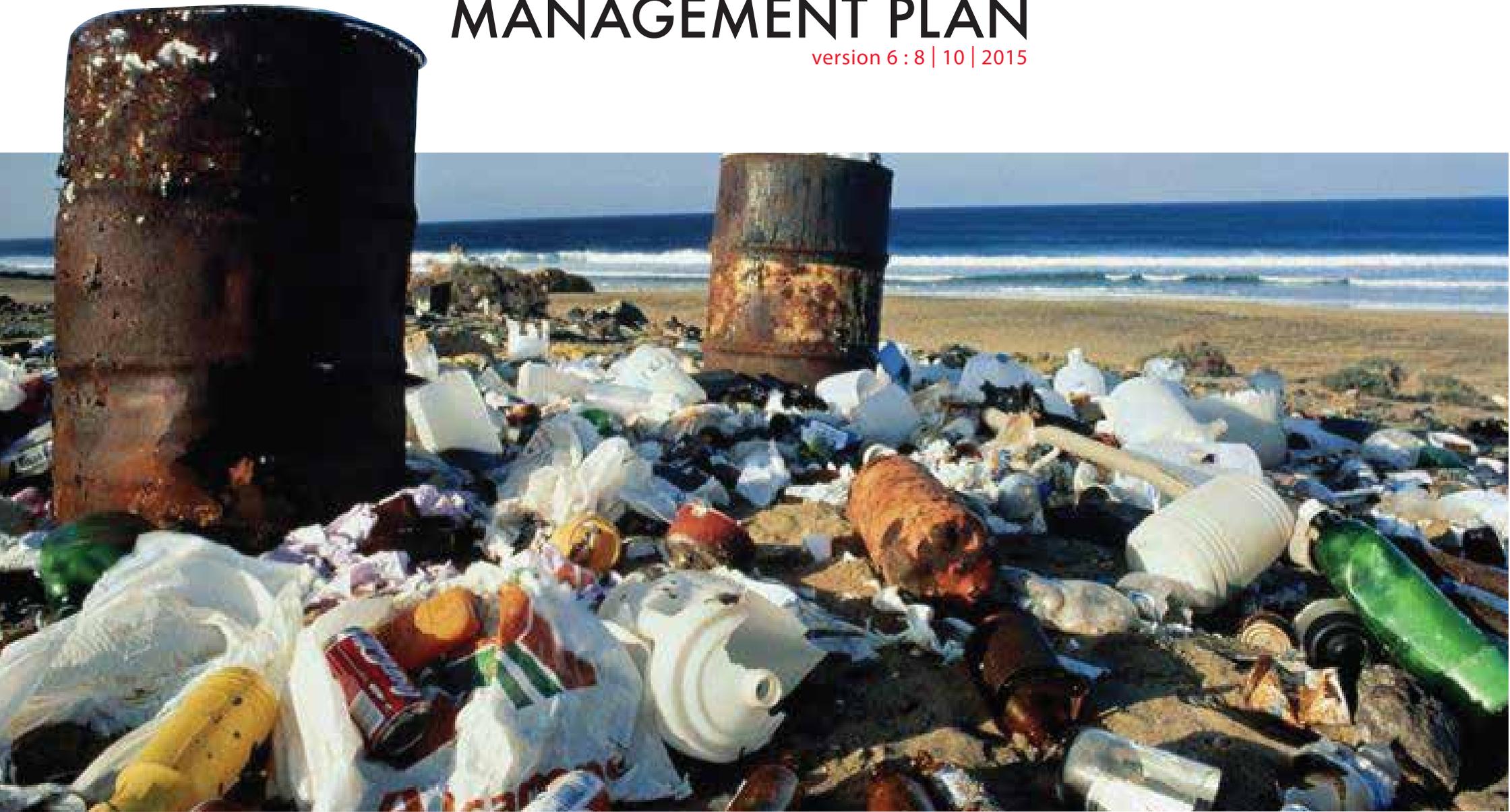


arcenciel.aec

engage in development

MUNICIPAL WASTE MANAGEMENT PLAN

version 6 : 8 | 10 | 2015



Introduction

This guide was developed in an emergency context, in a period of crisis related to solid waste management in Lebanon. This tool is primarily intended for municipalities, mainly concerned with waste management, to give them management tools to face the crisis. It gives an idea about the various components and procedures of waste management, as well as standards, ratios, and costs affiliated with each step. This work is based on the national solid waste management strategy elaborated by arcenciel and under which several pilot projects have already been undertaken, of which the TER-OM project (Sorting and Recycling in the Organizations and Municipalities) undertaken by arcenciel in partnership with the French Development Agency (AFD). This version, designed in a very critical situation, is to be followed by other versions, much more developed.

