United Nations Industrial Development Organization (UNIDO)

Project: "*Promotion of BAT and BEP to reduce uPOPs releases from waste open burning in the participating African countries of SADC sub-region*"

SOLID WASTE MANAGEMENT PLAN

Municipality of ANTEHIROKA

(Draft version)

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Table des matières

ANTEHIROKA

ANTEHIROKA municipality is located in the Faritany of Antananarivo, Analamanga region, Ambohidratrimo District. The capital of the municipality is Ambohibao.

The Rural Commune of Antehiroka is located 5 km from the district capital; 8 km from Antananarivo Renivohitra and 5 km from Ivato International Airport.

It is crossed by the national road n°4 towards Mahajanga.

The total area of the commune is 10.11 km2, it is classified among the rural communes of the 1st category, containing 09 fokontany subdivided into 49 districts.

- Total population: 80,360
- Number of voters: 28597

1 INTITIAL CONSIDERATIONS

1.1 Pre-planning decisions

Table 1: Decisions taken during the initial meeting with stakeholders about the planning process of the solid waste management plan

Results of initial pre-planning meeting with stakeholders on 22 September 2022						
List of stakeholders to take an active role in the planning process (make note of which ones attended the meeting with an *)		Number and purpose of each working group	Stakeholders and their assigned working group	Timeline for the planning process	Meeting frequency of working groups	Other significant planning deadlines
Waste managers: Mayor, technical service, chief of fokontany Rafitra fanadiovana fidiovana II (RF2)	Waste generators: Households, company, market, school, hotel,	WG1: Reduction of scattered waste WG1: waste collection is timely matter WG2: Setting up waste treatment site	WG1: Mayor, technical service, chief fokontany, RF2, health and safety committee *CHS: campaign to dispose of waste in garbage bin* WG2: Mayor Technical service (*Planning, Equipment)*	(*)	(*)	Waste generation rate and waste collection rate determined by WG1 Scheme, design of facility (RCC) defined and approved by WG2 by

(*) Note that this plan was prepared in several steps:
1- Preparation of the plan by a small group composed of the Technical Service with the support of the Technical Consultant;
2- Presentation of the draft plan to the Mayor;
3- Organization of a workshop with the stakeholders;
4- Presentation of the draft Plan by the Mayor to the Communal Council for validation

2 BACKGROUND

2.1 Waste problematic in the local context

Table 2: List of reasons why waste is problematic in ANTEHIROKA

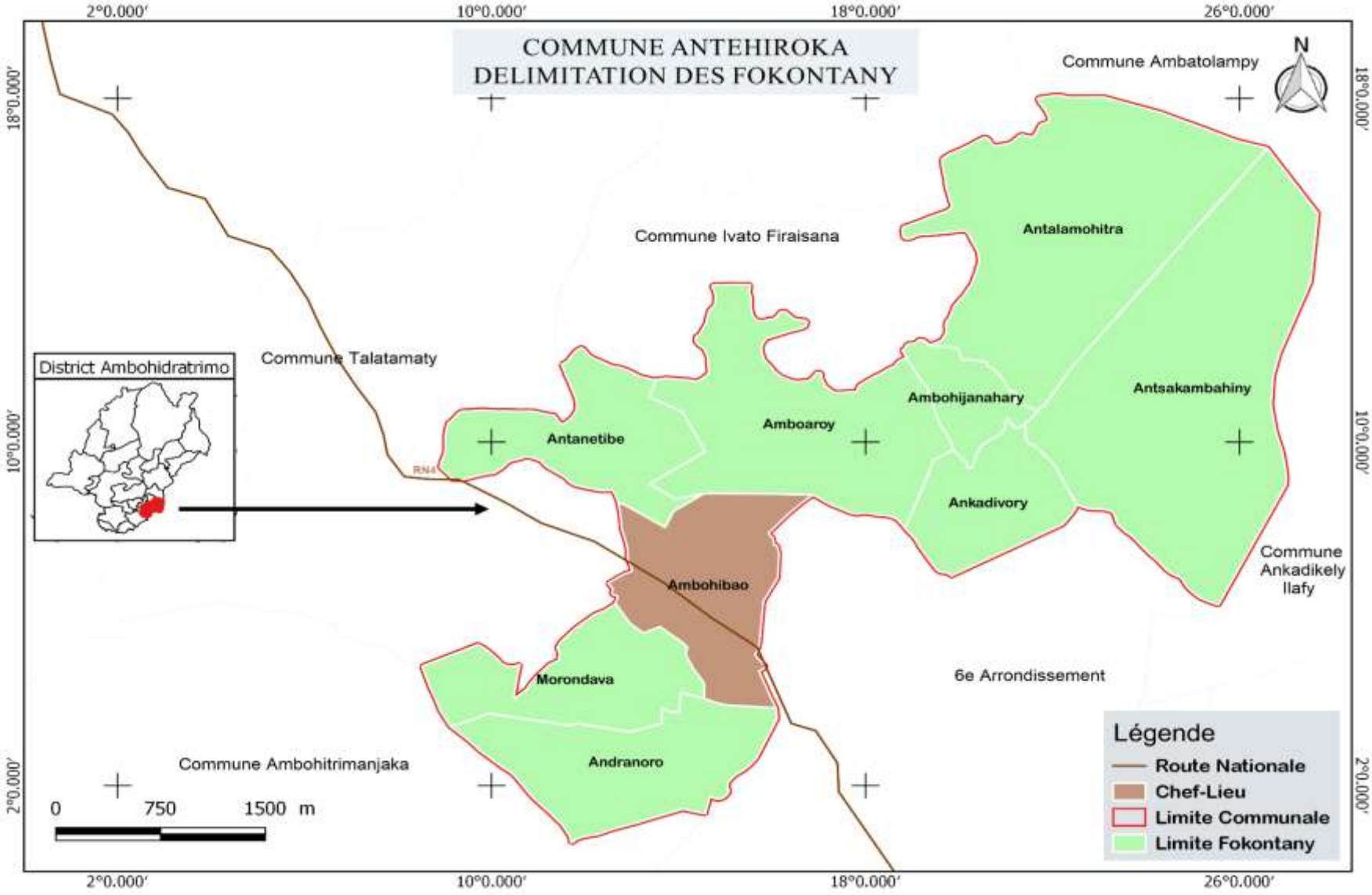
Problems waste is causing in ANTEHIROKA	
Health-related: CSB II	• Respiratory problems, skin disease, microbes spread, • Increased sightings of rodents like mice and rats scavenging in uncollected waste piles
Environmental:	• Pollute the spread, air pollute (bad breath); the drain is clogged • No pre-treatment for wet organic waste going to landfill; methane emissions • Clogging of storm water drainage channels • Clogging of wastewater networks
Aesthetic:	• Damage to infrastructure such as waterways, disfiguring the area, unattractive area • bad breath

2.2 Initial scope of the plan

Table 3: Initial scope of the solid waste management plan

Solid Waste Management Plan Scope		
Geographic	Types of Waste	Timeline (e.g., overall 5-10 years; 1-2 action plans resp.)
Included: - all 10 718 households of 9 Fokontany - all 7 fokontany markets - the 1 municipality market Excluded: - 242,64 hectares of agricultural fields	Included: - Municipal solid waste (MSW) - households waste Excluded: - industrial waste - healthcare *waste* - agricultural waste	5 *years*

Map of geographic area where waste management plan applies



3 STATUS QUO ASSESSMENT

3.1 Default data collection

3.1.1 Population and municipal data

Table 4: Required population and municipal data for the SWMP

[ANTEHIROKA]'s Population and Municipal Data			
Population size	Size of WM area	Population density	GNI/capita
(No. of people)	(km^2) or (No. of households)	(ppl/km^2) or (ppl/household)	(USD/person)
80,*360 people*	10,11 km2/*10,718 households*	7.5 *people/household* 7 948 ppl/ km2	*$ 521USD/person*

3.1.2 Waste quantity and composition data

Table 5: Required waste quantity and composition data for the SWMP

<table>
<tr><th colspan="3">[ANTEHIROKA]'s Waste Quantity and Composition Data</th></tr>
<tr><td>Determined average waste generation rate per person</td><td>(kg/pers/day)</td><td>0.15 kg/day</td></tr>
<tr><td>Population</td><td>(no. of ppl)</td><td>80,360people</td></tr>
<tr><td>Total waste generated per day (tonnes/day)</td><td>(tonnes/day)</td><td>12 tonnes/day</td></tr>
<tr><td>Total waste generated per year (tonnes/year)</td><td>(tonnes/year)</td><td>4 380 tonnes/year</td></tr>
<tr><td>Determined average waste composition</td><td>(%)</td><td>
<table>
<tr><th>Waste Material</th><th>Average Percent in Waste</th></tr>
<tr><td>Organic</td><td>64,06%</td></tr>
<tr><td>Paper & Cardboard</td><td>7,55%</td></tr>
<tr><td>Plastics</td><td>13,80%</td></tr>
<tr><td>Metals</td><td>0,52%</td></tr>
<tr><td>Glass</td><td>2,60%</td></tr>
<tr><td>Rubber, Leather, and Synthetics</td><td>0%</td></tr>
<tr><td>Textiles</td><td>4,69%</td></tr>
<tr><td>Wood</td><td>1,04%</td></tr>
<tr><td>Inert Material</td><td>1,30%</td></tr>
<tr><td>Other</td><td>4,41%</td></tr>
</table>
</td></tr>
<tr><td>Determined average waste density (kg/m^3)</td><td>(kg/m^3)</td><td>300 *kg/m^3*</td></tr>
</table>

