness- should be strengthened and they should get the necessary resources to effectively monitor and to take effective action against those who violate the legislation, such as by littering or dumping.

To be deterrent, the threat of being penalised, should be real. Overall, the police, and other enforcement officers, and the judicial system should give higher priority to environmental cases.

3.9 Priority waste streams

3.9.1 General

Priority waste streams are waste streams that require extra effort and targeted action, because of the quantities generated, their potential environmental and health impacts and their potential for recycling. This Masterplan has defined the following priority waste streams, which are also targeted in the latest National Waste Policy. Other waste streams can be added as priority streams if deemed relevant by the Government. The proposed priority waste streams are:

- Waste Electronic and Electrical Equipment (WEEE or E-waste);
- End-of-life Vehicles (ELVs);
- Organic waste;
- Hazardous waste.

3.9.2 Waste Electronic and Electrical Equipment

Existing situation

WEEE is currently dumped and/or stockpiled, mostly at existing disposal sites. A few scrap metal companies accept or have accepted E-waste for dismantling and export, however, this practice is not well-organised and seems to have stopped. Repair or cannibalization of spare parts by privately run service shops, is not very well-developed.

E-waste may contain a range of hazardous substances including heavy metals (e.g. mercury, cadmium, lead), flame retardants and other substances, which may pose significant environmental and human health risks if released to soil, water and air through inappropriate practices such as burning and dumping.

Effective E-waste management poses economical, logistical and technical challenges due to limited access to recycling markets and disposal facilities and due to the high costs in transporting E-waste out of the country.

Sustainable waste management

Sustainable management of WEEE consists of separate collection, pre-treatment (including sorting, decontamination, dismantling, mechanical treatment, etc.) and final disposal. For each of these steps, specialized operators/plants must be used. It has to be assessed if/which pre-treatment operations could/should be undertaken in Seychelles prior to final disposal, which should in any case entail shipment of the island. It may be that for some appliances, the export of whole appliances is the preferred option. On the basis of this, a strategy for the reuse, recycling and export of recoverable components needs to be developed, such that E-waste resulting from repair or complete failure/obsolescence, is directed towards a recycling system. The following Table summarizes the vision on sustainable E-waste management.

Table 8Sustainable E-waste management

Area	Description
Collection	› Establishment of a regular collection programme, including the establishment and coordination of E-waste collection points, which could be the retailers for electronics, redeem centres and/or disposal sites. › Collection on scheduled intervals or on as-need basis, for example during an annual "E-waste Day". › Economic incentives to promote recycling, such as e.g. a recycling fee and a buy-back programme › A public media campaign to raise awareness about E-waste and promote the return of items to collection points for recycling.
Storage and pre-treatment	› A storage facility shall be established, where the E-waste can be temporarily stored under-cover and where possible some dismantling can take place, prior to shipment to treatment facilities in other countries. Sufficient space is required to receive, process for dismantling, pack and store E-waste for future shipment. › Depending on available capacity of the private waste recycling sector, land availability and commercial interest, certain categories of WEEE could be dismantled prior to export. › The aim of dismantling and pre-processing is to liberate the materials and direct them to adequate subsequent final treatment processes: hazardous substances must be removed and stored or treated safely and valuable components/materials must be taken out for recovery. › Removal practices should not damage or destroy components in a way that hazardous substances may be released to the environment or distributed to fractions, unless subsequent treatment of the hazardous substances is secured.
Off-island shipping	› Transport should only be carried out by a licensed, permitted or otherwise authorised carrier, according to the applicable legislation. › Trans boundary movements of hazardous e-waste are subject to the Basel Convention control procedure and should be conducted in a manner which will protect human health and the environment. › In addition, e-waste may be subject to restrictions and control procedures in certain countries. Contact needs to be made with relevant competent authorities for further information on such procedures and/or restrictions.
Market value and cost recovery	› The value of e-waste stems from the presence of a range of precious metals (e.g. gold, silver, platinum, palladium), scarce materials (e.g. indium, gallium), and other recyclable materials (e.g. aluminium, iron, copper). However, the cost of exporting E-waste is significant, and returns are uncertain until the buyer can evaluate the value of the shipment the other end. Due to the cost of exporting, E-waste management will incur a net cost to the Seychelles. › The cost should be recovered from the importers of electric and electrical equipment, through EPR arrangements (an advance recycling fee, an import levy).
Measures	› Import of low-quality equipment could be controlled and banned and a mandatory after-sales repair services could be imposed for all imported electric and electrical equipment. › Mandatory separate collection, to enable materials or products to be extracted for reuse or recycling at a specialised facility, possibly in-country, but most likely abroad. › The private sector may be reluctant to participate in a new market where the profits are doubtful and are most likely not sufficient to make it a commercially viable operation. A subsidy system to encourage the participation and interest in the collection and processing of E-waste, should therefore be devised.

Area	Description
	› Recycling companies should get a reduced rate, or free tipping, for waste derived from dismantling (stripping out) WEEE. The waste would largely be plastic cases from electronics but might also encourage more dismantling of things like refrigerators and washing machines which can a have a bulky plastic or insulation waste component.

3.9.3 End-of-Life Vehicles

Existing situation

There is no system for the management of vehicles, other than that the total number of vehicles allowed in an island is restricted. Many ELVs end up at the disposal sites or remain at private properties, bare lands, roadsides and public places. Most component parts of the vehicle are being salvaged for reuse and only the carcasses remain. Many dealers in spare parts from ELVs operate illegally without de-polluting the vehicles, which can lead to expensive clean-ups of contaminated land and water in the future. There is currently no official disposal site or management system for scrap vehicles.

Sustainable waste management

To support environmental protection and waste recycling, it is necessary to develop, adopt and implement a strategy and regulations to standardize the management of end-of-life vehicle processing sites, including requirements related to depollution, dismantling, spare parts salvage, waste storage, crushing and shredding, training and record keeping. These regulations help ensure end-of-life vehicle processing and associated wastes are managed in an environmentally responsible manner. The following Table summarizes the vision on sustainable management of ELVs.

Table 9: Sustainable management of ELVs

Area	Description
Collection	› The registered owner that intends to discard an ELV should be required to deposit that vehicle at an authorised treatment facility for appropriate treatment and recovery.
Storage and pre-treatment	› ELVs should be stored at an intermediate storage site that must operate under a waste licence or waste facility permit. › It is important to lay down requirements for storage and treatment operations in order to prevent negative impacts on the environment and to avoid the emergence of distortions in trade and competition. › At the storage site, components or other materials may be removed from an ELV. Stripping operations (and storage) shall be carried out in such a way as to ensure the suitability of vehicle components for reuse and recovery, and in particular for recycling. › If economically feasible, after parts and components have been extracted from ELVs, shredding may take place. However, the shredder process is capital intensive and uses a considerable amount of energy. A shredder residue is defined as hazardous waste in many countries.
Off-island shipping	› Remaining components of an ELV that cannot be properly disposed of on the island (e.g. batteries, metal carcass) could be exported for to shredder companies or scrap metal traders for metal recovery. › Transport should only be carried out by a licensed, permitted or otherwise authorised carrier, according to the applicable legislation.

Area	Description
Market value and cost recovery	› ELVs contain various valuable metal fraction, such as cast iron from engines and aluminium. Other components and materials from ELVs, such as glass, and plastics are connected to limited available recycling technologies and markets › The cost should be recovered from the importers of vehicles, through EPR arrangements (an advance recycling fee, an import levy).
Measures	› Vehicle manufacturers should provide authorised treatment facilities with all requisite dismantling information, in particular for hazardous materials › Consumers have to be adequately informed in order to adjust their behaviour and attitudes; to this end information should be made available by the relevant economic operators › Certain measures and technical standards concerning ELV collection and treatment needs to be established.

3.9.4 Organic waste

Existing situation

Currently, organic waste from household and commercial enterprises is not separately collected, transported and treated. It is mixed with the other waste streams and disposed of at one of the landfills in Seychelles. There is no specific infrastructure, such as dedicated containers or a treatment facility, to deal with the organic waste stream. As almost 50% of the waste generated is of organic nature, this means that a huge potential to reduce the pressure on Seychelles' landfills is left unused. Furthermore, the co-disposal of organic waste with the other waste is aggravating the environmental degradation as increased amounts of leachate are generated and released.

Sustainable waste management

In line with organic waste management practises in EU countries and elsewhere, organic waste should be addressed separately to reduce the environmental impacts and in particular required landfill space. This means that the organic fraction should be separated from the rest waste at source and then directed to a treatment facility,that can include composting or anaerobic digestion (or a combination). I there are market constraints to handle the outputs (e.g. sale of compost), alternative use for these outputs should be investigated (e.g. application in parks, cover material for landfill operations, earthworks etc.). The following Table summarizes the vision on sustainable management of organic waste.

Table 10: Sustainable management of organic waste

Area	Description
Collection	› Households should be provided with receptacles to source segregate the organic fraction.
Treatment	› Treatment of organic waste can take place centralized or decentralized (or a combination thereof). Under centralized treatment, the organic fraction is transported to a large composting or AD facility to undergo treatment. Residues/outputs should be marketed. Under decentralized treatment households and other generators are treating the organic waste, and residues, on site.
Off-island shipping	› There is no need for shipping organic waste off-island as it is perfectly possible to establish the required processing capacity in Seychelles.