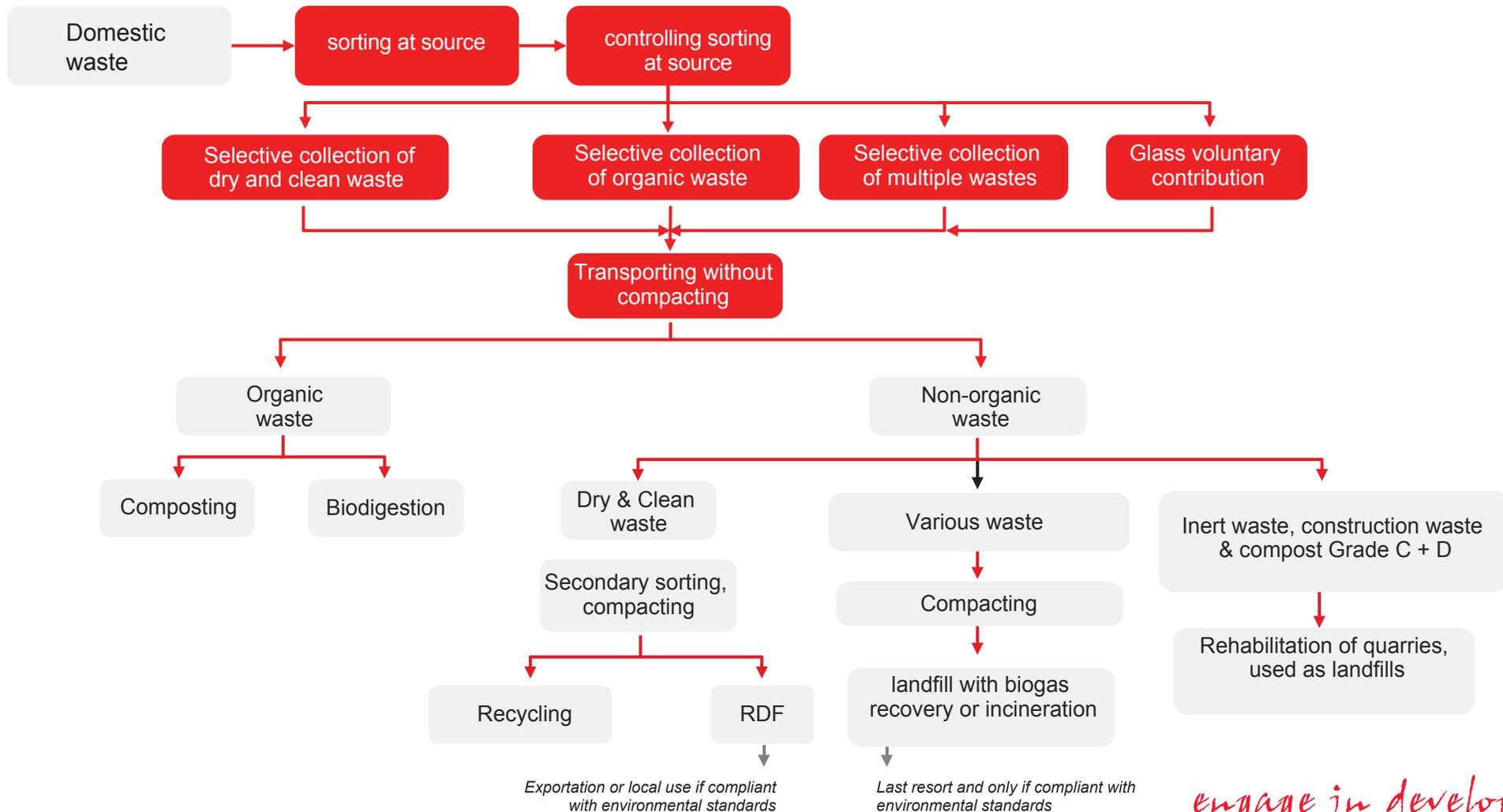
Table of Content

- I. General recommendations
 - a. Waste management
 - b. Waste incineration: a big threat
 - c. Waste composition
 - d. Waste production
- II. The division of roles & responsibilities
 - a. The role of the municipality & its agent
 - b. The role of the service provider
- III. The components of waste management
 - a. Awareness
 - b. Sorting at source
 - c. Collection without compaction
 - d. Secondary sorting of non-organic waste
 - e. Composting
 - f. Landfilling
- IV. Some practical information
 - a. Contacts of actors involved in the waste management chain
 - b. Equipment suppliers
 - c. In emergency situations
- V. The services provided by arcenciel
- VI. Some suggestions at a political level
- VII. Crisis exit plan
- VIII. Some awareness tools