3.1.3 Waste policies and legislation

Table 6: Policies and legislation relevant to solid waste management; reproduced from (UNEP, 2009)

Area of Waste Management	Laws and Acts	Regulations and Standards	Economic Instruments	Enforcement
Overall (General)	- Law No. 90-033 of 21 December 1990 on the Malagasy Environment Charter - Law n° 98-029 du 20 /01/99 relating to Water Code (applies to waters dependent on the public domain, surface water, groundwater) - Law N° 99-021 du 19/08/ 99 on Industrial pollution management policy (wastewater management, solid waste management) - Decree N ° 2004-167 modifying some provisions of decree n ° 99-954 of December 15, 1999 relating to the compatibility of investments with the environment (MECIE)	Bylaw N° 09/22/Com/Ante on Municipal Code of Hygiene		
Source Reduction (Production & Consumption)	- Decree N° 2017-010 prohibiting the production, import, marketing, stockpiling and use of plastic bags in the national territory			

Area of Waste Management	Laws and Acts	Regulations and Standards	Economic Instruments	Enforcement
	- Decree N° 2015-930 on Classification and environmentally sound management of waste electrical and electronic equipment in Madagascar			
Segregation of Waste (at source)				
Primary Storage & Collection				
Transportation & Transfer Stations				
Treatment				
Landfills				
Incinerators				

Area of Waste Management	Laws and Acts	Regulations and Standards	Economic Instruments	Enforcement
Recycling				
Resource Recovery				
(Healthcare Waste)				

3.1.4 Institutions in place

Table 7: Institutions involved in solid waste management; reproduced from (UNEP, 2009)

Type of Service	Regulator	Service Provider			
		National Government	Local Government	Private Sector	Informal
Municipal Solid Waste Management					
1. Collection			Municipality	RF2	
2. Transportation			Municipality		
3. Treatment					
4. Disposal			Municipality		
5. Recycling / Resource Recovery					

Type of Service	Regulator	Service Provider			
		National Government	Local Government	Private Sector	Informal
(Healthcare Waste Management)			*CSB II*		

3.1.5 Technologies in use

Table 8: Technologies available for solid waste management; taken and modified from (UNEP, 2009)

Type of Service	Technology				
	Type	**Quantity**	**Year of Purchase / Years in Operation**	**Condition (old, new, well maintained, overused, worn, out of operation)**	**Important Features**
Municipal Solid Waste Management					
1. Collection/2. Transportation	Wheelbarrows	9	2021	Out of operation	
	Carts RF2		2020	Overused	
	Truck	1	2021	Well maintained	
3. Treatment					
4. Disposal					
5. Recycling / Resource Recovery					

3.1.5.1 Waste collection rate

Table 9: Waste collection rate as determined by quantity and load capacity of entire waste collection fleet

Waste Collection Register					
Collection vehicle type and its load capacity	**Average waste density of waste type (e.g., MSW)**	**Calculated mass of waste delivered per truck load**	**Average number of trips to disposal site per vehicle per day**	**Number of active collection vehicles of this type per day**	**Total waste collected (tonnes/day)**
(m^3)	(kg/m^3)	(kg/vehicle load)	(No.)	(No.)	(tonnes/day)
Truck (5.0 m^3)	300 kg/m^3	1,5 kg/load = 1.5 tonnes/load	3	1	**4.5 tonnes/day**
			Total Waste Collected per Day		**4.5 tonnes/day**

3.1.5.2 Percentage of the population serviced

Table 10: Percentage of the population served by waste collection services, according to surveys or other data

Waste Collection Coverage Rate	
Total number of households that participated in survey	30
No. households that participated from impoverished areas	17
No. households that participated from affluent areas	13
Collection rate for impoverished households	20.6%
Collection rate for affluent households	54.4%
No. people living in impoverished areas	44 198
No. people living in affluent areas	36 162
Calculated waste collection coverage rate	**37.5%**

3.1.5.3 Waste recycling, recovery, and organic waste valorization rate

Table 11: Waste valorization rate of ANTEHIROKA

[2022] Waste Recycling, Recovery, and Organic Waste Valorization Rate		
Recovery activity description	**Quantity of waste (tonnes per year)**	**Percentage of total waste generated (%)**
Organic waste converted to compost or applied directly to soil as an organic fertilizer in agriculture	0	0
Combustible waste used as a fuel or for energy generation in an incineration plant (unrecyclable paper and plastics, rubber, wood, textiles, etc.)	0	0
Waste materials separated for recycling purposes (metals, plastics, paper)	0	0
Waste materials recovered for direct reuse or repurposing (e.g., plastic bottles)	0	0
	Total Percent Waste Valorized	**0**

3.1.6 Costs and financing of the WMS

3.1.6.1 Total costs

Operating costs

Labor costs

Table 12: Register of total labor costs, based on all workers formally and informally employed by the WMS

Waste Management Stage	**Job Title/ Description**	**Number of Workers**	**Employer/ Employed by**	**Primary Source of Payments**	**Annual Salary + Other Costs per Worker**	**Annual total**
Waste Collection/ Waste transportation	Collection truck driver	3	Municipality	Municipal budget	2 374 800	**7 124 400**
	Collection truck loader	4	Municipality	Municipal budget	2 374 800	**7 322 300**
	Street sweepers	18	Municipality	Municipal budget	2 374 800	**42 746 400**
	Technical Service	2	Municipality	Municipal budget	2 374 800	**4 749 600**
Waste Treatment						
Recycling / Resource Recovery						
Waste Disposal	Disposal site manager	2	Municipal waste authority	Municipal budget	2 374 800	**4 749 600**
	Engine driver	1	Municipal waste authority		400 000	**400 000**

Waste Management Stage	Job Title/ Description	Number of Workers	Employer/ Employed by	Primary Source of Payments	Annual Salary + Other Costs per Worker	Annual total
Informal Solid Waste Management***						
					Total Labor Costs per Year	**69 269 200**

Energy costs

Table 13: Register of total energy costs, based on all of the vehicles, equipment, and facilities in operation in the WMS

Type of Service	Fuel/Energy-consuming vehicle, equipment, or facility	Quantity (No.)	Fuel/Energy consumption rate (liters/hr; kWh)	Hours per year in operation (hrs/yr)	Total fuel/energy consumed per year (liters or kWh)	Average fuel price of the last 12 months (Ariary/liter)	Annual total (Ariary/yr)
Municipal Solid Waste Management							
1. Collection and 2. transportation	Truck 5 m3	1	3,6 liters/hr	2 160 hours/year	7,776 liters of petrol/year	4 900 per liter petrol	**38 102 400**
2. Transportation							
3. Treatment							
4. Disposal	Engine for management	1	16 liters/hr	60hours/year	960 liters or petrol/year	4 900per liter petrol	**4 704 000**

Type of Service	Fuel/Energy-consuming vehicle, equipment, or facility	Quantity	Fuel/Energy consumption rate	Hours per year in operation	Total fuel/energy consumed per year	Average fuel price of the last 12 months	Annual total
		(No.)	(liters/hr; kWh)	(hrs/yr)	(liters or kWh)	(Ariary/liter)	(Ariary/yr)
5. Recycling / Resource Recovery							
					Total Energy Costs per Year		**42 806 400**

Maintenance costs

Table 14: Register of total maintenance costs, based on all of the technologies and equipment in use in the WMS

Type of Service	Type of technology, vehicle, or equipment	Quantity	Years in operation	Condition	Original cost / Price at time of purchase	Estimated maintenance cost percentage	Annual total
		(No.)	(No.)	(old, new, overused, out of operation)	(Ariary)	(~5-10%)	(Ariary/year)
Municipal Solid Waste Management							
1. Collection/2. Transportation	Truck	1	2 years	relatively new; good condition	130 340 000	10	**13 034 000**
3. Treatment							
4. Disposal							
5. Recycling / Resource Recovery							
					Total Maintenance Costs per Year		**13 034 000**

Financial Costs

Depreciation

Table 15: Register of total depreciation costs, based on all financial assets included in the WMS

Area of waste management	**Type of financial asset**	**Quantity**	**Original price of asset**	**Typical economic life**	**Inflation rate**	**Annual total**
		(No.)	**(Ariary)**	**(No. years)**	**(%)**	**(Ariary/year)**
Municipal Solid Waste Management						
1. Collection /2. Transportation	Truck	1	130 340 000	7 years	<N/A>	**18 620 000**
3. Treatment						
4. Disposal						
5. Recycling / Resource Recovery						
				Total Depreciation Costs per Year		***31 654 000***

Interest rates

Table 16: Register of total financial costs associated with borrowing money for larger purchases in the WMS

Purpose of loan (for purchase of which asset/s)	**Amount of money borrowed ("P" = principal in Ariary)**	**Interest rate on loan ("r" in %)**	**Duration of loan ("n" in years)**	**Annual payment (A) due to lender (annual financial cost of the loan) (Ariary/year)**
				(*)
		Total Financial Costs of Loans per Year		***0***

(*) There was no loan made by the municipality for the acquisition of large equipment like the truck because it is a gift.