Area	Description
Market value and cost recovery	› Organic waste can be converted to either biogas or compost. Both outputs could be further marketed and/or processed. Common applications for biogas included cooking purposes or transport (after refining/upgrading). Compost can be used as fertilizer if the quality can be assured. Otherwise lower-level application as e.g. landfill cover or in earthworks is possible. › The cost should be recovered from the introduction of a waste fee for consumers, in combination with a PPP scheme.
Measures	› Government to set targets for organic treatment, i.e. a percentage of the total generated waste. Subsidy schemes could be established to promote the use of compost. › As part of a wider source segregation system, it could be considered to introduce differentiated tariffs for households. This means that household who generate less dry waste (and thus are better in separating organic waste) pay a lower fee.

3.9.5 Hazardous waste

Existing situation

Hazardous wastes encompass a large group of substances, which by nature of their (chemical) properties poses a threat to human health and the environment. Common types of hazardous waste generated in Seychelles include medical waste, waste oils from electricity production, household hazardous waste (batteries, paints, solvents, engine oil, acids, pesticides, expired medicines etc.) and chemicals from laboratories, agricultural use etc. Unless incinerated, these types all require their own method of treatment. Currently most hazardous waste ends up at the landfills.

Sustainable waste management

Due to the characteristics, which are very different from those in municipal (domestic) solid waste, hazardous waste requires the establishment of a national treatment system and regulatory framework. This could include reception sites for types of hazardous waste discarded along with the municipal waste as well as the set-up of a treatment/disposal facility for medical waste. Some of the hazardous waste types (e.g. waste oil from electricity production, lead batteries, and expired medicines) may be better suited for temporary storage and off-island transport as treatment costs, especially for small quantities, are very high

Table 11: Sustainable management of hazardous waste

Area	Description
Collection	› Households should be offered a reception point for disposal of their hazardous waste. This could be in the form of a mobile collection point (pick up) or fixed locations (drop-off).
Treatment	› The optimum treatment technology depends on the type of hazardous waste. For medical waste this could include on-site or centralized disinfection (autoclaves) or incineration. For waste oils this includes incineration or expert. › ›
Off-island shipping	› For certain other types of household hazardous waste (batteries, WEEE) it would be economically most feasible with temporary storage and export. › Construction of interim facility for hazardous waste prior to shipment

Area	Description
Market value and cost recovery	› There is no market value for hazardous waste. › Costs should be recovered by the industrial waste generator on a "pay-as-you throw" basis and through a tariff system for households.
Measures	› Adopt a hazardous waste classification, reporting and data management system › Introducing extended producer responsibility schemes to manage specific hazardous waste streams, such as used oils, spent batteries and accumulators and WEEE. › Making generators of hazardous waste responsible for the entire hazardous waste management cycle to the point of its final disposal or recovery. › Comply with the requirements of the Basel Convention in all matters relating to the import, export, and transit of hazardous waste.

4 Financing

4.1 Introduction

The financial means to develop environmentally sound waste management practices are currently insufficient. The key element of the proposed approach is that waste producers (consumers, enterprises, etc.) must pay for the management of the waste that they generate, in line with the Producers Pay Principle.

For this, an app appropriate mix of economic instruments is required, which will not only generate revenues to cover the costs of improved waste management but will also help to move waste management higher up in the waste management hierarchy (e.g. more prevention and recycling, less landfilling, energy recovery for residual non-recyclable waste etc.).

4.2 Sustainable financing

4.2.1 Financial sustainability

Waste management in Seychelles is currently largely a government burden, as nearly all waste management costs are covered by the Government through general tax funds (and thus by the general tax payer). The Polluter Pays Principle is thus not being applied. Improving the existing waste management system will in any case come with a cost, which will not be off-set by the revenues. The Government may decide to significantly increase public spending on waste management to cover this cost, but this is not a financially sustainable approach.

One of the main reasons for lack of investments in improving the existing system and for failure of the existing system, is the lack of cost recovery. Without cost recovery systems, there is no money in the system to reinvest in systems and equipment.

For the waste management system to become financially sustainable, it must be revenue-based, i.e. it should be financed by revenues generated by operations. For waste management to become a revenue generating sector, the application of the Polluter Pays Principle (PPP) and of the user pays principle, is required. The application of these principles requires the introduction of service-related charges and Extended Producer Responsibility (EPR) schemes. However, as outlined earlier, the application of service-related charges is not feasible in Seychelles with the current collection system, but at least variable-rate charges must be introduced.

4.2.2 Sustainable financing principles

Furthermore, to ensure financial sustainability, financing policies must meet a set of key principles, which are listed in the Table below.

Table 12: Principles for financing polices

Principles	Description
Sufficiency	The GoS must commit sufficient financing to sustainably manage MSW and must mobilize the required resources for investment in MSW facilities and equipment and for the operation of the services.
Efficiency	The LWMA must use the available resources as effectively as possible. This means that MSW costs must be reduced as much as possible, while improving the efficiency of MSW management operations.
Affordability	› The affordability of the system for all users, must be safeguarded. While it is recognized that households should increasingly contribute to financing improving in waste management, it is important that the tariffs are kept at an affordable level. › The national affordability threshold is defined as follows: max % share of household income and public budget.
Full cost accounting	› The full costs of MSW services are often not well known because they are allocated under different budget categories that are often not attributed to MSW services. › Full Cost Accounting (FCA) is a systematic approach for identifying, summing, and reporting the actual costs of MSW management, including upfront and back-end costs (e.g. landfill closure and aftercare) as well as environmental or social costs resulting from unsustainable waste management or opportunity costs of waste secondary raw material value. › FCA requires practical and transparent systems of budgeting and cost accounting for waste management actions. › FCA is required to achieve transparency with regard to the real costs of waste management. › Benefits of FCA: An understanding of the real costs: › Makes cost reduction potentials visible, which is crucial to improve waste management efficiency. › Provides a basis for planning, for making evidence-based infrastructure decisions. › Improves the competitive position of recycling as opposed to landfilling. › May reveal that the technological options with the lowest capital and operating costs may have higher total costs than more advanced technological options.
Cost recovery	› GoS must ultimately achieve cost-oriented revenues for waste management services, based on user charges. › GoS must establish efficient and effective fee collection systems.
Incentivising	› Economic instruments, such as user charges, are not only instruments to recover the cost of waste management, but also to influence behaviour, among other to encourage source separated collection. As such, user charges must provide incentives to households for the separation and recycling of organic waste and of dry recyclables. › The stakeholders that are paying the levies and taxes should be informed of the use made of the revenues and of the results achieved, to encourage them to pay the levies and taxes.
Revenue purpose	› GoS must apply the collected revenues to the intended purposes of MSW management, i.e. to improve the performance of their MSW system. › All funds collected through environmental levies and taxes must be diverted, in a transparent manner, to the Ministry or Agency responsible for the management of the waste stream for which the levies or taxes were raised.

Principles	Description
Accountability	Accountability is key to improving performance. This requires the establishment of practical procedures for financial reporting and auditing.

4.2.3 Existing level of cost recovery

Currently, the residential users of the waste management services do not pay any fees, while the fees paid by commercial users cover about 25% of the total operational costs of the system.

In a full cost recovery world, with approximately 70% of the waste generated by the residents, and 30% by the commercial establishments, the fees charged should be raised to 560 SCR per tonne. Judging by the revenues generated by the commercial sector, this would be equivalent to an increase for commercial establishments by a factor 2 (50%/25%), while residential users should be charged, on average, 400 SCR per person per year, or for a 4-person household: 1,600 SCR per year, as assessed in Section 4.3. This would be affordable and could be gradually introduced over a period of years

While for the commercial sector there should be no discussion as to the adherence to the full cost recovery principle, there might be a political wish to charge the residential population less than full cost recovery tariffs. In that case, it should be noted that any gaps between the resulting operating revenues and costs of the waste management system must be covered by the state budget. This might require tax increases. Presently, the income tax level is 15%, and the VAT is 15% as well. Business incomes are taxed at 25% for the first million of taxable income, and at 33% above that level.

In 2017, personal income tax revenue amounted to 869 million SCR, and these revenues covered the unbilled part of solid waste management costs, say 80 minus 20 million SCR = 60 million SCR. Increasing the waste fees for the commercial sector from 20 to 40 million SCR to recover half of the current costs would reduce the cost burden on the state budget by a similar amount.

Charging the full costs to the residential users, and applying service-related charges, that are also based on the weight of the waste offered for collection, would give the residents an incentive to reduce their waste amounts – such an incentive is not incorporated in the present system where the state budget covers the costs. However, as discussed earlier, the introduction of service-related charges is not feasible in Seychelles with the current collection system. It is therefore recommended to introduce in the short-term least variable-rate charges.

As a consequence of the decisions on the model for cost recovery, the fee rates shall be designed.