engage in development

I. General recommendations

a. Waste management : This flow chart summarizes the main steps of the waste management process, according to the solution elaborated by arcenciel

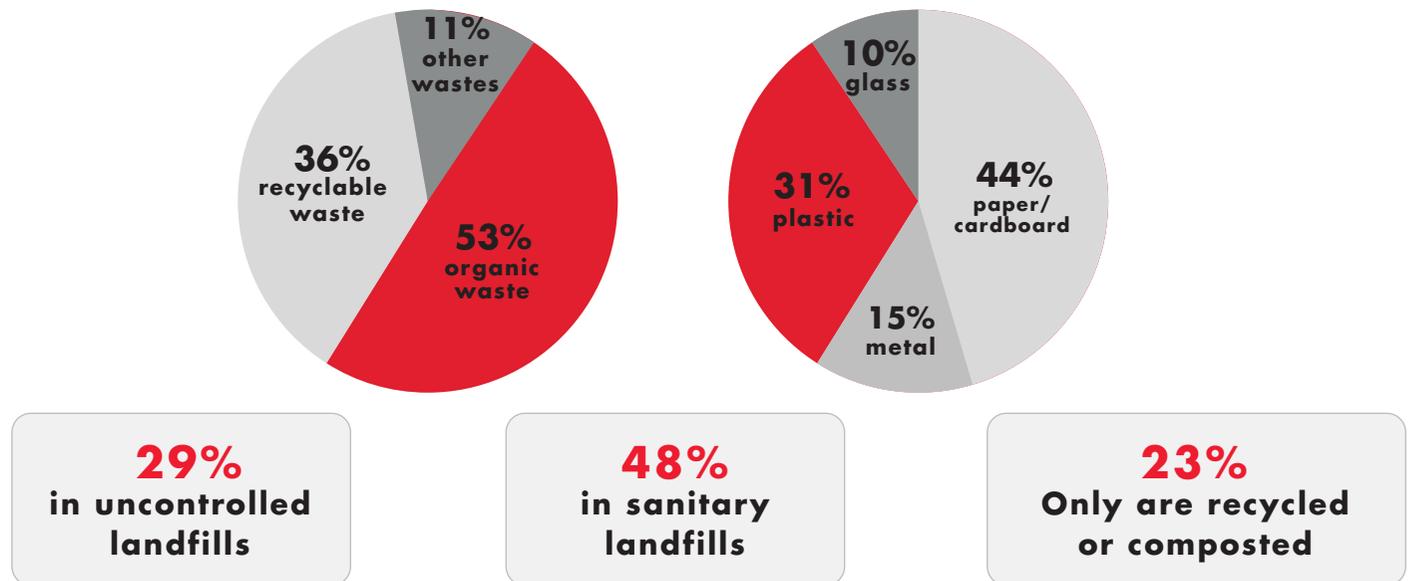


engage in development

b. The waste incineration : a big threat...

- Over 50% of wastes in Lebanon are organic, with a low calorific value. Incineration of this type of waste will consume a lot of energy
- 80% of waste can currently be recovered without incineration
- Incinerators emit hazardous & toxic emissions (NO, NO₂, SO₂, HCl, dioxins...)
- Incineration generates hazardous residues to be buried in special landfills that do not exist in Lebanon
- Even countries with efficient and well controlled incinerators like Austria tax severely the incineration method, encouraging recycling
- The adoption of incineration would result in the extinction of the recycling sector in Lebanon which constitutes a "green" sector important to the economy and that creates jobs opportunities

c. Waste composition



Source: Country report on the solid waste management in Lebanon, Sweepnet, April 2014

80% can currently be recycled, composted or biodigested and exploited, generating economic opportunities while preserving the environment