TOTAL COSTS PER YEAR: 169 932 743 Ariary/year

3.1.6.2 Total available funding

Table 17: Financing methods used to fund the solid waste management system; reproduced from (UNEP, 2009)

Type of Service	Organization	Financing Mode		
		Direct Revenue	Local or Natl. Govt. / Intl. Cooperation	Private Sector
Municipal Solid Waste Management				
1. Collection /2. Transportation	Municipality/ Household waste fees (ROM)	**17 000 000**		
3. Treatment				
4. Disposal				
5. Recycling / Resource Recovery				

TOTAL AVAILABLE FUNDING PER YEAR:	**17 000 000 Ariary/year**

3.1.6.3 Total cost per ton of waste managed

Table 18: Total cost per tonne of waste managed

Total costs for WM services	(Ariary/year)	169 932 743 */year*
Total waste collected annually (MSW/day) x (365 days)	(tonnes/year)	*1 642.5 tonnes MSW/year*
Total cost per tonne MSW managed	(Ariary/tonne)	103 459 Ariary***/tonne MSW***

3.1.6.4 Financial summary

Table 19: Financial summary based on all salient economic factors involved in waste management in the municipality

Financial Summary for ANTEHIROKA		
TOTAL AVAILABLE FUNDING	(ARIARY/year)	**17 000 000 Ariary/year**
TOTAL COSTS PER YEAR	(ARIARY/year)	**169 932 743 Ariary/year**
FINANCIAL BOTTOM LINE (Funds minus Costs)	(ARIARY/year)	**-152 932 743 Ariary/year**
ECONOMICALLY SUSTAINABLE (YES or NO)	(YES or NO)	**NO**
COST RECOVERY PERCENTAGE (Funds divided by Costs)	(%)	**0.10 → 10%**
COST PER CAPITA	(ARIARY/person)	**2115**
COST PER TONNE OF WASTE MANAGED	(ARIARY/tonne MSW)	**103 459Ariary /tonne MSW**

3.1.7 Stakeholder participation

Table 20: Stakeholder participation in solid waste management; reproduced from (UNEP, 2009)

Type of Service	Major Stakeholders	Level of Stakeholder Participation	Measures to Improve Stakeholder Participation
Municipal Solid Waste Management	Municipality	Extensive: collection, transportation, landfilling; Direct collection by the municipality (high charge) compared to the resources (financial, personal, material resources)	- Increase of resources
	RF2	Limited to pre-collection: low coverage rate - Routing to municipal bins - Materials and equipment (maintenance and renewal)	- Increase of the coverage rate - Renewal of materials

3.2 Future projections

3.2.1 Projected municipal solid waste quantity

Current Population:	**80 360**
Population Growth Rate:	**2 %**
Duration of SWM plan:	**5 years**
Current per Capita Waste Generation Rate:	**0.15 kg/pers/day**

Projected Population:	**88 396**
Projected per Capita Waste Generation Rate:	**0.3/pers/day**
Projected Total Waste Generation Rate:	**26.5 tonnes/days**

3.2.2 Projected municipal solid waste composition

Current Gross National Income per Capita: **521 USD/pers**
Current Income Category: **low**
Municipal GNI per Capita Growth Rate: **2 %**
Duration of SWM plan: **5 years**

Projected Gross National Income per Capita: **573 USD/pers**
Projected Income Category (if different): **low**
Projected Waste Composition (if new income)[1]:

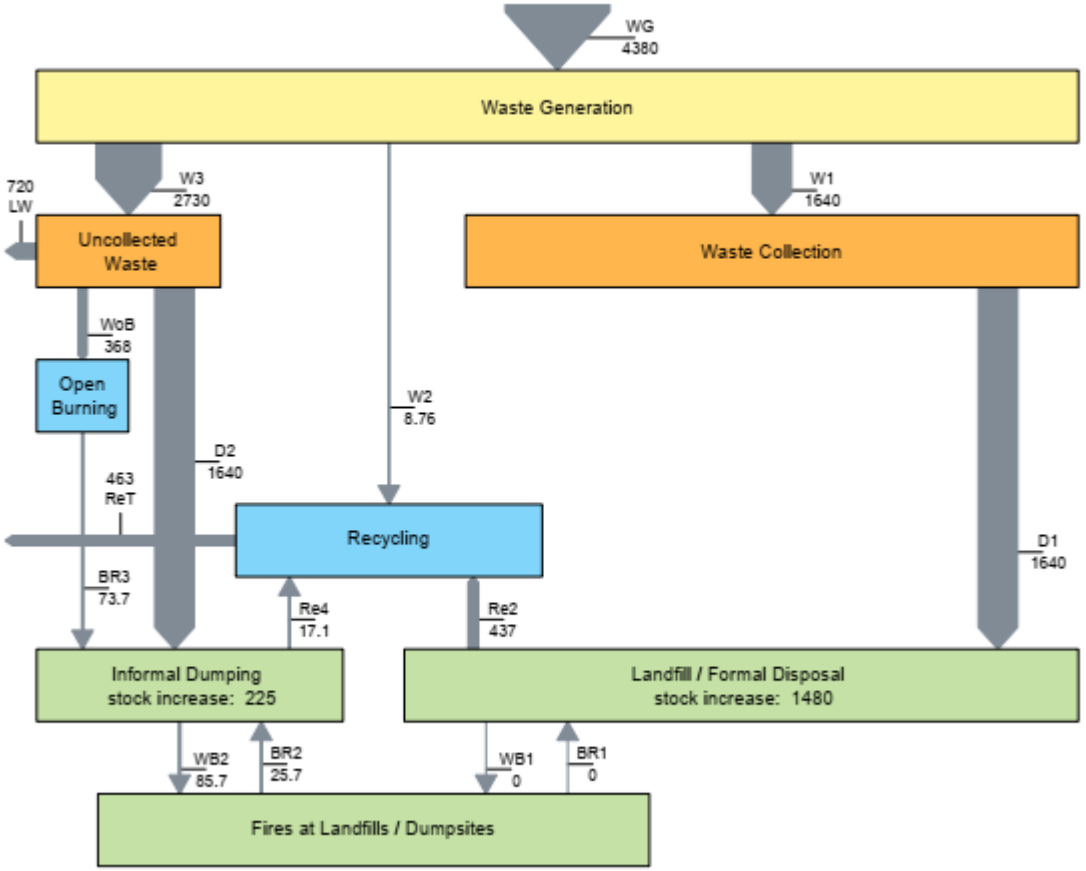
As there is no change in category for the country after projection, the composition of the waste is considered the same

Other	7,5%
Waste Material	**Average Percent in Waste**
Organic	64,06%
Paper & Cardboard	7,55%
Plastics	13,80%
Metals	0,52%
Glass	2,60%
Rubber, Leather, and Synthetics	0%
Textiles	4,69%
Wood	1,04%
Inert Material	1,30%
Other	4,41%

[1]Take values from Box 13 in the SWMP toolkit under Section 3.4.2 in the absence of more precise projection values.

3.3 Deficit analysis

3.3.1 Material flow analysis diagram of municipal waste management system



3.3.2 Waste management system deficiencies based on material flow analysis and other data collection

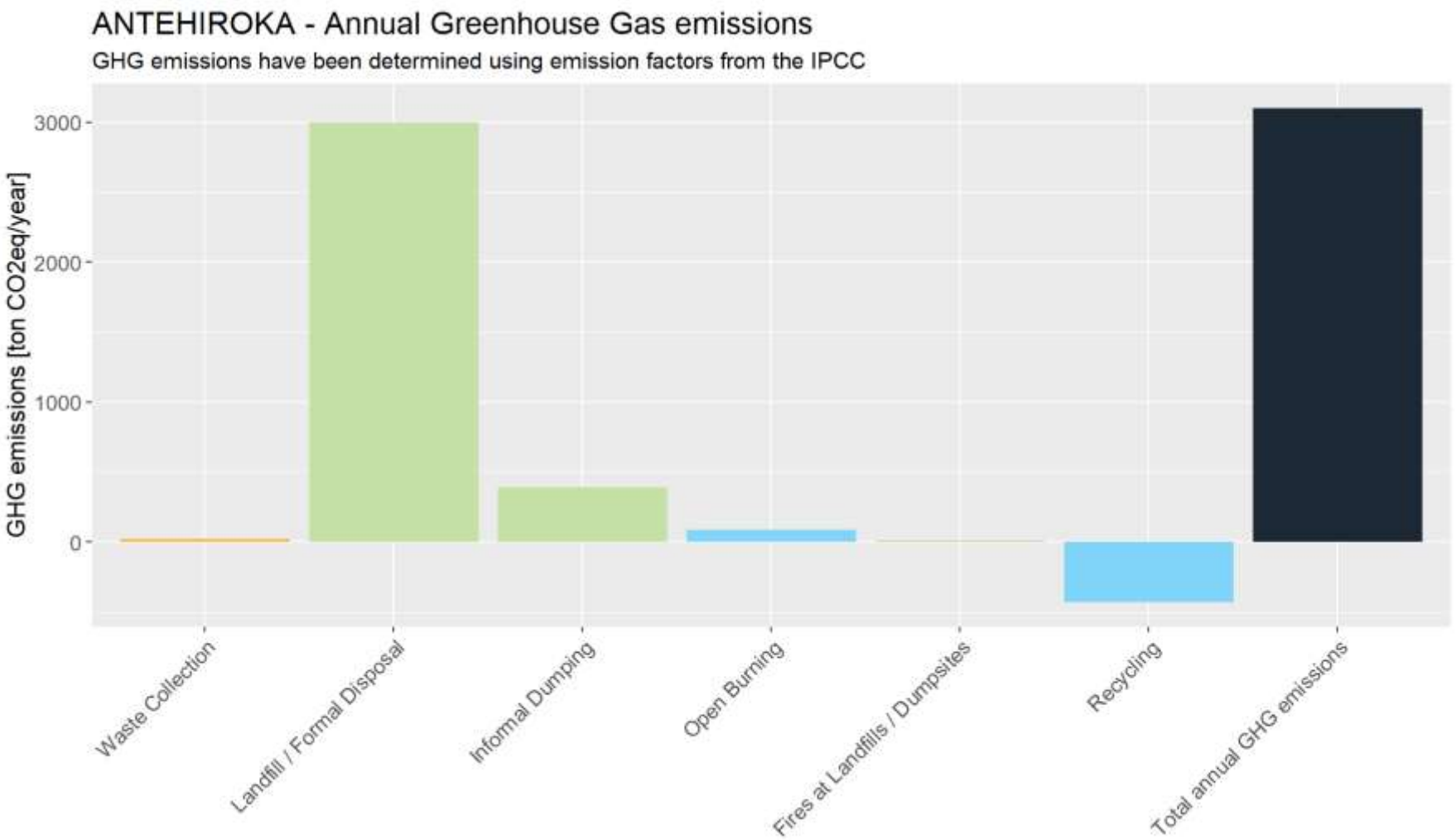
- Data on uncollected waste were estimated but are not based on household studies or surveys:
  - % of waste sent by households to informal dumping;
  - % of waste sent to water;
  - % of waste burned
  - % of waste to recycling process