4.2.4 Sources of financing

A sustainable waste management system is founded on well-planned investments, to meet evolving needs and on the responsible planning and management of resources and infrastructure. The costs of planned investments must be covered, which requires financing.

The 6 commonly applied sources of financing for waste management operations are described below:

1 Payments of fees or taxes by waste generators;
2 Fees paid by producers of products in the context of EPR;
3 Revenues from sales of marketable wastes and products;
4 Government funding, subsidies or general taxes.
5 Loans from financial institutions.
6 Private equity financing

Waste generators

A common element of approaches to ensure sustainable financing for waste management is making waste generators pay for waste management services, in line with the polluter pays principle. Possible instruments include:

- Waste collection charges collected by the authorities to cover the costs of collection of waste from households; this economic instrument is being discussed extensively in Section 3.6.4.
- Operators of waste disposal facilities require waste generators to pay a gate fee when they deliver waste to the facility.

Producers

Authorities may introduce Extended Producer Responsibility (EPR) schemes for appropriate products. EPR is not a single policy instrument, but a policy approach under which producers/importers are held environmentally accountable and are given a significant responsibility – financial and/or physical – for the management of the waste associated with their products and packaging. As discussed above, Seychelles could extend the responsibility of producers/importers and give them financial responsibility, through a product tax on the import of designated products that aims to cover the full net cost of collection and treatment. The revenues of the EPR tax will be earmarked and centralized in the Waste Management Fund and used to finance (i.e. to subsidise) the collection and treatment of the waste from the targeted products.

Markets

Managing waste may have a cost, but some of the waste may generate revenues. Examples include equipment or parts of equipment that are still useable and can be sold or tyres that are suitable for direct reuse or re-treading. In other cases, materials that are collected separately for recycling can be sold as commodities and generate revenue. However, as argued above, in the case of Seychelles, the

revenues will rarely outweigh the cost of collection, pre-treatment and export for recycling. In the case where waste is incinerated for energy recovery, this may generate revenues from the sale of energy. These revenues can be used to cover (part of) the costs of collection and management of the residual wastes.

Regarding potential revenues of marketable wastes and products, it should be kept in mind that if certain types of waste or parts of waste have a value, operators may be inclined to concentrate on collecting these wastes and obtaining the revenues, whilst not collecting the fractions that would only generate costs. This cherry-picking would leave the management of the residual waste to be managed by public authorities.

Governments

If financing originating from other sources is insufficient to cover the costs of waste management, financing may be provided from the budget of the government that is fed by general tax revenues. Mechanisms that authorities could apply to cover part of the cost of waste management may include:

- Subsidies for, and direct investments in, waste management activities:
  - Subsidies are a sum of money given to help keeping down the price at which waste management services are provided. Subsidies for improved waste management are indispensable in the small-island context. While they may be justified in some case, they are not in conformity with the Polluter Pays principle.
  - Subsidies must be given for the purpose of financing a particular activity or facility and must be carefully designed, such that improvement of services is ensured.
  - Subsidies may have the risk that they will not lead to self- sustainable waste management. "Sustainable" in this case means adequately funded initial investments and operation and maintenance of the necessary equipment and facilities in the long term.

- Subsidies can be given by either the national government or by multilateral, such as the World Bank or the European Commission, or by bilateral organisations. Tax advantages for activities governments would like to promote, such as preferential tax levels and possibilities to use reduced depreciation times for investment;

- Guarantees allowing access to loans with preferential interest rates.

Some governments use specific environmental funds for this purpose and the funds may be established with revenues from taxes and/or financial penalties in cases of non-compliance with environmental legislation.

Generally, financing mechanisms would include a mixture of approaches, especially for the management of hazardous waste where the costs are generally higher. There are advantages and disadvantages for each type of financing.

The Government could consider the guiding policy principles to determine which types of financing they could apply. As such, the GoS is committed to ensuring that public financial support is directed towards waste treatment options that are in line with the waste hierarchy, and that priority is given to waste prevention, reuse, separate collection and recycling.

Loans from financial institutions

Loans are debt instruments and can be granted by commercial financial institutions or international financing sources. The Government, when applying for a loan, will have to prove that it is able to meet its payments to lending institutions.

Private equity financing

Globally, there has been an increasing trend in the participation of the private sector in areas traditionally controlled by the public sector. Private sector participation can satisfy a number of goals, including bringing investment capital, advanced technical and management capacities etc.

It is clear that there is added value for increased participation by the private sector in all areas of waste management in Seychelles, in terms of capital investment in infrastructure, specialist expertise in relation to new technologies and a better understanding of the dynamics of the marketplace, particularly in relation to recyclables. Already, private sector involvement in waste collection is increasing with the recent tendering of 8 concessions.

The Ministry of Finance approved in 2017 a PPP policy. PPP is conducted in other areas, but not yet in solid waste management. It should be assessed to what extent the PPP policy should be amended to encourage private sector involvement in the management sector in Seychelles.

Private sector participation requires the establishment of a partnership between the public sector and the private sector for the purpose of development of investment projects or carrying out of MSW management services traditionally provided by the public sector. Such partnerships should exploit the strengths and advantages of both sectors in the performance of specific tasks, allowing each sector to do what it does best so that the infrastructure and public services can be provided and operated in the most economically efficient manner.

4.3 Required tariffs and affordability

4.3.1 Tariffs before and after investment[26]

Assuming that the amount of waste entering the landfills is roughly 100,000 tonnes per year, and that 50% is commercial, and 50% municipal, it follows that the population of about 100,000 inhabitants produce about 50,000 tonnes of waste per year, or 500 kg per capita per year.

The operation and maintenance costs are roughly 80 million SCR per year, or 800 SCR per tonne. This means that the average O&M cost per capita is 400 SCR per year (0.5 tonnes at 800 SCR per tonne), or 33 SCR per capita per month.

The calculation is shown in Table 13.

Table 13: O&M cost recovery and per capita costs

	Units	No. of units
Amount of waste entering the landfills	Tonnes per year	100,000
of which: commercial	Tonnes per year	50,000
of which: municipal	Tonnes per year	50,000
Number of inhabitants	Inhabitants	100,000
Waste per capita	T/cap/year	0.5
O&M costs related to waste management	Million SCR per year	80
O&M costs related to waste management	SCR/tonne	800
O&M costs per capita (municipal waste)	**SCR/cap/year**	**400**
O&M costs per capita (municipal waste)	SCR/cap/month	33

Adding investment costs (i.e. depreciation, interest, repayment of loan and additional O&M costs), depends on the size of the project. For an investment of 12M EUR, or 181.2 million SCR[27], with an average asset lifetime of 25 years, fully loan financed with a 10-year loan at 2% p.a., and with additional O&M costs of 2% of the investment, the annual expenses would amount to 18.12 million SCR for loan repayment, 7.25 million SCR for depreciation, 7.25 million SCR for interest costs, and 3.62 million SCR for additional O&M, or a total of 36.23 million SCR per year. Please refer to Table 14.

[26] Refer to Section 5 for estimates of proposed investments.

[27] Exchange rate: 15.1 SCR/EUR

Table 14: Investment and full cost recovery

Investment	**Million SCR**	181.2
Average lifetime	Years	25
Depreciation	Million SCR/year	7.25
Interest rate	Percent	4%
Interest costs, maximum	Million SCR/year	7.25
Loan duration	Years	10
Annual loan repayment	Million SCR/year	18.12
Additional O&M	Percent of %	2%
Additional O&M	Million SCR/year	3.62
Total investment related costs	Million SCR/year	36.23
Investment related costs per capita, allocated to municipal waste	SCR/cap/year	181
Investment related costs per capita, allocated to municipal waste	SCR/cap/month	15
Full cost recovery costs for municipal waste	SCR/cap/year	581
Full cost recovery costs for municipal waste	SCR/cap/month	48
Household size	Inhabitants/HH	4
Full cost recovery for municipal waste, before investment	SCR/HH/year	1,600
Full cost recovery for municipal waste, including investment	SCR/HH/year	2,325
Full cost recovery costs for municipal waste, before investment	SCR/HH/month	133
Full cost recovery cost for municipal waste, including investment	SCR/HH/month	194

Before the investment, the total cost of waste management is 80 million SCR per year. The investment adds 36 million SCR per year. Thus, the investment brings the total waste management costs to 80+36 = 116 million SCR per year.

Assuming a waste amount of 100,000 tonnes per year, the investment project would increase the costs from 800 to 1,160 SCR per tonne, or from 0.8 to 1.2 SCR per kilogramme.

As 50% of the waste is municipal, the annual, investment related costs for municipal waste would amount to 18 million SCR, or 180 SCR per capita per year, or 15 SCR per capita per month.

Thus, the full cost recovery bill per person would amount to 400+180 = 580 SCR per year, or 48 SCR per month. For a 4-person household the cost would increase from 1,600 to 2,325 SCR per year, or from 133 to 194 SCR per month.

4.3.2 Affordability

Waste management services are normally judged affordable, if the costs are within 1.5% of the household income.