The current situation is not sustainable

- Limited landfill lifespan
- Limited natural resources
- Important flow of greenhouse gases

engage in development

d. Waste production

Generation Rate per Capita	
Domestic production (weighted average)	1.05 Kg/day/person
Average in urban areas	0.95-1.2 Kg/day/person
Average in rural areas	0.8 Kg/day/person

Source : Country report on the solid waste management in Lebanon, Sweepnet, April 2014

II. The division of roles & responsibilities

a. The role of the municipality & its agent

- Ensure awareness with outsourcing option
- Ensure cleaning the streets with outsourcing option
- Ensure a budget for the sorting bins
- Ensure waste collection
- Gather into service zones or clusters of 10,000 to 100,000 inhabitants, to increase the economic efficiency of the waste management process
- Ensure waste management centers:
 - Secondary sorting unit for dry and clean waste
 - Composting unit for organic waste
 - Landfilling site / rehabilitation of quarries
- Outsource the treatment to an operator and monitor its work

- Assign a municipal officer for monitoring the process :
 - Check the quality management of the process & the sorting & determination of bins optimal locations
 - Check the capacity of bins and collection frequency
 - Coordinate with operators for collection and treatment operations
 - Control the waste weighing by the waste management operators

b. The role of the service provider

- Ensure treatment centers in accordance with arcenciel standards & hopefully government standards
- Ensure waste management services in accordance with arcenciel's standards & hopefully government's standards

III. The components of waste management

a. Awareness

STANDARDS	Involvement of the municipality's leaders (politicians and religious figures)
	Training of trainers
	Training of ambassadors by trainers (conciierge, etc.)
	Awareness (posters, sorting guide, door to door)
RATIOS	Approximately 12 trainers for 50,000 inhabitants
	About 1 ambassador for 20 families
BUDGET (US\$)	0.53 - 1 USD/inhabitant/year (including training of the trainers, public awareness, sorting guide + distribution of flyers)
TOOLS	Sorting guide
	Posters / flyers
	Power point presentations
	The animated movie "Sodak the Champion"
	The anti-waste kit
	Facebook page: www.facebook.com/aec.arcenciel

b. Sorting at source

STANDARDS	Sorting in 3 categories <ul style="list-style-type: none"> • Organic (food scraps, pizza boxes): black bin ■ • Dry and clean (packaging, paper, metal, cardboard and plastic): blue bin ■ • Other (diapers, toilet paper, sanitary napkins): red bin ■ 		
	Glass can be put in specific bins (voluntary waste drop-off receptacles) Hazardous waste (ex. batteries, computers, compact fluorescent lamps) can be dropped in "recovery centers" (voluntary waste drop-off)		
	Visual inspection of the sorting quality by the collection operator		
RATIOS	For a 20 apartments building: <ul style="list-style-type: none"> • 2 bins for dry and clean waste (240L) • 1 bin for other wastes (240L) • 1 bin for organic waste (240L) 		
	Every 300 m ² : <ul style="list-style-type: none"> • 1 bin for passers-by (60L) • 1 bin for glass voluntary waste drop-off receptacle (1100L if vehicles include a loading system) • Every 50,000 to 100,000: 1 recovery center (Social shop / 2nd hand market / recycling of electronic waste) 		
INVESTMENT COST (US\$)	60,600 \$	OPERATIONAL COST PER YEAR (US\$)	34,542 \$
TOOLS	Plastic bins of 240 L with awareness message		
	Metal or plastic bins of 1100 L		
	Intelligent bins with sensors as an option		
	Bins for organic waste with drawer recovery of leachate & an aeration system as an option		
	Developing incentives for sorting (financial or others, such as non collection of unsorted waste) with the municipality		

c. Collection without compaction

STANDARDS	Selective collection in different closed vehicles from each building		
	Collection without compaction with closed vehicles		
	3 tons vehicle for narrow streets preferably with loading system		
	10 tons vehicle for large streets preferably with loading system		
	Daily collection of organic and twice weekly for other waste		
	The vehicle for organic waste should be equipped with a leachate collection system		
RATIOS	1 vehicle 3 T = 1.25 T of non-organic waste per collection		
	1 vehicle 10 T = 3.75 T of non-organic waste per collection		
	1 vehicle 3T = 4.55 T of organic waste per collection		
	1 vehicle 10T = 13.65 T of organic waste per collection		
	1 vehicle with drain system = 1 driver+ 1 assistant driver		
	1 vehicle without drain system = 2 assistant drivers per vehicle		
INVESTMENT COST (US\$)	412,500 \$	OPERATIONAL COST PER YEAR (US\$)	634,323 \$
TOOLS	Possibility of using a GPS system for the vehicle		