- Except for waste fees, there is no other revenue for waste management.
- % of fires at landfill and dumpsite are estimates but not based on study/survey

3.3.3 Emissions estimates based on waste composition and quantities

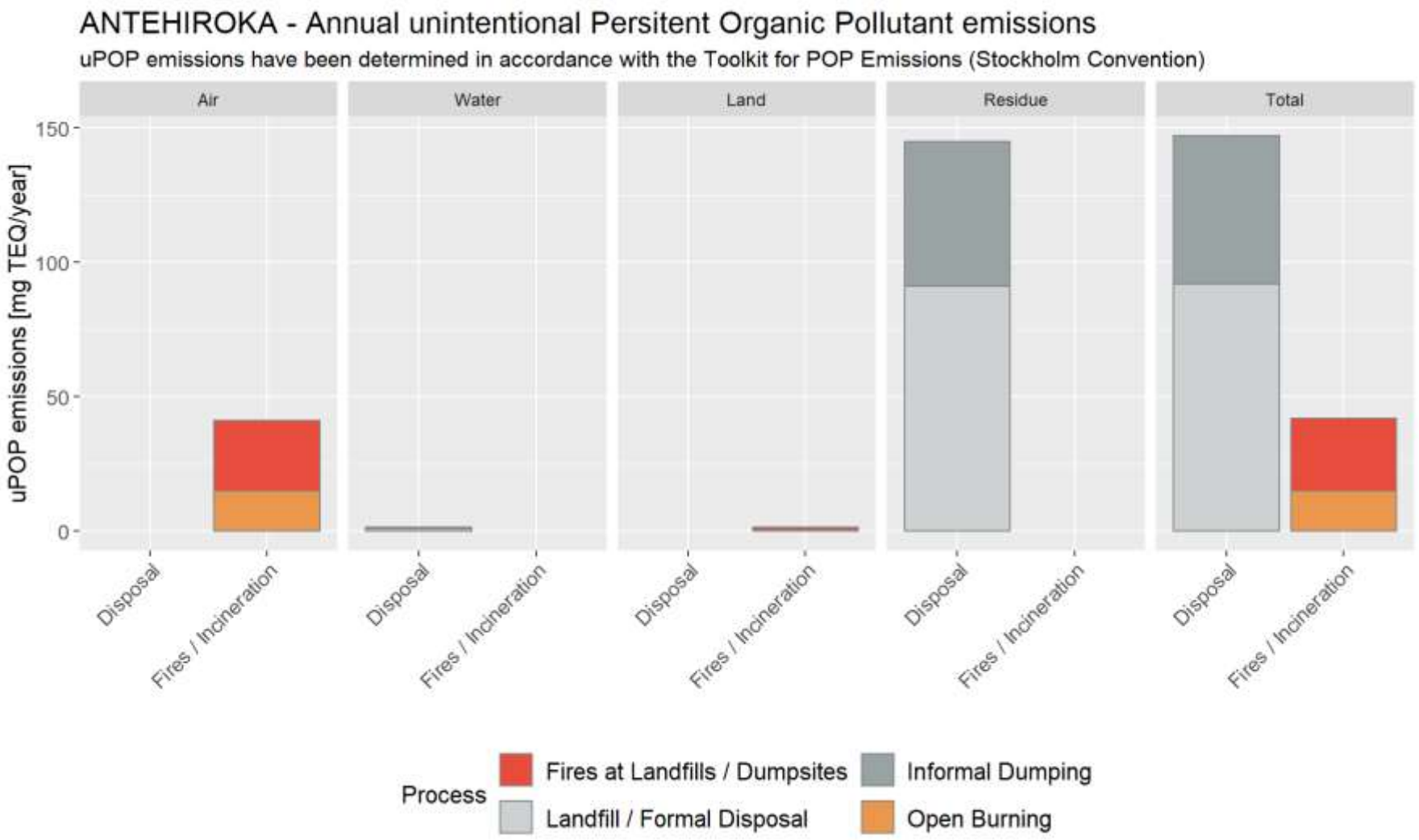
3.3.3.1 Greenhouse gas emissions

PROCESS	EMISSION (Tonnes CO2 eq/Year
Waste Collection	100
Landfill / Formal Disposal	8600
Informal Dumping	340
Open Burning	73
Fires at Landfills / Dumpsites	9.2
Recycling	-1300
Composting	0
TOTAL	7800


ANTEHIROKA - Annual Greenhouse Gas emissions
GHG emissions have been determined using emission factors from the IPCC
GHG emissions [ton CO2eq/year]
3000
2000
1000
0
Waste Collection
Landfill / Formal Disposal
Informal Dumping
Open Burning
Fires at Landfills / Dumpsites
Recycling
Total annual GHG emissions

3.3.3.2 Unintentional persistent organic pollutants (uPOPs) emissions

PROCESS	EMISSION (microGTEQ/year)
Landfill / Formal Disposal	260
Informal Dumping	47
Open Burning	13
Fires at Landfills / Dumpsites	24
Composting	0
TOTAL	344


ANTEHIROKA - Annual unintentional Persitent Organic Pollutant emissions
uPOP emissions have been determined in accordance with the Toolkit for POP Emissions (Stockholm Convention)
Air
Water
Land
Residue
Total
uPOP emissions [mg TEQ/year]
150
100
50
0
Disposal
Fires / Incineration
Process
Fires at Landfills / Dumpsites
Informal Dumping
Landfill / Formal Disposal
Open Burning

3.4 Status report

Table 21: Benchmark indicators in ANTEHIROKA; reproduced from (Wilson, et al., 2012)

Overall Status Report of [insert municipality name]					
	Analytical criteria	*No.*	*Indicator*	*Unit*	*Value or Description*
Drivers for solid waste management	Public Health	1	Percentage collection coverage	(%)	**37.5**
	Environmental control	2A	Percentage controlled treatment or disposal	(%)	**0**
	Environmental control	2B	Quantity of uPOPs emitted from open burning	(µg TEQ/year)	**377.68**
	Environmental control	2C	Quantity of greenhouse gas emissions from WMS	(tonnesss CO_2-eq/year)	**3100**
	Resource management	3	Percentage materials recycled or recovered (valorized)	(%)	**0**
Governance strategies	User inclusivity	4A	Degree of user-inclusivity (HIGH – MEDIUM/HIGH – MEDIUM – LOW)	Qualitative	**LOW**
	Provider inclusivity	4B	Degree of provider-inclusivity (HIGH – MEDIUM/HIGH – MEDIUM – LOW)	Qualitative	**LOW**
	Financial sustainability	5A	Population using and paying for collection as percentage of total population	(%)	**37**
	Financial sustainability	5B	Overall cost recovery percentage	(%)	**10**

4 PLANNING PHASE

4.1 Setting objectives and targets

Table 22: Complete list of objectives and targets with their descriptions for the SWMP