Estimates of household income are based on statistical information of employee earnings. According to the National Bureau of Statistics[28], in the 4th quarter of 2018, the average monthly earnings across all sectors stood at 14,184 SCR, with a spread from Construction (9,822 SCR per month) to Financial Services and Insurance (26,271 SCR per month). These three income levels reflect the relatively skewed income distribution, also indicated by a Gini coefficient of 46.8%[29].

In the following, these three officially recorded earnings levels are used to represent low, middle and high incomes.

The relative cost of municipal waste services per household depends on the household size and the household income. With a work force of roughly 50,000 out of a total population of 96,000, two out of four inhabitants are earning a salary. With an average household size of 4 persons, the average household has 2 breadwinners. For this calculation, to check the robustness of households towards additional expenses, six cases are chosen:

- A household size of 4 persons with 1 income earner (breadwinner), at three income levels (medium, low and high); and
- A household size of 4 persons with 2 breadwinners, at middle, low and high-income levels.

Please refer to Table 15.

For the case of 1 breadwinner, at the middle-income level, the relative cost of municipal waste services excluding the investment project is 0.9%; for the low-income level, it is 1.4%, and for the high-income level, the relative cost of municipal waste services is 0.5%.

For the case of 2 breadwinners, at the middle-income level, the relative cost of municipal waste services excluding the investment project is 0.5%; for the low-income level, it is 0.7%, and for the high-income level, the relative cost of municipal waste services is 0.3%.

When the investment project is included, these percentages change to:

- 1 breadwinner: 1.4%, 2.0% and 0.7%;
- 2 breadwinners: 0.7%, 1.0%, and 0.4%.

[28] National Bureau of Statistics, Statistical Bulletin, Formal Employment and Earnings 2018-Q4, released 29 March 2019.

[29] 2019 CIA world factbook: Seychelles Economy 2019.

Table 15: Household incomes and municipal waste cost percentages

Salary levels		1 bread-winner	2 bread-winners
Middle-income level	SCR/month	14,184	28,368
Low-income level	SCR/month	9,822	19,644
High-income level	SCR/month	26,271	52,542
Cost percentage of municipal waste, before investment			
For a 4-person household with middle income	%	0.9%	0.5%
For a 4-person household with low income	%	1.4%	0.7%
For a 4-person household with high income	%	0.5%	0.3%
Cost percentage of municipal waste, including investment			
For a 4-person household with middle income	%	1.4%	0.7%
For a 4-person household with low income	%	2.0%	1.0%
For a 4-person household with high income	%	0.7%	0.4%

It is seen that in case of 2 breadwinners, in all cases, the costs of waste management services do not exceed 1% of the household income; in the case of 1 breadwinner, the low-income household would spend 1.4% or 2.0% for waste services (without and with the investment). However, this calculation assumes that the low-income household produces the same amount of waste as the median income household.

It can be argued that the low-income household would generate less waste than the average, while the high-income household would generate more. Thus, if charged by the weight of waste generated, the low-income household would be charged less[30].

It can also be argued that households with incomes below the poverty line (about 4,000 SCR per month) should be exempt from paying for waste management services. In order to retain full cost recovery, such exempting should be reflected by an increase in the tariffs charged to households above such an exemption line[31].

On this background, it can be concluded that the municipal waste services at their present level are affordable, and would remain affordable when including an investment of 181 million SCR. The typical household bill would amount to 1,600

[30] Although service-related charges (i.e. pay-as-you-throw) would be best, it is assumed not feasible to introduce them in Seychelles on the short term.

[31] For example, the tariffs could be increased by dividing the nominal tariffs by the share of paying households. Thus, if 10% of households were exempt, the tariffs charged to the remaining 90% of the households should be the nominal tariffs divided by 0.9.

SCR per year without the investment, and 2,325 SCR per year with the investment.

5 Road Map and Action Plan

Establishing an effective waste management system requires an agreed, long-term and stable policy framework (i.e. a national strategy and an action plan) within which the necessary facilities and infrastructure for proper MSW management can be provided. By reflecting upon the vision, the guiding principles and the identified SWM issues, the specific activities required to pursue the realization of this plan are summarized below in table-form. Thereafter, 3 specific actions that require the (preparation for the) buildup of heavy-cost infrastructure are detailed.

5.1 Road map

Area	Action required
Institutional & capacity building	› Establish clear roles and responsibilities of the various governmental organizations, in particular MACCE and LWMA, removing the current overlap in activities. › Encourage environmental integration by the establishment of an inter-ministerial working group for waste management. › Establish clear lines and procedures for communication between the private operators selected for SWM services and the government, including regular meetings. › Increase MACCE staff involved in waste management and develop a training program for its waste management staff and hire experienced consultants to assist with training, policy and strategic development and implementation.
Economic policy instruments (to enhance sustainable financing)	› Expand landfill gate fee to also cover municipal waste, in addition to the already exiting fees for commercial waste. › Establish waste collection charges for households and charge industrial and commercial waste generators the full cost of the waste management services. › Establish an EPR program that requires producers/importers of particular goods to take financial responsibility, through a mix of policy measures, including among other a product tax on the import of designated products, including electric and electronic equipment, batteries and accumulators and vehicles, that aims to cover the full net cost of collection and treatment. Such a tax would complement the already existing levies on bottles, beverage cans and alcoholic glass bottles.
Regulatory development and measures	› Broaden the scope of the legislation that covers waste management and increase the level of detail by establishing 2 layers of legislation: framework legislation and subsidiary detailed regulations. › Develop a law that prescribes an extended warranty on a selection of new products that are imported. › Adopt a legal ban on the disposal of waste streams for which landfilling is not an appropriate form of disposal, along with standards to ensure that all landfills are operated according to best practices. › Complement the legislation with technical instructions and guidance, issued by LWMA, for example regarding the operation of landfills. › Establish a formal authorisation procedure for the operation of waste management services and facilities, with penalties for non-compliance. › Establish environmental standards on emission, technology, practice to force facilities to consider the environmental impact of their operations and the cost of meeting the standards.

Area	Action required
	› Include waste management requirements in business licenses for certain commercial enterprises and institutions. › Develop statutory instruments which ban the importation of electrical appliances that do not meet product quality standards for electrical appliances and products, that will be developed, in line with what has already been done on energy efficient products. › Expand the sustainable tourism management and certification program by making it obligatory for all tourism establishments. › Develop a compliance assurance strategy is required to ensure that legal requirements are being met by waste management operations and that they are achieving environmentally sound management.
Information-based policy measures	› Develop a comprehensive Education, Information and Communication (EIC) program in waste management, including on littering and waste segregation (when introduced). › Involve local communities in the monitoring and improving performance of solid waste collection service. › Provide information and technical advice to operators of waste collection and treatment facilities. › Curriculum development for waste management, in cooperation with and delivered by University of Seychelles. › Public recognition; to encourage good waste management performance of organizations, by establishing a system of “Waste Awards”
Priority waste streams	› Develop an action program for the sustainable management of WEEE and ELV, including a collection, storage and processing system. › Establish an appropriate mix of regulatory, economic and information-based policy measures to effectively deliver the program. › Develop action plan for the management of Hazardous such as chemicals, paints, waste oil, tyres and any hazardous waste › Develop action program for composting of organic waste and the feasibility of anaerobic Digestion,
Waste Collection	› Introduce wet/dry source segregation, first by means of a pilot and later by full-scale implementation, starting on Mahé. › Change from 240 liters to 1.100 liters bins to increase cost-efficiency.
Recycling initiative	› Establish a decentralized home composting scheme for of household organic waste and construct a centralized windrow composting plant for green wastes (e.g. waste from gardens and parks). › Establish a Mechanical Recycling Facility (MRF) to further sort out valuable dry recyclables from the source-segregated collection. › Establish an intermediate storage site on Mahé for the collection, pretreatment and export of some of the priority waste streams (WEEE and ELV). › Assess the feasibility of Anaerobic Digestion (AD)
Final disposal and treatment	› Assess the feasibility of waste incineration › Improve disposal operations at all active disposal sites by training & capacity building and supply of machinery (where needed). › Close and rehabilitate Amitié disposal (dump) site on Praslin and construct a new sanitary landfill. › Fully and properly close and rehabilitate Providence I landfill on Mahé, including final, cover, surface water control and leachate collection system and landfill gas extraction/flaring. › Restore functioning leachate treatment facilities at Providence II (Mahé) and l'Union (La Digue).

5.2 Action plan for infrastructure investments

The identified actions for potential investments in improved infrastructure are detailed below. It should be noted that many more "softer" actions are required to implement all recommendations for an improved SWM system on Seychelles, including policy & regulatory measures and information and public awareness campaigns. The action plan consists of the following 4actions:

Action 1: Reduction of final disposal by increased recycling;
Action 2: Improvement of final disposal sites;
Action 3: Addressing priority waste streams;
Action 4: Careful examination of new SWM technologies.

For each action the necessary activities and implementation costs are detailed. Costs are based on the Consultant's experience and should be considered as high-level aggregates only. Total estimated costs amount to app. EUR 14M.