engage in development

d. Secondary sorting of non-organic waste - Recycling and RDF

STANDARDS	Development of a secondary sorting unit including one reception zone, one sorting conveyor line and one bailer / compactor to press waste		
	Monitoring of waste weighting and waste sorting for the billing		
	If there are excessive sorting errors, take photos and return the waste to the municipality		
	Secondary sorting of recyclable waste and non-recyclable waste		
	Compacting secondary sorted dry & recyclable waste & transportation : <ul style="list-style-type: none"> • To the recycling centers (for recyclable waste) • To the producers of RDF (if not recyclable & usable as RDF) • To landfills / quarries (if not recyclable & not usable in RDF) 		
RATIOS	Floor area of the sorting center: 1 400 m ² for 16T / day (over 40 T of total waste)		
	Capacity of the sorting line: 2 T / hour		
	Compactor capacity: 2 T / hour		
	10 workers for sorting and compacting of 16 T / day (over 40 T of total waste)		
INVESTMENT COST (US\$)	267,000 \$	including <ul style="list-style-type: none"> • Construction of the center about 180,000 USD • A conveyor (2T / hour) = about 12,000 USD • A compactor (2T / hour) = about 12,000 USD 	OPERATIONAL COST PER YEAR (US\$) 98,439 \$
TOOLS	List of recycling plants		

engage in development

e. Composting

STANDARDS	Development of a composting center built on a concrete floor with 2% slope : <ul style="list-style-type: none"> • windrow (if the center is more than 500 meters far from houses) • tunnel with controlled ventilation & air treatment & suction with biofilters (peat ...) & activated carbon (if the center is located 200 to 500m far from houses) 	
	If excessive sorting errors, take photos and return the waste to the municipality	
	Composting of 1 volume of biowaste with 4 green waste volumes	
	6 weeks of fermentation and 2 months of maturation	
	Secondary sorting after completing the maturation cycle Leachate treatment (from the composting and collection vehicles) (Biological treatment followed by treatment by phyto epuration)	
	Tests on each batch of compost	
	Possibility of vermicomposting at home	
	RATIOS	Floor area of the composting center: 3,500 m ² for 24T / organic waste per day (over 40 T of total waste)
4 workers for composting for 24 T / day		
INVESTMENT COST (US\$)	169,149 \$	OPERATIONAL COST PER YEAR (US\$) 89,127 \$
TOOLS	Guide for composting	

engage in development

f. Landfilling

STANDARDS	Landfilling in controlled sites in compliance with safety & environment protection standards, with biogas recovery		
	Sites should be provided with an active isolation (geomembrane liner) & a passive isolation (clay)		
	Leachate treatment systems		
RATIO	15,000 m ² for 15 tons / day for 15 years		
INVESTMENT COST (US\$)	1,000,000 \$	OPERATIONAL COST (US\$)	25\$/ton
TOOLS	Consultants contact list		

N.B : A sanitary landfill allows the storage of non-recyclable and non-organic waste minimizing the risk of pollution or contamination of the environment, unlike open dumping in uncontrolled landfills