Objective	Target and its quantifiable value to be reached (if applicable)	Target Inputs (necessary resources)	Target Outputs (expected results)	Responsible Party and/or Stakeholder	Milestones and applicable Deadlines	Priority (High, Medium, or Low)
Increase the investment spent on waste management	Find other financial resources for waste management	• Connection • Means of transport	• Partnership contract established	-Municipality : mayor ; municipal council -Financial service - Technical service	1st et 2nd year of the Plan	High
Increase of waste collection rate	Increase the collection to 75%	• Garbage bins • Rolling equipment: - Maintenance of existing equipment - Acquisition of new equipment • Staffing • Financial resources	• Satisfying of all Fokontany served • Well-maintained equipment • Number of operational/available materials increases • Fund available for waste collection increases	Municipality : - Technical service	5th year	High
	A site RCC implemented	• Material equipment for RF2: Charettes, wheelbarrows • Sorting bins for households • Facility • Human resources:	• RCC built and operational	Municipality : - Technical Service - Fokontany - RF2	2nd semester of the 1st year	Medium

Objective	Target and its quantifiable value to be reached (if applicable)	Target Inputs (necessary resources)	Target Outputs (expected results)	Responsible Party and/or Stakeholder	Milestones and applicable Deadlines	Priority (High, Medium, or Low)
		- Municipal employees - RF2 • Financial resources • Communication				
Put in place recycling and recovery process in the waste management	Composting: 20% of collected waste composted	• Facility: Platform of composting • Human resources: -Municipal employees • Financial resources • Communication	• Composting site built and operational	Municipality: Technical service Parteners Farmers' Association Waste pickers	2nd year	Medium

4.2 Stakeholder feedback on targets and objectives

Table 23: Results of stakeholder consultation target feasibility questionnaire

Target Number with Brief Description	Stakeholders Associated with the Target	Average/Most Relevant Response to Question 1	Average/Most Relevant Response to Question 2	Average/Most Relevant Response to Question 3	Average/Most Relevant Response to Question 4

As mentioned in the pre-planning phase, consultation with waste management stakeholders will take place after the preparation phase by a restricted team. The stakeholder feedback table will be completed at this stage.

4.3 Scenario creation

4.3.1 Description of scenarios

Scenario 01

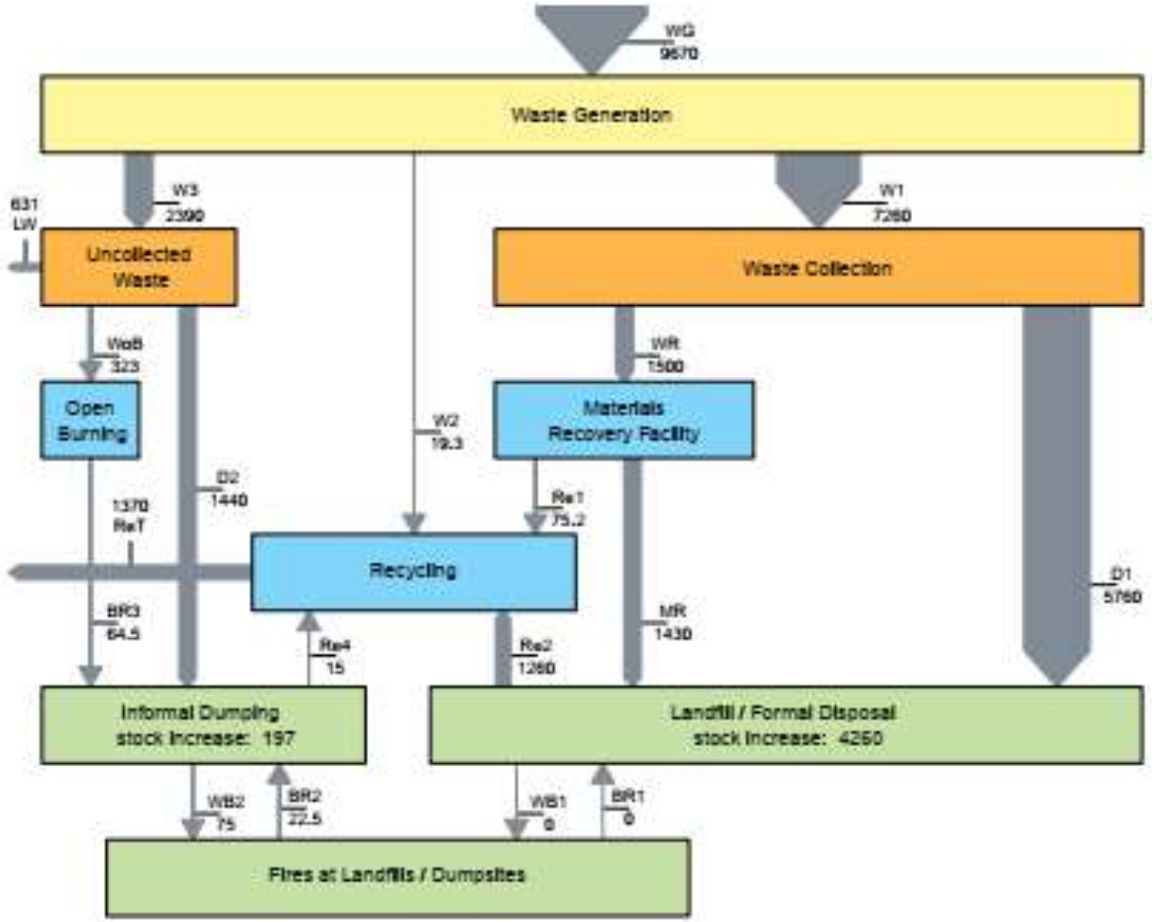
- Increase in current collection rate to 75%
- RCC implementation
- 20% of waste collected (paper, plastic, glass, metals) treated at RCC level

Scenario 02

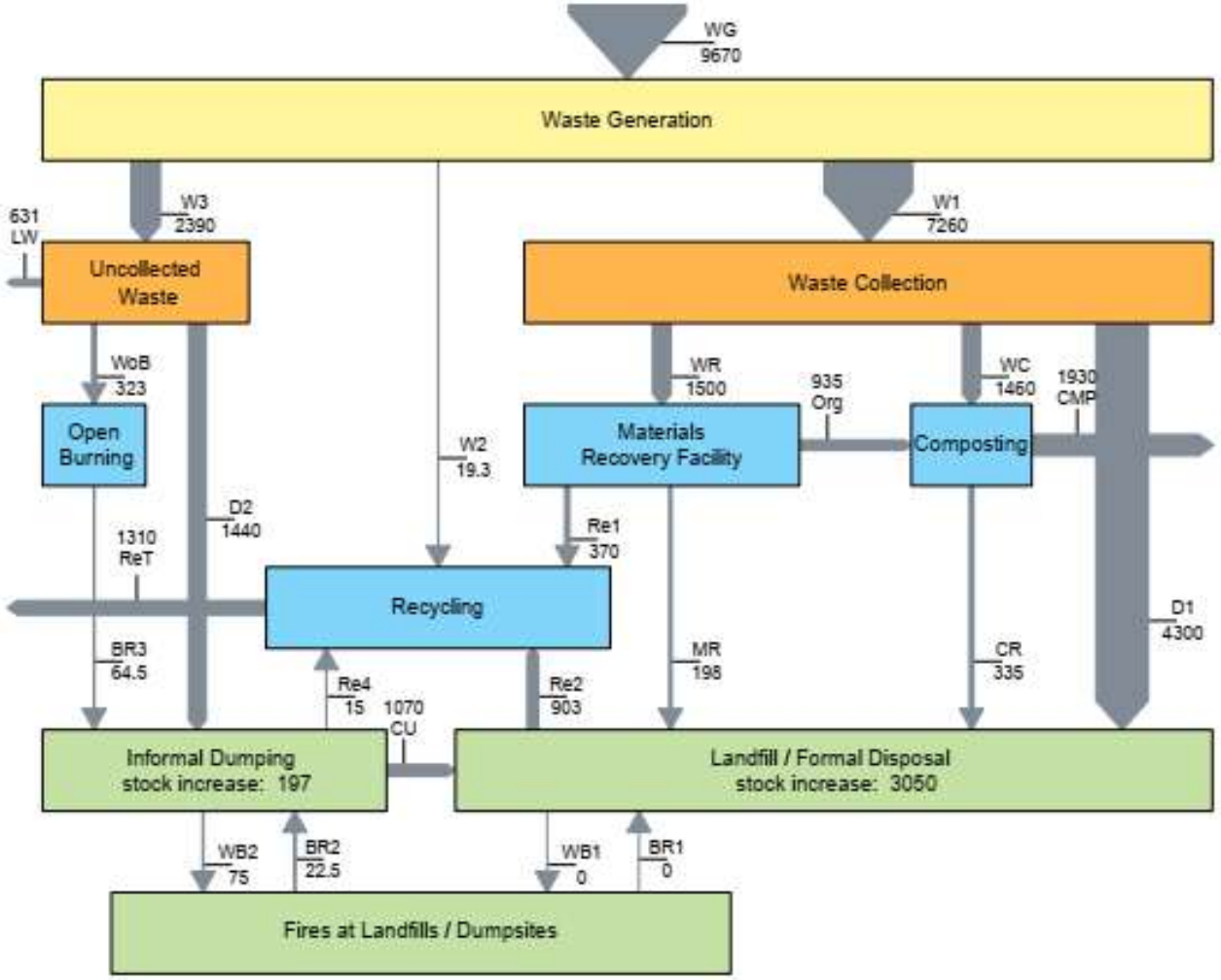
- Increase in current collection rate to 75%
- RCC implementation
- 20% of waste collected (paper, plastic, glass, metals) treated at RCC level
- 20% of compostable waste will be treated on site

4.3.2 MFA diagrams for each scenario

SCENARIO 1



SCENARIO 2


WG
9670
Waste Generation
W3
2390
631
LW
Uncollected
Waste
W1
7260
Waste Collection
WoB
323
Open
Burning
W2
19.3
WR
1500
935
Org
Materials
Recovery Facility
WC
1460
1930
CMP
Composting
D2
1440
1310
ReT
Re1
370
Recycling
D1
4300
BR3
64.5
MR
198
CR
335
Re4
15
1070
CU
Re2
903
Informal Dumping
stock increase: 197
Landfill / Formal Disposal
stock increase: 3050
WB2
75
BR2
22.5
WB1
0
BR1
0
Fires at Landfills / Dumpsites

4.3.3 Comparison of scenarios and scenario selection

Create a table for the purpose of comparing the pros and cons of each scenario alongside one another. Things to consider should include: environmental implications, financial burdens, health effects, stakeholder effects, and physical/material effects of each scenario. Choose a scenario for implementation using this comparative table for final consideration.