5.2.1 Action 1: Reduction of final disposal

Activity	Unit Costs	Number	Est. Costs
Implement a pilot project on source segregation in Perseverance (4,500 inh)[32]			**53,000 EUR**
Planning & monitoring (consultant)	10,000 EUR	1	10,000 EUR
Construction adjustment CPs	2,000 EUR	15	30,000 EUR
Procurement of green bins (240 L)	100 EUR	30	3,000 EUR
Public Awareness	10,000 EUR	1	10,000 EUR
Implement source segregation (95,000 inh)			**935,000 EUR**
Planning & monitoring (consultant)	25,000 EUR	1	25,000 EUR
Construction adjustment CPs	2,000 EUR	400	800,000 EUR
Procurement of green bins (240 L)	100 EUR	600	60,000 EUR
Public Awareness	50,000 EUR	1	50,000 EUR
Establish composting capacity			**1,200,000 EUR**
Feasibility study, incl. design, EIA etc. (consultant)	200,000 EUR	1	200,000 EUR
Procurement of home composters (10,000 hh)	50 EUR	10,000	500,000 EUR
Construction of central CP (5,000 tpy)	500,000 EUR	1	500,000 EUR
Increased recycling capacity for dry waste			**2,650,000 EUR**
Feasibility study, incl. design, EIA etc. (consultant)	200,000 EUR	1	200,000 EUR
Construction of MRF (5,000 tpy)	2,000,000 EUR	1	2,000,000 EUR
Reverse vendor machines (1:2,000)	10,000 EUR	45	450,000 EUR
Establishment of regional bring centers			**1,200,000 EUR**
Feasibility study, incl. design, EIA etc. (consultant)	200,000 EUR	1	200,000 EUR
Construction of 4 regional centers on Mahé	250,000 EUR	4	1,000,000 EUR
Total			**6,038,000 EUR**

5.2.2 Action 2: Improvement of final disposal sites

Activity	Unit Costs	Number	Est. Costs
Rehabilitate Providence landfill (Mahé)			**1,075,000 EUR**
Feasibility study, incl. design, EIA etc. (consultant)	200,000 EUR	1	200,000 EUR
Repair LPTP	50,000 EUR	1	50,000 EUR
Secondary treatment and discharge (PUC) - 10 yrs(m^3)	0.1 EUR	250,000	25,000 EUR
Closing Providence I landfill (m^2)	20 EUR	40,000	800,000 EUR
Rehabilitate Amitié landfill (Praslin)			**4,000,000 EUR**

[32] During the Validation Workshop it was mentioned that a pilot on source segregation in Perseverance is underway.

Activity	Unit Costs	Number	Est. Costs
Feasibility study, incl. design, EIA etc. (consultant)	200,000 EUR	1	200,000 EUR
Closing Amitié landfill(m^2)	20 EUR	15,000	300,000 EUR
Construction of new SLF (ton)	50 EUR	70,000	3,500,000 EUR
Rehabilitate L'Union landfill (La Digue)			**350,000 EUR**
Feasibility study, incl. design, EIA etc. (consultant)	200,000 EUR	1	200,000 EUR
Develop auxiliary structure for registration	100,000 EUR	1	100,000 EUR
Repair LTP	50,000 EUR	1	50,000 EUR
Total			**5,425,000 EUR**

5.2.3 Action 3:Addressing priority waste streams

Activity	Unit Costs	Number	Est. Costs
Waste Electronic and Electrical Equipment (WEEE)			**750,000 EUR**
Feasibility study, incl. design, EIA etc. (consultant)	200,000 EUR	1	200,000 EUR
Establishment of E-waste collection points[1]	50,000 EUR	4	200,000 EUR
Implementation of collection scheme	100,000 EUR	1	100,000 EUR
Construction of interim storage & treatment facility	250,000 EUR	1	250,000 EUR
End of Life Vehicles (ELV)			**450,000 EUR**
Feasibility study, incl. design, EIA etc. (consultant)	200,000 EUR	1	200,000 EUR
Construction of scrap yard	250,000 EUR	1	250,000 EUR
Organic waste– *included in Action 1*			
Hazardous waste			**750,000 EUR**
Feasibility study, incl. design, EIA etc. (consultant)	200,000 EUR	1	200,000 EUR
Construction of interim Hazardous Waste Storage Facility[2]	250,000 EUR	1	250,000 EUR
Procurement of autoclaves for disinfection of medical waste	100,000 EUR	3	300,000 EUR
Total			**1,950,000 EUR**

1) Can be at the regional bring centers; 2) can be at WEEE interim storage facility

5.2.4 Action 4: Careful examination of new SWM technologies

Activity	Unit Costs	Number	Est. Costs
Feasibility Studies, incl. design, EIA etc.			**400,000 EUR**
Feasibility study Anaerobic Digestion (AD)	200,000 EUR	1	200,000 EUR
Feasibility study Waste-to-Energy (WtE)	200,000 EUR	1	200,000 EUR
Total			**400,000 EUR**

Appendix A Glossary

Some of the existing policy documents and legislation include unclear and/or inconsistent definitions, which may lead to differences in interpretation. Therefore, the below glossary is included to ensure a common understanding of the terms used in this Master Plan.

A.1 Policy instruments

Pay-as-you-throw is a usage-pricing model for disposing of municipal solid waste. Users are charged a rate based on how much waste they present for collection and on the level of sorting.

A gate fee (or tipping fee) is the charge levied upon a given quantity of waste received at a waste treatment facility, by the operator of the facility.

Gate fee: clarification

- A gate fee can be charged per load, per ton, or per item depending on the source and type of the waste. It is generally levied to offset the operation, maintenance, labour costs, capital costs of the facility along with any profits and final disposal costs of any residual waste.
- The gate fee should not include any landfill tax which may be applicable in the country. A landfill is a charge levied by a public authority for the treatment of the waste and is often collected and subsequently transferred to the government, by the operator of the facility.
- The gate fee differs from the waste collection fee which is a charge that is levied on people in countries, where waste collection is not fully covered by the general budget.

Extended producer responsibility scheme means a set of measures taken by Member States to ensure that producers of products bear financial responsibility or financial and organisational responsibility for the management of the waste stage of a product's life cycle. (EU)

A Public Private Partnership (PPP) means a cooperative arrangement between one or more public and private sectors, typically of a long-term nature.

A.2 Waste management operations

Prevention means measures taken before a substance, material or product has become waste, that reduce: (i) The quantity of waste, including through the re-use of products or the extension of the life span of products; (ii) The adverse impacts of the generated waste on the environment and human health; or (iii) The content of hazardous substances in materials and products.[33]

Re-use means any operation by which products or components that are not waste are used again for the same purpose for which they were conceived.[1]

* As used in EU regulation/policy

Waste management means the collection, transport, recovery (including sorting), and disposal of waste, including the supervision of such operations and the after-care of disposal sites, and including actions taken as a dealer or broker.[1]

Environmentally sound management means taking all practicable steps to ensure that wastes are managed in a manner which will protect human health and the environment against the adverse effects which may result from such wastes.[34]

Collection means the gathering of waste, including the preliminary sorting and preliminary storage of waste for the purposes of transport to a waste treatment facility.[1]

Separate collection means the collection where a waste stream is kept separately by type and nature so as to facilitate a specific treatment.[1]

Treatment means recovery or disposal operations, including pre-treatment.[1]

Pre-treatment means the physical, chemical, thermal or biological processing, including sorting, that change the characteristics of the waste in order to reduce its volume or hazardous nature, facilitate its handling or enhance recovery or disposal.[35]

Pre-treatment: clarifications
Pre-treatment of waste, prior to either recovery or disposal, means the processing of waste which still results in a waste which subsequently undergoes further recovery or disposal steps.

Recovery means any operation the principal result of which is waste serving a useful purpose by replacing other materials which would otherwise have been used to fulfil a particular function, or waste being prepared to fulfil that function, in the plant or in the wider economy. Recovery is divided into the following sub-categories: (i) Material recovery; (ii) Preparing for re-use; (iii) Recycling; (iv) Backfilling; and v) Other recovery (e.g. waste-to-energy processes).[1]

Material recovery means any recovery operation, other than energy recovery and the reprocessing into materials that are to be used as fuels or other means to generate energy. It includes, inter alia, preparing for re-use, recycling and backfilling.[1]

Preparing for re-use means checking, cleaning or repairing recovery operations, by which products or components of products that have become waste are prepared so that they can be re-used without any other pre-processing.[1]

Re-use: clarification
The key difference between 're-use' and 'preparing for re-use' is that in the former case the material or object has not become a waste, whereas in the case of 'preparing for re-use', the material in question has become waste in the meaning of the waste definition. Re-use is thus not a

[34] As per Basel Convention

[35] Adapted from the EU Landfill Directive definition of "treatment"

Re-use: clarification
waste management operation, but a means of waste prevention. Examples of *preparing for re-use* comprise repairing bicycles, furniture, or electrical or electronic equipment which have been previously discarded by their owners. An example of *re-use*: If packaging is refilled or used for the same purpose for which it as conceived, then such packaging is re-used and it is not packaging waste.