engage in development

IV. Some practical information

a. Contacts of actors involved in the waste management chain

REGION	MUNICIPALITY	ACTIVITY	NAME	TYPE	CONTACT	MATERIALS
Bekaa	Taadod Riyak	Storage / Trading	Abou Ahmad el Achhab	Company	03-201324	Metal/Lead
South	Nabitiyeh	Collection / Trading	Ahmad Chaib	Company	03-314608	Metal
South	Zahrani	Storage / Trading	Ahmad Khalife	Company	03-243514 / 07 -222106	Metal/Lead
South	Sarafand	Pre-treatment / Treatment	Al Zoujaj al Yadawi	Company	03-906091	Glass
Beirut	Bourj el Barajneh	Pre-treatment / Treatment	Alpha Plast Est. trading	Company	01-471507 / 03-750290	Plastic (HDPE)
Beirut	Bourj el Barajneh	Pre-treatment / Treatment	Alpha Plast Est. trading	Company	01-471507 / 03-750290	Plastic (HDPE)
Beirut	Chouwaifat	Pre-treatment / Treatment	Aluxal	Company	05-480406	Aluminum
Bekaa	Taanayel	Collection/Pre-treatment/Treatment	arcenciel	NGO	01-495561 ext 1413	Plastic, Paper, Cardboard
Beirut	Baabda	Collection / Pre-treatment	arcenciel	NGO	01-495561 ext 1414	Plastic, Paper, Cardboard
Beirut	Beirut	Collection / Treatment	Averda	Company	01-360000 / 01-364444	All
South	Tyre	Pre-treatment / Treatment	Baza Plast	Company	07-376376 / 03-780282	Plastic (All)
Beirut	Dora	Collection / Treatment	Beeatoona	NGO	01-249653 / 71-974751	Paper/Cardboard
Mt Lebanon	Jbeil	Collection / Trading	Byblos ecologia	NGO	03-444401	Plastic PET (Water Bottles)
Beirut	Beirut	Pre-treatment / Treatment	Cedar Environmental	NGO	03-293222	Compost, Plastic, glass
Mt Lebanon	Mazraet Youcheh	Pre-treatment / Treatment	Charbel Daou	Company	04-913300	Textiles
Mt Lebanon	Mtaileb	Pre-treatment / Treatment	Elie Daou	Company	03-620850	Textiles
Beirut	Dekwaneh	Collection / Trading	Elie Sawma	Company	01-689105 / 03-666520	Paper/Cardboard
Beirut	Bouchrieh	Pre-treatment / Treatment	Ets. Carlo pour le Baouchrieh	Company	03-888006 / 01-500293	Aluminum
Beirut	Borj Hammoud	Pre-treatment / Treatment	Garabed Babahekian	Company	01-261029	Lead
Bekaa	Taadod Riyak	Collection / Trading	Hanine Trading	Company	03-201324	Metal/Lead
Beirut	Beirut	Collection / Trading	Hsain Daher	Company	03-498663	Paper/Cardboard
Beirut	Ouzai	Collection / Trading	Hussein Daher	Company	03-498663	Plastic (PET, HDPE)
Bekaa	Niha/Timnin	Pre-treatment / Treatment	Issam Kassem Ets. For commerce & industry	Company	08-911119	Plastic (All)
South	Saida	Pre-treatment / Treatment	Kama Plast	Company	07-222200	Plastic (HDPE)

REGION	MUNICIPALITY	ACTIVITY	NAME	TYPE	CONTACT	MATERIALS
Beirut	Fanar	Pre-treatment / Treatment	Kilzi & Co. S.A.R.L.	Company	01-872133/4/5 03-896669	Plastic (PP)
Beirut	Zoukak el Blat	Collection / Pre-treatment	L'Ecoute	NGO	70-391908	Carton, electronics, metal, plastic
Tripoli/North	Tripoli	Collection / Landfilling	Lavajet	Company	04- 522228	Landfilling bulk waste
North	Tripoli		Lebanese Companies For Raw Materials		03-281434	
Tripoli/North	Beddawi	Pre-treatment / Treatment	Lebanese Metal Industry	Company	03-281434	Lead
Beirut	Roumieh	Pre-treatment / Treatment	Lebanese Recycling Works	Company	01-890383 / 03-307060	Plastic (All)
Tripoli/North	Tripoli	Pre-treatment / Treatment	Lebanese Recycling Works	Company	70-955909	
Beirut	Nahr El Mot	Pre-treatment / Treatment	Liban fonderie	Company	01-897619	Metal
Bekaa	Qab Elias	Pre-treatment / Treatment	Mazar Plast	Company	08-500623 / 03-843929	Plastic (HDPE)
Bekaa	Qaa El Eim	Pre-treatment / Treatment	Mimoza	Company	08-803052	Paper/Cardboard
Mt Lebanon	Kfarshima	Pre-treatment / Treatment	Ohanis Kasarjian	Company	05-462462	Metal
South	Toul	Collection / Treatment	OLA 3R	Company	03-977041	Rubber Tires
Bekaa	Taanayel	Pre-treatment / Treatment	Oreibi	Company	08-510194	Lead
Bekaa	Zahle	Pre-treatment / Treatment	Panda Plast	Company	01-650888 / 01-650660	Plastic
South	Zahrani	Pre-treatment / Treatment	Plastic Chem Company	Company	07-223535 / 03-337788	Plastic (HDPE, PVC)
Beirut	Sin El Fil	Collection / Trading	Plastic Wood	Company	01-491152	Plastic (water bottles)
Mt Lebanon	Baakline	Pre-treatment / Treatment	Publitem Co	Company	03-607678	Plastic (HDPE)
Mt Lebanon	Jbeil	Pre-treatment / Treatment	Rocky Plast	Company	03-634400	Plastic (HDPE)
Beirut	Shatila	Pre-treatment / Treatment	Sharmetal	Company	01-823675/6 / 03-810876	Metal/Lead
Bekaa	Qab Elias	Pre-treatment / Treatment	Sicomo	Company	08-500550	Paper/Cardboard
Mt Lebanon	Zouk Mosbeh	Pre-treatment / Treatment	Sidem	Company	09-220163/1	Aluminum
Mt Lebanon	Kfarchima	Pre-treatment / Treatment	SIPCO	Company	05-431048	Paper/Cardboard
Mt Lebanon	Wadi Shahrour	Pre-treatment / Treatment	Solicar	Company	05-940248	Paper/Cardboard
Beirut	Chouwaifat	Pre-treatment / Treatment	Soliver	Company	05-803903	Glass
Bekaa	Zahle	Pre-treatment / Treatment	Somoplast	Company	08-930718	Plastic (PET)
Beirut	Beirut	Collection / Pre-treatment	Terre Liban	NGO	03-327975	Paper/Cardboard
Mt Lebanon	Halat	Pre-treatment / Treatment	Unipack/Tissue Mill	Company	09-477191	Paper/Cardboard
Tripoli/North	Baddawi Industrial City	Pre-treatment / Treatment	United Glass Products Co	Company	06-389107 / 03-230247	Glass
Beirut	Badaro	Collection / Pre-treatment	Zero Waste act	Company	01-381381	All