Comparative table for the two scenarios					
	Analytical criteria	*Indicator*	*Unit*	*Value or Description*	
				Scenario 1	***Scenario 2***
	Public Health	Percentage collection coverage	(%)	75	75
	Environmental control	Percentage controlled treatment or disposal	(%)	20	20
	Environmental control	Quantity of uPOPs emitted from all process	(µg TEQ/year)	344	308
	Environmental control	Quantity of greenhouse gas emissions from WMS	(tonnes CO_2-eq/year)	7800	6000
	Resource management	Quantity of materials recycled or recovered (valorized)	Tons/year	1500	2960
	Financial sustainability	Population using and paying for collection as percentage of total population	(%)	75%	75%

SCENARIO SELECTED FOR IMPLEMENTATION: ***scenario 2***

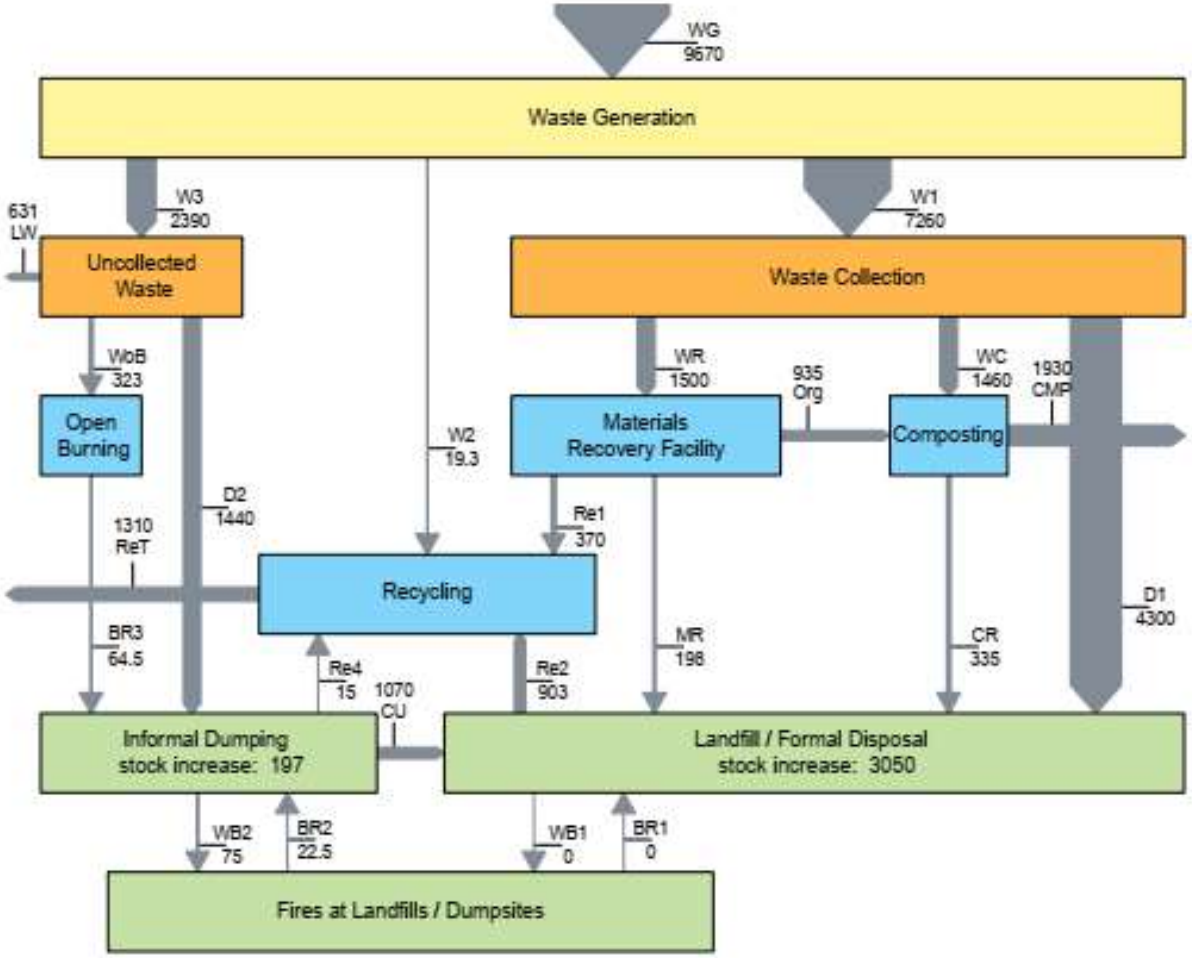
4.4 Action plan

Action Plan for Period: **2023 - 2028**						
Waste Type	**Objective**	**Target Number with Brief Description**	**Responsible Party and/or Stakeholder**	**Actions to be Taken**		
				Short-term (2023)	**Mid-term (2024-2026)**	**Long-term (2027-2028)**
Municipal Solid Waste	1.Increase the investment spent on waste management	1.1. Find other financial resources for waste management	-Mayor - Municipality council -Financial service - Technical service	1.1.1. Contact and negotiation with public and private partners 1.1.2. Presentation of the Waste Management Plan 1.1.3. Organization of site visits	1.1.4. Establishment of a partnership agreement	
	2.Increase of waste collection rate	2.1.Increase the collection to 75% *the collection rate of 37.5% should be improved*	Municipality : - Technical service	2.1.1 Periodic maintenance and commissioning of existing equipment 2.1.2. Improvement of the collection program (pre-collection...) 2.1.3. Raising the awareness of the population 2.1.4 Strengthening the governance system of the municipality	2.1.5 Periodic maintenance of materials and equipment 2.1.6. Acquisition of new materials 2.1.7. Improvement of the collection program (pre-collection...)	2.1.8 Periodic maintenance of materials and equipment 2.1.9. Improvement of the collection program (pre-collection)

Action Plan for Period: **2023 - 2028**						
Waste Type	**Objective**	**Target Number with Brief Description**	**Responsible Party and/or Stakeholder**	**Actions to be Taken**		
				Short-term (2023)	**Mid-term (2024-2026)**	**Long-term (2027-2028)**
	3.Put in place recycling and recovery process in the waste management	3.1. 20% of collected waste is composted	• Municipality: Technical service • Farmers' Association • Garbage pickers • Company	3.1.1. Set up a composting platform 3.1.2. Setting up the waste system	3.1.1. Set up a composting platform 3.1.3. Recruitment of agents 3.1.4. Training of agents 3.1.5. Start-up of the site 3.1.6. Sensitization of the community (farmers, users)	3.1.7. Setting up an agricultural demonstration for the local farmers 3.1.8 Compost Production and Sales
		3.2 RCC *To recover recoverable materials and reduce emissions, the installation of a RCC is planned*	• Municipality: Technical service • RF2 • Garbage pickers • Company	3.2.1. Setting up a RCC platform 3.2.2. Setting up the waste system at the pre-collection level (bin, sorting...) 3.2.3. Recruitment of agents RF2 3.2.4. Training of agents 3.2.5. Identification and setting up of pilot sites 3.2.6. Start-up of the site 3.2.7. Community awareness (generators, buyers/sellers)	3.2.9. Operationalization of the RCC 3.2.10. Awareness campaign 3.2.11. Extension of pilot sites	3.2.9. Operationalizing the RCC