Recycling means any recovery operation by which waste materials are reprocessed into products, materials or substances whether for the original or other purposes. It includes the reprocessing of organic material but does not include energy recovery and the reprocessing into materials that are to be used as fuels or for backfilling operations.[1]

Recycling: clarification
The common idea behind recycling is that a waste material is processed or reprocessed in order to alter its physical-chemical properties, allowing it to be used again for the same or other applications. Recycling includes any physical, chemical or biological treatment leading to a material which is no longer a waste. It follows from the recycling definition that only the reprocessing of waste into products, materials or substances can be accepted as recycling. The recycling process begins when no further mechanical sorting operation is needed, and waste materials enter a production process and are effectively reprocessed into products, materials or substances. Processing of waste which still results in a waste which subsequently undergoes other waste recovery steps can thus not be considered recycling, but pre-treatment prior to further recovery. Pre-treatment prior to recovery or disposal does not sit on any particular rung of the Waste Hierarchy (Article 4 EU WFD).

Biological treatment means composting or anaerobic digestion.[1]

Organic recycling means the aerobic (composting) or anaerobic (anaerobic digestion) treatment, under controlled conditions and using micro-organisms, of biodegradable waste, which produces stabilized organic residues or methane.[1]

Composting means the biological process in which, under controlled conditions and using micro- and macro-organisms, separately collected bio-waste, breaks down in the presence of oxygen, in order to produce a product used on land or for the production of growing media or substrates, resulting in benefit to agriculture or ecological improvement. Composting can vary from basic, relatively low-cost, open air windrow composting, which is suitable for waste from gardens and parks, to sophisticated, relatively high-cost, in-vessel composting which is suitable for the separately-collected organic fraction of the municipal waste stream.

Windrow composting is suited for large volumes an involves placing bio-waste into rows of long piles called "windrows" and aerating them periodically by either manually or mechanically turning the piles, in order to increase the porosity of the piles and homogeneity of the waste.

Anaerobic digestion (or anaerobic fermentation or biomethanisation) means the biological process in which, under controlled conditions and using micro-organisms, bio-waste breaks down in the absence of oxygen, to produce biogas with high methane (i.e. CH_4) concentration and stabilized organic residues (digestate). The digestate can, following any further necessary reprocessing, be used as a

recycled product, material or substance for land treatment resulting in benefit to agriculture or ecological improvement. The biogas produced can be refined by removing the carbon dioxide and water vapour and it can then be used in a combined heat and power (CHP) plant to produce electricity and heat.

Backfilling means any recovery operation where suitable non- hazardous waste is used for purposes of reclamation in excavated areas or for engineering purposes in landscaping. Waste used for backfilling must substitute non-waste materials, be suitable for the aforementioned purposes, and be limited to the amount strictly necessary to achieve those purposes.[1]

Backfilling: clarification
It should be stressed that one of the conditions of this definition is that the operation concerned meets the recovery definition, which has to be assessed depending on the specific circumstances of the operation planned in the light of the objectives of the WFD. The fact that an operation is referred to as 'backfilling' by the operator does not automatically make the operation a recovery operation.[36] Examples of back-filling include e.g. the use of waste for stowage of mines and quarries. or the use of waste for recultivation, land reclamation or landscaping.Backfilling does not have a clear assignment to the R-codes. Depending on the wastes used for backfilling it may be assigned to R5 or R10. In both cases backfilling operations build a sub-set of the respective recovery operations. The reprocessing of waste into materials that are to be used for backfilling, is not recycling, given that recycling (the processing or reprocessing activity) must serve the objective of generating a material, which is used for the original or for other purposes and thus of closing the economic material circle.

Incineration means the thermal treatment of waste, to reduce its weight and volume, with or without recovery of the combustion heat generated. This includes the incineration by oxidation of waste as well as other thermal treatment processes, such as pyrolysis, gasification or plasma process, in so far as the substances resulting from the treatment are subsequently incinerated. Incineration converts the waste into ash, flue gas, and heat.[37]

Co-incineration means the generation of energy or production of material products, using waste as a regular or additional fuel or in which waste is thermally treated for the purpose of disposal through the incineration by oxidation of waste as well as other thermal treatment processes, such as pyrolysis, gasification or plasma process, if the substances resulting from the treatment are subsequently incinerated.[38]

Incineration/co-incineration: clarification
Incineration and co-incineration whereby generating energy is the principal result, is a waste management operation, classified as R1 in Annex II to the EU Waste Framework Directive (EU WFD), and thus a recovery operation. This contrasts with the incineration of waste with low (or without) energy recovery, classified as a disposal operation D10 in Annex I to the EU WFD. To be classified as an energy recovery operation, the incineration of waste must meet the following criteria:

[36] WFD Guidance

[37] Adapted from the EU IED definition of waste incineration plant.

[38] Adapted from the EU IED definition of waste co-incineration plant)

Incineration/co-incineration: clarification

- The main purpose of the operation must be to use the waste as a means of generating energy, replacing the use of a source of primary energy.
- The energy generated by, and recovered from, the combustion of the waste must be greater than the amount of energy consumed during the combustion process (net energy production).
- The surplus energy must effectively be used, either immediately in the form of the heat produced by incineration or, after processing, in the form of electricity.
- The greater part of the waste must be consumed during the operation and the greater part of the energy generated must be recovered and used.
- R1 also includes incineration facilities dedicated to the processing of municipal solid waste under the condition that their energy efficiency is equal to or above the level set in Annex II of the EU WFD (footnote to recovery operation R1) and referred to as R1 energy efficiency formula[39].
- In certain production processes, such as co-processing, waste can be used in an operation combining two waste management recovery options at the same time:
- The energy content of the waste is recovered (R1 operation) as thermal energy, thus substituting fuels,
- While the mineral fraction of the waste can be integrated (hence recycled) in the matrix of the product or material produced, e.g. cement clinker, steel or aluminum (R4 or R5 operation).

Disposal means any operation which is not recovery, even where the operation has as a secondary consequence the reclamation of substances or energy.[1]

Waste-to-energy is a process whereby waste is burned and heat from the combustion process is converted into high-pressure steam, which can be used to generate electricity.[40] Waste-to-energy processes can be either disposal or recovery operations, depending on the level of energy recovery. The main waste-to-energy processes include: (i) Waste incineration in dedicated facilities; (ii) Co-incineration of waste in combustion plants (and in cement and lime production; (iii) Anaerobic digestion of biodegradable waste and use of the biogas; (iv) Utilisation of captured landfill gas; (v) Reprocessing of waste into materials that are to be used as liquid, gaseous or solid fuels; and (vi) Indirect incineration following a pyrolysis or gasification step.

Waste-to-Energy

Waste-to-Energy (WtE) is a not a legal term but is commonly used by policy makers and industry. WtE processes have different environmental impacts and rank differently in the waste hierarchy. In fact, waste-to-energy processes encompass very different waste treatment operations, ranging from 'disposal' and 'recovery' to 'recycling'.

[39] The application of the efficiency formula is specified and explained in the document 'European Guidance for the use of the R1 energy efficiency formula for incineration facilities dedicated to the processing of Municipal Solid Waste according to Waste Framework Directive 2000/98/EC, Annex II, R1 formula'.

[40] Communication from the Commission on t*he role of waste-to-energy in the circular economy, Brussels, 26.1.2017 COM(2017) 34 final.*

A.3 Waste management operators

Waste producer means anyone whose activities produce waste (original waste producer) or anyone who carries out pre- processing, mixing or other operations resulting in a change in the nature or composition of this waste.[1]

Waste holder means the waste producer or the natural or legal person who is in possession of the waste.[1]

Waste management service provider means any undertaking which provides collection, transport, recovery (including sorting) and/or disposal services.

Informal sector means individuals or enterprises that are involved in recycling and other waste management activities but are not recognised or authorised by the authorities. They can be organized by private persons or they can operate independently.

A.4 Waste streams

Waste means any substance or object which the holder discards or intends or is required to discard[1].

Hazardous waste means waste which displays one or more of the following hazardous properties: oxidizing, explosive, flammable, irritant, toxic, carcinogenic, corrosive, infectious, mutagenic, sensitizing, ecotoxic or which is defined as hazardous waste by an International Convention to which Seychelles is party to.

Non-hazardous waste means waste which is not covered by the definition of hazardous waste.

Municipal waste means: (i) mixed waste and separately collected waste from households, including paper and cardboard, glass, metals, plastics, bio- waste, wood, textiles, packaging, waste electrical and electronic equipment, waste batteries and accumulators, and bulky waste, including mattresses and furniture; (ii) mixed waste and separately collected waste from other sources, such as where such waste is similar in nature and composition to waste from households. Municipal waste does not include waste from production, agriculture, forestry, fishing, septic tanks and sewage network and treatment, including sewage sludge, end-of-life vehicles or construction and demolition waste.[1]

Household waste means waste generated by households.

Commercial waste means waste generated by commercial establishments such as hotels and restaurants, markets, offices, wholesale business establishments or retail stores.

Institutional waste means waste generated by institutions, such as government agencies, schools, hospitals or prisons.

Bulky waste means large wastes, such as appliances, mattresses and furniture.

Residual waste means waste remaining after the separation of recyclable waste fractions, which is not fit for prevention, re-use or recycling, because it is contaminated with potentially polluting products or materials and needs to be sent for energy recovery or disposal.

Dry waste is waste that is inorganic or non-biodegradable, i.e. not capable of undergoing anaerobic or aerobic decomposition, and has little or no moisture content.

Dry recyclables are dry wastes which are free from contaminants, such as construction, food or garden waste, and which can be recycled. Most dry waste is recyclable and common dry waste items include Metal, Glass, Plastic, Wood/Wooden Objects, Paper and Cardboard and Textiles.

Inert waste means waste that does not undergo any significant physical, chemical or biological transformations. Inert waste will not dissolve, burn or otherwise physically or chemically react, biodegrade or adversely affect other matter with which it comes into contact in a way likely to give rise to environmental pollution or harm human health. The total leachability and pollutant content of the waste and the ecotoxicity of the leachate must be insignificant, and in particular not endanger the quality of surface water and/or groundwater (EU Landfill Directive).

Waste electrical and electronic equipment or 'WEEE' (or E-waste), means electrical or electronic equipment which is waste, including all components, sub-assemblies and consumables which are part of the product at the time of discarding.[1]

WEEE clarification: EEE-categories covered by the EU Directive on WEEE.

Electric and Electronic Equipment (EEE) categories covered by the EU Directive in WEEE, with for each category a non-exhaustive list of products that would fall under each category.

1. Large household appliances

- Large cooling appliances: Refrigerators; Freezers;
- Washing machines: Washing machines; Clothes dryers; Dish washing machines
- Cooking: Electric stoves, Microwaves
- Electric radiators
- Electric fans; Air conditioner appliances

2. Small household appliances

- Vacuum cleaners
- Appliances used for sewing, knitting, weaving and other processing for textiles
- Irons and other appliances for ironing, mangling and other care of clothing
- Cooking: Toasters; Fryers; Grinders, coffee machines Electric knives
- Appliances for hair-cutting, hair drying, tooth brushing, shaving, massage and other body care appliances
- Clocks, watches; Scales

WEEE clarification: EEE-categories covered by the EU Directive on WEEE.
3. IT and telecommunications equipment Computers, printers, copying equipment; Calculators; Telephones **4. Consumer equipment** Radio; TV; Hi-Fi equipment; Musical instruments **5. Lighting equipment** Fluorescent lamps and other Lighting equipment **6. Electrical and electronic tools (with the exception of large-scale stationary industrial tools)** Drills; Saws; Sewing machines; Tools for mowing or other gardening activities **7. Toys, leisure and sports equipment** Video games; Computers for sports; Sports equipment with electric or electronic components; Coin slot machines **8. Medical devices (with the exception of all implanted and infected products)** Radiotherapy equipment; Cardiology; Dialysis; Freezers **9. Monitoring and control instruments** Smoke detector; Heating regulators; Thermostats **10. Automatic dispensers** Automatic dispensers for drinks and solid products.

Waste oils means any mineral or synthetic lubrication or industrial oils which have become unfit for the use for which they were originally intended, such as used combustion engine oils and gearbox oils, lubricating oils, oils for turbines and hydraulic oils.[1]

Bio-waste means biodegradable garden and park waste, food and kitchen waste from households, offices, restaurants, wholesale, canteens, caterers and retail premises and comparable waste from food processing plants.[1]

Bio-waste: Clarification
Clarification: Bio-waste does not include forestry or agricultural residues, manure, sewage sludge, or other biodegradable waste such as natural textiles, paper or processed wood. It also excludes those by-products of food production that never become waste.

Biodegradable waste means any waste that is capable of undergoing anaerobic or aerobic decomposition, such as bio-waste, and paper and cardboard.

Organic waste is material that is derived from plant our animal sources, and which can generally be decomposed by micro-organisms.

Green waste means biodegradable garden and park waste, tree cuttings, branches, grass, leaves (with the exception of street sweepings), sawdust, wood chips and other wood waste not treated with heavy metals or organic compounds.

Green waste: clarification
'Green waste' includes grass cuttings, hedge/shrub cuttings, fallen leaves, plant and flower heads, branches, tree stumps and timber.

Biomass means the biodegradable fraction of products, waste and residues from agriculture (including vegetal and animal substances), forestry and related industries, as well as the biodegradable fraction of industrial and municipal waste.[41]

Packaging means all products made of any materials of any nature to be used for the containment, protection, handling, delivery and presentation of goods, from raw materials to processed goods, from the producer to the user or the consumer. 'Non-returnable' items used for the same purposes shall also be considered to constitute packaging.[1]

Packaging waste means any packaging or packaging material covered by the definition of waste

A.5 Waste management equipment and infrastructure

Container means any receptacle used to accumulate waste from residential, commercial and industrial sites. Containers vary in size and type according to the needs of the customer or restrictions of the community.

Materials Recovery Facility (MRF) means a central facility where discarded recyclable waste materials may be taken for segregation and pre-treatment.

Waste transfer station means a facility where waste is stored and consolidated over a certain period of time, for more economical shipment to and for meeting the acceptance criteria of domestic or international waste treatment facilities.

Landfill means a waste disposal site for the deposit of the waste onto or into land (i.e. underground).[1]

Sanitary landfill means a waste disposal site for the deposit of waste onto or into land, so located, designed and operated that it does not pose a substantial present or potential hazard to human health or the environment, including pollution of air, land, surface water or ground water. A sanitary landfill must meet the standard specifications, including sound siting, extensive site preparation, placement of

[41] Glossary of the European Environmental Agency (EEA)

waste on an impermeable bed such that it is isolated from the environment, proper leachate and gas management and monitoring, compaction, daily and final cover with a layer of earth or another inert material, complete access control, no scavenging on site, weighing and record-keeping.

Dumpsite means a waste disposal site where waste is dumped indiscriminately, without the controls necessary to avoid a substantial present or potential hazard to human health or the environment, including pollution of air, land, surface water or ground water.

Controlled dumpsite means a waste disposal site that is controlled to some extent and which has some characteristics of a sanitary landfill, like siting with respect to hydrogeological suitability, partial compaction, leachate control, partial gas management, regular cover, access control, basic recordkeeping and controlled scavenging.

A.6 Recyclates

Secondary raw materials are waste materials that enter a production process (possibly after some form of pre-treatment) and that are effectively reprocessed into products, materials or substances. In a Circular Economy, secondary raw materials are thus waste materials that are being injected back into the economy.

Refuse Derived Fuel (RDF) is produced from combustible components of waste. The waste is shredded, dried and baled and then burned to produce electricity,

Compost means the stable, sanitized and humus-like material rich in organic matter and free from offensive odours resulting from the composting process of separately collected bio-waste, which complies with specified minimum standards of environmental quality.

Appendix B Waste Forecast 2020-2035

Seychelles, low-growth scenario waste forecast

Year	Population				Urban generation	Rural generation	Tourists generation	Urban generation	Rural generation	Tourist generation	Total MSW generation	Waste collection rate	Total waste collected	Recycling		Bio-treatment		For disposal/treatment	
	Urban	Rural	Total	Tourists	(kg/cap/day)	(kg/cap/day)	(kg/cap/day)	(t/year)	(t/year)	(t/year)	(t/year)	(%)	(t/year)	(%) Urban	Amount (t/year)	(%)	Amount (t/year)	(%)	Waste amount (t/year)
2018	54.187	42.575	96.762	349.861	0,50	0,25	0,50	9.889	3.885	1224,51	14.999	90	13.499	5	675	1	135	94	12.689
2019	54.349	42.703	97.052	367.354	0,50	0,25	0,50	9.948	3.908	1228,19	15.085	90	13.577	5	679	1	136	94	12.762
2020	54.512	42.831	97.343	385.722	0,50	0,25	0,50	10.008	3.932	1231,87	15.172	90	13.655	5	683	1	137	94	12.835
2021	54.676	42.960	97.635	405.008	0,50	0,25	0,50	10.068	3.955	1235,57	15.259	91	13.829	6	778	3	346	92	12.705
2022	54.840	43.088	97.928	425.258	0,51	0,25	0,51	10.129	3.979	1239,27	15.347	91	14.005	6	875	4	560	90	12.569
2023	55.004	43.218	98.222	446.521	0,51	0,25	0,51	10.190	4.003	1242,99	15.436	92	14.182	7	975	6	780	88	12.427
2024	55.169	43.347	98.517	468.847	0,51	0,25	0,51	10.251	4.027	1246,72	15.525	93	14.361	8	1.077	7	1.005	86	12.278
2025	55.335	43.477	98.812	492.290	0,51	0,26	0,51	10.313	4.051	1250,46	15.614	93	14.541	8	1.181	9	1.236	83	12.124
2026	55.501	43.608	99.109	516.904	0,51	0,26	0,51	10.375	4.076	1254,21	15.705	94	14.723	9	1.288	10	1.472	81	11.962
2027	55.667	43.739	99.406	542.749	0,51	0,26	0,51	10.437	4.100	1257,97	15.795	94	14.907	9	1.397	12	1.714	79	11.795
2028	55.834	43.870	99.704	569.887	0,52	0,26	0,52	10.500	4.125	1261,75	15.886	95	15.092	10	1.509	13	1.962	77	11.621
2029	56.002	44.002	100.003	598.381	0,52	0,26	0,52	10.563	4.150	1265,53	15.978	96	15.279	11	1.623	15	2.215	75	11.440
2030	56.170	44.134	100.303	628.300	0,52	0,26	0,52	10.626	4.175	1269,33	16.070	96	15.467	11	1.740	16	2.475	73	11.253
2031	56.338	44.266	100.604	659.715	0,52	0,26	0,52	10.690	4.200	1273,14	16.163	97	15.658	12	1.859	18	2.740	71	11.058
2032	56.507	44.399	100.906	692.701	0,52	0,26	0,52	10.754	4.225	1276,96	16.256	98	15.850	13	1.981	19	3.011	69	10.857
2033	56.677	44.532	101.209	727.336	0,52	0,26	0,52	10.819	4.250	1280,79	16.350	98	16.043	13	2.106	21	3.289	66	10.649
2034	56.847	44.666	101.513	763.703	0,52	0,26	0,52	10.884	4.276	1284,63	16.444	99	16.239	14	2.233	22	3.573	64	10.433
2035	57.018	44.800	101.817	801.888	0,53	0,26	0,53	10.949	4.302	1288,49	16.539	100	16.539	15	2.481	25	4.135	60	9.924
																		2020-2035	185.930