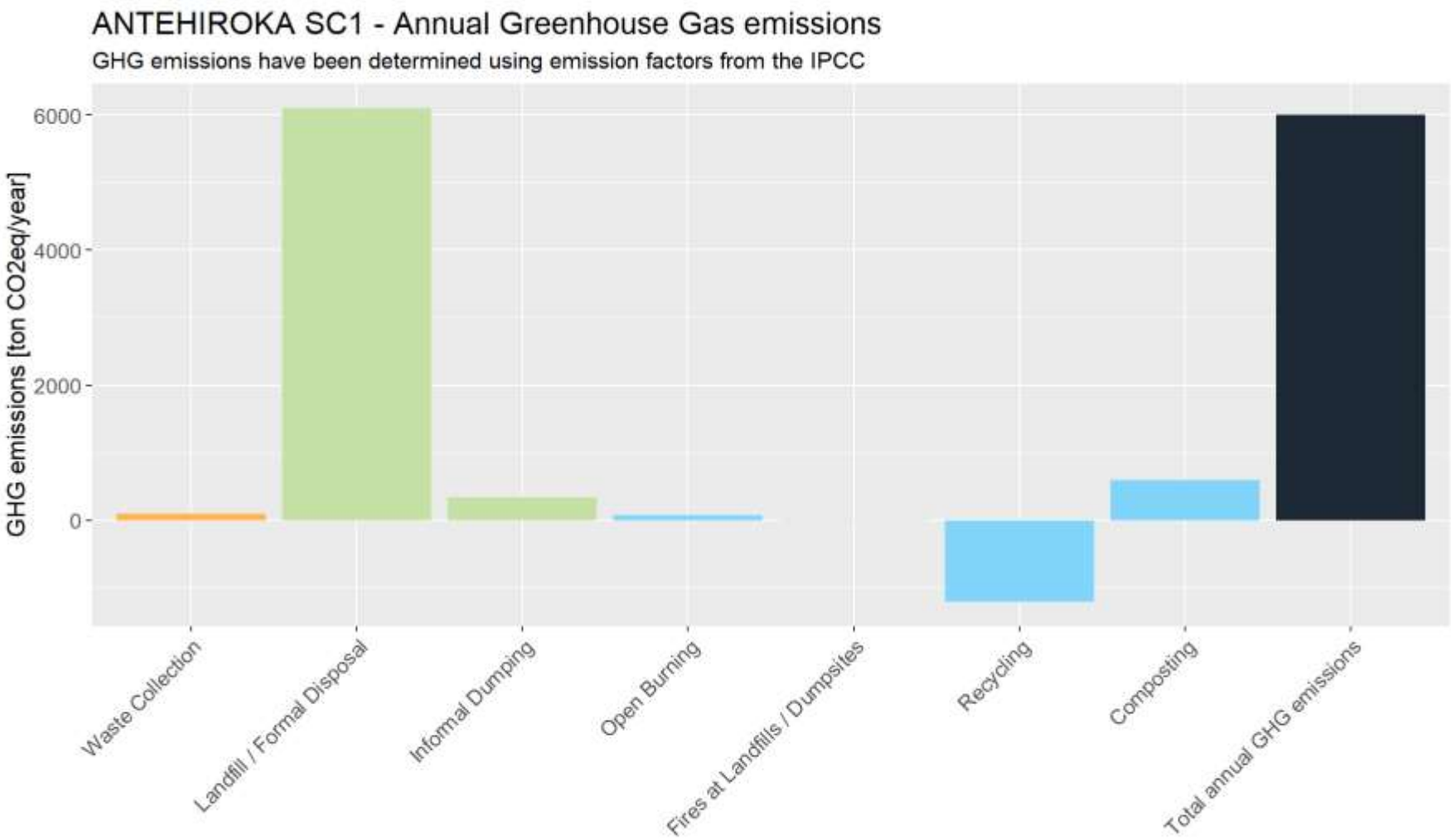
Action Plan for Period: **2023 - 2028**						
Waste Type	**Objective**	**Target Number with Brief Description**	**Responsible Party and/or Stakeholder**	**Actions to be Taken**		
				Short-term (2023)	**Mid-term (2024-2026)**	**Long-term (2027-2028)**
				3.2.8. Contact and contracting with recyclers		

4.4.1 Predicted MFA diagram based on WMS improvements

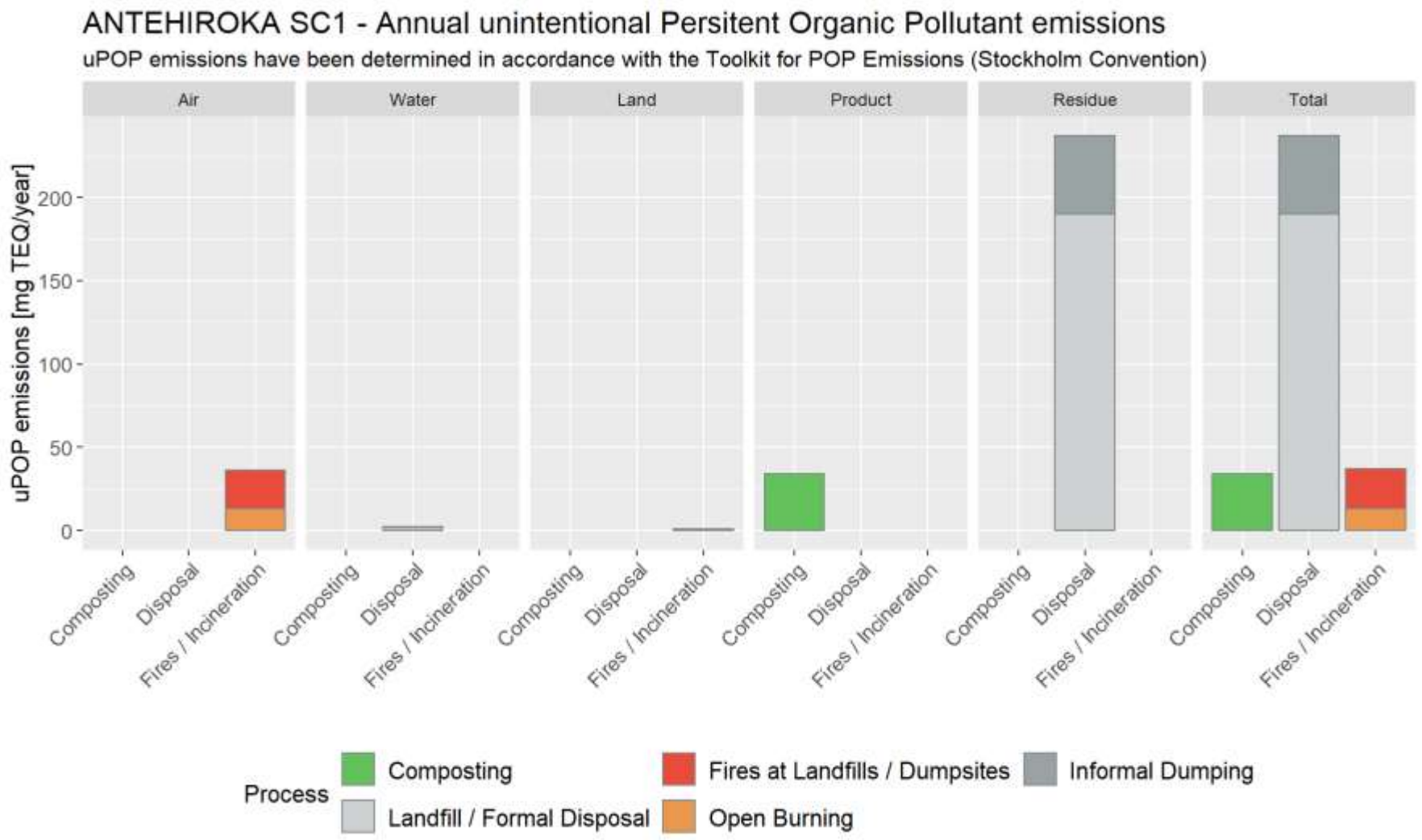


4.4.2 Expected reduction of uPOP and GHG emissions based on WMS improvements

PROCESS	EMISSION (Tonnes CO2 eq/Year
Waste Collection	100
Landfill / Formal Disposal	6100
Informal Dumping	340
Open Burning	73
Fires at Landfills / Dumpsites	9.2
Recycling	-1200
Composting	590
TOTAL	6000


ANTEHIROKA SC1 - Annual Greenhouse Gas emissions
GHG emissions have been determined using emission factors from the IPCC
GHG emissions [ton CO2eq/year]
6000
4000
2000
0
Waste Collection
Landfill / Formal Disposal
Informal Dumping
Open Burning
Fires at Landfills / Dumpsites
Recycling
Composting
Total annual GHG emissions

PROCESS	EMISSION (microGTEQ/year)
Landfill / Formal Disposal	190
Informal Dumping	47
Open Burning	13
Fires at Landfills / Dumpsites	24
Composting	34
TOTAL	308


ANTEHIROKA SC1 - Annual unintentional Persitent Organic Pollutant emissions
uPOP emissions have been determined in accordance with the Toolkit for POP Emissions (Stockholm Convention)
Air
Water
Land
Product
Residue
Total
uPOP emissions [mg TEQ/year]
0
50
100
150
200
Composting
Disposal
Fires / Incineration
Process
Composting
Landfill / Formal Disposal
Fires at Landfills / Dumpsites
Open Burning
Informal Dumping

s

5 IMPLEMENTATION

5.1 Implementation program

Table 24: Planned implementation program to ensure effective execution of the plan's actions to be taken

Implementation Program						
Waste Type	**Actions to be taken**	**Costs of actions (Ariary)**	**Economic Instruments to cover costs of each action**	**Relevant Policy and Legal Instruments**	**Relevant Partnerships and Environmental Agreements to be forged**	**Relevant Stakeholder Participation and Public Awareness efforts**
Municipal Solid Waste	**1.Increase the investment spent on waste management**					
	1.1. Find other financial resources for waste management					
	1.1.1. Contact and negotiation with public and private partners	1 000 000	- Own resources of municipality	Letter of request for partnership from the municipality	- Public partners - National and international partners	
	1.1.2. Presentation of the Waste Management Plan	6 000 000	- Own resources of municipality - Donations - Contributions from persons and companies		- Public partners - National and international partners	Inclued
	1.1.3. Organization of site visits	5 000 000	- Own resources of municipality		- Public partners - National and international partners	Inclued