Seychelles, medium-growth scenario waste forecast

Year	Population				Urban generation	Rural generation	Tourists generation	Urban generation	Rural generation	Tourist generation	Total MSW generation	Waste collection rate	Total waste collected	Recycling		Bio-treatment		For disposal/treatment	
	Urban	Rural	Total	Tourists	(kg/cap/day)	(kg/cap/day)	(kg/cap/day)	(t/year)	(t/year)	(t/year)	(t/year)	(%)	(t/year)	(%)	Amount (t/year)	(%)	Amount (t/year)	(%)	Waste amount (t/year)
2018	54.187	42.575	96.762	349.861	1,57	0,79	1,57	31.052	12.199	3844,97	47.096	90	42.386	5	2.119	1	424	94	39.843
2019	54.566	42.873	97.439	388.346	1,58	0,79	1,58	31.532	12.387	3877,27	47.796	90	43.017	5	2.151	1	430	94	40.436
2020	54.948	43.173	98.121	431.064	1,60	0,80	1,60	32.019	12.579	3909,84	48.508	90	43.657	5	2.183	1	437	94	41.038
2021	55.333	43.476	98.808	478.481	1,61	0,80	1,61	32.514	12.773	3942,68	49.230	91	44.615	6	2.510	3	1.115	92	40.990
2022	55.720	43.780	99.500	531.114	1,62	0,81	1,62	33.017	12.971	3975,80	49.963	91	45.592	6	2.849	4	1.824	90	40.919
2023	56.110	44.086	100.196	589.536	1,64	0,82	1,64	33.527	13.171	4009,20	50.708	92	46.588	7	3.203	6	2.562	88	40.823
2024	56.503	44.395	100.898	654.385	1,65	0,83	1,65	34.045	13.375	4042,87	51.463	93	47.604	8	3.570	7	3.332	86	40.701
2025	56.898	44.706	101.604	726.367	1,66	0,83	1,66	34.572	13.582	4076,83	52.230	93	48.640	8	3.952	9	4.134	83	40.553
2026	57.297	45.019	102.315	806.268	1,68	0,84	1,68	35.106	13.792	4111,08	53.009	94	49.696	9	4.348	10	4.970	81	40.378
2027	57.698	45.334	103.032	894.957	1,69	0,85	1,69	35.649	14.005	4145,61	53.799	94	50.773	9	4.760	12	5.839	79	40.174
2028	58.102	45.651	103.753	993.403	1,71	0,85	1,71	36.200	14.221	4180,44	54.602	95	51.872	10	5.187	13	6.743	77	39.941
2029	58.508	45.971	104.479	1.102.677	1,72	0,86	1,72	36.760	14.441	4215,55	55.416	96	52.992	11	5.630	15	7.684	75	39.678
2030	58.918	46.293	105.210	1.223.971	1,74	0,87	1,74	37.328	14.665	4250,96	56.243	96	54.134	11	6.090	16	8.661	73	39.383
2031	59.330	46.617	105.947	1.358.608	1,75	0,88	1,75	37.905	14.891	4286,67	57.083	97	55.299	12	6.567	18	9.677	71	39.055
2032	59.746	46.943	106.688	1.508.055	1,77	0,88	1,77	38.491	15.121	4322,68	57.935	98	56.487	13	7.061	19	10.732	69	38.693
2033	60.164	47.272	107.435	1.673.941	1,78	0,89	1,78	39.086	15.355	4358,99	58.800	98	57.698	13	7.573	21	11.828	66	38.297
2034	60.585	47.602	108.187	1.858.075	1,79	0,90	1,79	39.690	15.593	4395,60	59.678	99	58.932	14	8.103	22	12.965	64	37.864
2035	61.009	47.936	108.945	2.062.463	1,81	0,90	1,81	40.304	15.834	4432,53	60.570	100	60.570	15	9.085	25	15.142	60	36.342
																		2020-2035	634.828

Seychelles, high-growth scenario waste forecast

Year	Population				Urban generation	Rural generation	Tourists generation	Urban generation	Rural generation	Tourist generation	Total MSW generation	Waste collection rate	Total waste collected	Recycling		Bio-treatment		For disposal/treatment	
	Urban	Rural	Total	Tourists	(kg/cap/day)	(kg/cap/day)	(kg/cap/day)	(t/year)	(t/year)	(t/year)	(t/year)	(%)	(t/year)	(%) Urban	Amount (t/year)	(%)	Amount (t/year)	(%)	Waste amount (t/year)
2018	54.187	42.575	96.762	349.861	2,30	1,15	2,30	45.490	17.871	5632,76	68.993	90	62.094	5	3.105	1	621	94	58.368
2019	54.729	43.001	97.730	402.340	2,36	1,18	2,36	47.047	18.483	5767,95	71.298	90	64.168	5	3.208	1	642	94	60.318
2020	55.276	43.431	98.707	462.691	2,41	1,21	2,41	48.658	19.116	5906,38	73.680	90	66.312	5	3.316	1	663	94	62.334
2021	55.829	43.865	99.694	532.095	2,47	1,23	2,47	50.324	19.770	6048,13	76.143	91	69.004	6	3.881	3	1.725	92	63.398
2022	56.387	44.304	100.691	611.909	2,53	1,26	2,53	52.047	20.447	6193,29	78.688	91	71.803	6	4.488	4	2.872	90	64.443
2023	56.951	44.747	101.698	703.695	2,59	1,29	2,59	53.829	21.147	6341,93	81.319	92	74.712	7	5.136	6	4.109	88	65.466
2024	57.520	45.195	102.715	809.250	2,65	1,33	2,65	55.673	21.871	6494,13	84.038	93	77.735	8	5.830	7	5.441	86	66.464
2025	58.095	45.646	103.742	930.637	2,72	1,36	2,72	57.579	22.620	6649,99	86.849	93	80.878	8	6.571	9	6.875	83	67.432
2026	58.676	46.103	104.779	1.070.233	2,78	1,39	2,78	59.550	23.395	6809,59	89.755	94	84.145	9	7.363	10	8.415	81	68.368
2027	59.263	46.564	105.827	1.230.768	2,85	1,42	2,85	61.589	24.196	6973,02	92.758	94	87.541	9	8.207	12	10.067	79	69.266
2028	59.856	47.030	106.885	1.415.383	2,92	1,46	2,92	63.698	25.024	7140,37	95.863	95	91.070	10	9.107	13	11.839	77	70.124
2029	60.454	47.500	107.954	1.627.690	2,99	1,49	2,99	65.879	25.881	7311,74	99.072	96	94.738	11	10.066	15	13.737	75	70.935
2030	61.059	47.975	109.034	1.871.844	3,06	1,53	3,06	68.135	26.767	7487,23	102.389	96	98.550	11	11.087	16	15.768	73	71.695
2031	61.670	48.455	110.124	2.152.620	3,13	1,57	3,13	70.468	27.684	7666,92	105.819	97	102.512	12	12.173	18	17.940	71	72.399
2032	62.286	48.939	111.225	2.475.513	3,21	1,60	3,21	72.881	28.632	7850,92	109.363	98	106.629	13	13.329	19	20.260	69	73.041
2033	62.909	49.429	112.338	2.846.841	3,28	1,64	3,28	75.376	29.612	8039,35	113.027	98	110.908	13	14.557	21	22.736	66	73.615
2034	63.538	49.923	113.461	3.273.867	3,36	1,68	3,36	77.957	30.626	8232,29	116.815	99	115.355	14	15.861	22	25.378	64	74.116
2035	64.174	50.422	114.596	3.764.947	3,44	1,72	3,44	80.626	31.675	8429,87	120.731	100	120.731	15	18.110	25	30.183	60	72.438
																		2020-2035	1.105.533