Implementation Program						
Waste Type	**Actions to be taken**	**Costs of actions (Ariary)**	**Economic Instruments to cover costs of each action**	**Relevant Policy and Legal Instruments**	**Relevant Partnerships and Environmental Agreements to be forged**	**Relevant Stakeholder Participation and Public Awareness efforts**
	1.1.4. Establishment of a partnership agreement	5 000 000	Own resources of municipality	Deliberation of the City Council	- Public partners - National and international partners	
	2.Increase of waste collection rate					
	2.1. Increase the collection to 75%					
	2.1.1 Periodic maintenance and commissioning of existing equipment	75 000 000	Own resources of municipality		- Private partners	
	2.1.2. Improvement of the collection program (pre-collection...)	1 000 000	Own resources of municipality		- RF2 - Fokontany - CHS	Inclued
	2.1.3. Raising the awareness of the population	18 000 000	- Partners, - NGO - Donors		- MEDD/ MEAH - Private sector - NGO - Medias - RF2 - Fokontany - CHS	Inclued
	2.1.4. Strengthening the governance system of the municipality	40 000 000	- Partners - NGO - Donors		- Ministries (MEDD, MEAH, MEF, …) - Private sector	

Implementation Program						
Waste Type	**Actions to be taken**	**Costs of actions (Ariary)**	**Economic Instruments to cover costs of each action**	**Relevant Policy and Legal Instruments**	**Relevant Partnerships and Environmental Agreements to be forged**	**Relevant Stakeholder Participation and Public Awareness efforts**
					- Donors - NGO	
	2.1.5. Acquisition of new materials	184 340 000	- Grant from the government, - Donors, - Partners (private, …)	Deliberation of the City Council	- Government - Donors - Private partners	
	3.Put in place recycling and recovery process in the waste management					
	3.1.20% of waste collected composted					
	3.1.1. Setting up a composting platform	140 000 000	- Donors - Technical and financial Partners	Deliberation of the City Council	Investisseur local	
	3.1.2. Setting up the waste system	5 000 000				
	3.1.3. Recrutement des agents	10 000 000				
	3.1.4 Formation des agents		- Donors - Technical and financial Partners		- Ministries - Municipality - Consultants/ Training	
	3.1.5. Sensibilisation de la communauté (paysans, utilisateurs)	10 000 000	- Donors - Technical and financial Partners		- NGO - Medias - …	
	3.1.6. Démarrage du site	40 000 000	- Donors		-Public-private partenership	Inclued

Implementation Program						
Waste Type	**Actions to be taken**	**Costs of actions (Ariary)**	**Economic Instruments to cover costs of each action**	**Relevant Policy and Legal Instruments**	**Relevant Partnerships and Environmental Agreements to be forged**	**Relevant Stakeholder Participation and Public Awareness efforts**
	3.1.7. Production et vente de compost		- Technical and financial Partners		-Farmers	
	3.1.8. Mise en place de vitrine agricole					Inclued
	3.2 **RCC**					
	3.2.1. Setting up a RCC platform	140 000 000	- Donors - Technical and financial Partners	Deliberation of the City Council	- Municipality - Local investor	
	3.2.2. Setting up the waste system at the pre-collection level	10 000 000	- Donors - Technical and financial Partners		-Municipality -Partners -NGO	
	3.2.3 Recruitment of agents RF2	1 000 000	- Donors - Technical and financial Partners		-Municipality -Partners -NGO	
	3.2.4. Training of agents	9 000 000	- Donors - Technical and financial Partners		-Municipality -Partners -NGO	
	3.2.5. Identification and setting up of pilot sites	1 000 000			-Municipality -Partners -Fokontany -RF2	

Implementation Program						
Waste Type	**Actions to be taken**	**Costs of actions (Ariary)**	**Economic Instruments to cover costs of each action**	**Relevant Policy and Legal Instruments**	**Relevant Partnerships and Environmental Agreements to be forged**	**Relevant Stakeholder Participation and Public Awareness efforts**
	3.2.6. Start-up of the site	30 000 000	- Donors - Technical and financial Partners		-Municipality -Parners -Fokontany -RF2	Inclued
	3.2.7. Community awareness (generators, buyers/sellers)	10 000 000			-Municipality -Partners -NGO -Fokontany -RF2	
	3.2.8. Contact and contracting with recyclers	1 000 000			-Municipality -Partners	
	3.2.9Operationalization of the RCC	50 000 000	- Donors - Technical and financial Partners		-Municipality -Partners	
	3.2.10. Awareness campaign	25 000 000			-Municipality -Partners - NGO -Fokontany -RF2	
	3.2.11. Extension of pilot sites	30 000 000	- Donors - Technical and financial Partners	Deliberation of the City Council	-Municipality -Donors	

6 MONITORING AND REVIEW

6.1 Actions to be monitored

Table 25: Actions to be continually monitored as part of the new waste management system

Area of waste management	Actions to be monitored	Responsible party or stakeholder
General	Mobilizing municipal resources	• Financial service • Financial partners • Treasurer of RF2
	Reinforcement/ recruitment of agents for waste management	• Human resorces service/ RF2
	Construction of facilities	• Financial service • Financial partners • Treasurer of RF2
	Acquisition of materials and equipment	
Collection and Transportation		• Financial service • Technical service
	Management of rolling stock and equipment	
	Organization of the collection system	
	Evaluation of the financial impact of the cost of collection/transportation on the municipality's budget	
	Evaluation of fuel quantities and costs	
Recycling and Recovery	Formalization of the activities of informal waste pickers at the sources of waste generation	• Technical service • RF2 • Fokontany
	Collection of revenues generated by informal and formal recycling activities respectively	
	Evaluation of the quantity of each material recycled in a formal or informal way	
Treatment	Monitoring of the increase in the amount of waste treated compared to the waste collected (%)	• Manager of the site

Area of waste management	Actions to be monitored	Responsible party or stakeholder
	Monitoring of the quantities of "outputs" of the treatment processes: - compost produced - separated and sorted recyclables	• RF2 • Technical service
	Collection of revenue from compost sold and/or recycled materials	
	Evaluation of the costs and expenses of operating the RCC	
Disposal	Monitoring of open burning rate reduction at landfill sites	• Technical service
	Reduction of emissions from untreated organic waste going to landfill, as well as from open burning	
	Reducing the amount of waste going to landfills	

6.2 Performance indicators

Frequency at which a performance report will be published and a review of the system will occur: 1 year s

Table 26: Performance indicators for assessing performance outputs of the new WMS based on implementation of the SWMP

Area of waste management	**Performance Indicator (PI)[1]**	**Targets linked to PI**	**Necessary data collection[2]**	**Responsible party for data collection**
General	Production individuelle de déchets.	0,3kg/jour	- Waste characterization (type, quantity..)	Technical service
	Municipal Resource Recovery Rate	50%	- Number of collection agents - % of population aware of the use of the tax dedicated to household waste	Financial service
	Recovery rate of household waste fees	50%		
	Number of complaints received by the Municipality	0	- Number of complaints received by the municipality about the collection of waste in the bins - Number of complaints received about unsanitary conditions in neighbourhoods	Technical service
Collection and Transportation	Waste collectionl rate	75%	- Number of fokontany where the waste management system: pre-collection, composting site, sorting center is in place - % of population adhering to the system (survey)	Technical service
	Increased revenue from the provision of collection services	50%		RF2

[1]Performance indicators have the purpose of quantifying the performance outputs of the overall system. As such, the performance indicators selected to assess the plan will be closely linked to the targets determined to meet plan objectives.
[2]Should be closely related to the actions to be monitored.

Area of waste management	Performance Indicator (PI)[1]	Targets linked to PI	Necessary data collection[2]	Responsible party for data collection
	User and citizen satisfaction rate	75%	- % Satisfied users (survey)	Technical service RF2 Fokontany Hygiene, Social Commitee
	Overall reduction of insalubrity	75%	- Mapping of unhealthy areas in the municipality	
Recycling and Recovery	Increase in annual production of recycled waste	80%	- Amount of recoverable waste processed at the RCC level	Technical service RF2 Fokontany Hygiene, Social Commitee
	Increased revenue from recycled products	60%	- Quantities of recyclable waste sold	
	Annual reduction in the volume of waste going to landfill	30%	- Annual quantity of waste sent to landfill	
	Annual reduction in the amount of untreated waste disposed of	50%		
Treatment	Quantity of waste treated compared to waste collected	20%	- Annual production of the composting site	Service technique RF2 Fokontany Comité d'Hygiène Sociale
	Processing efficiency	90%	- % of compost vs residue	
	Quantity of composts sold compared to produced	70%	- Quality of compost produced - % of farmers using compost (survey))	
	Increased revenue from composts sold	50%	- Revenue from the sale of compost	
Disposal	Annual reduction in open burning and open waste disposal levels	-20%	- Annual amount of waste burned in the open uPOPs emissions	Service technique RF2 Fokontany Comité d'Hygiène Sociale