b. Equipment suppliers

Trailers suppliers

Medevco

tel : +961 9 233 550 / 1 / 2 | email : info@medevco.me | adresse : Jeita- Jrita Main Road

Panda Plast

tel : +961 8 911 119 / +961 8 912 024 | email : sales@pandaplast.com | adresse: Niha- Bekaa

3M Plast industrial Company

tel : +961 7 224 400 / +961 7 224 468 | adresse : Ghazieh - Zahrani main road

Conveyors suppliers

Technica

tel : +961 70 866 470

Mepaq

tel : +961 1 481 565 | email : info@mepaq.com | adresse: sin el fil

Bou Chalhoub

tel : +961 8 930 999 | email : info@chalhoub-est.com | adresse: Zahle

Cedar Environmental

tel : +961 1 389 404 / +961 3 293 222 | email : info@cedarenv.com

Rollers providers

Bou Chalhoub

tel : +961 8 930 999 | email : info@chalhoub-est.com | adresse: Zahle

Cedar Environmental

tel : +961 1 389 404 / +961 3 293 222 | email : info@cedarenv.com

Zakka

tel : +961 1 890 654 | email : info@zakkamultitec.com | adresse : Zakka Bldg, Fanar

C. In emergency situations



1. Do not burn waste
2. Do not use pesticides excessively
3. Use lime on existing piles to slow microbial growth & drive away pests

engage in development

4. To treat existing waste mounds :

The bags can be emptied / shredded and the waste spread to lower their level of humidity & accelerate stabilization
Then recyclable waste can be recovered.

CAUTION: this solution is not optimal and should be used as a last resort. Some companies such as Cedar Environmental can suggest solutions to accelerate the fermentation process.

You can contact this company at the following address :
info@cedarenv.com (Ziad Abichaker)

Waste that cannot be recycled through composting or recycling can be packaged and stored in a specific location in order to be later on taken in charge by operators.

5. To reduce the quantities of waste to be eliminated :
- Promote sorting at source immediately, collect recyclable waste separately or ask the inhabitants to gather it at a collection point, store them and send them to recycle plants or give them to organizations such as Terre Liban, l'Ecoute & arcenciel
 - Promote composting in gardens and vermi-composting on balconies as much as possible. In the villages, give the organic waste to feed chickens, rabbits, etc.
 - Educate people on waste reduction
(to avoid food waste, avoid surplus ...)
 - Check our Facebook page: www.facebook.com/aec.arcenciel

V. The services provided by arcenciel

Training & awareness

- Training of trainers
- Coaching trainers
- Public awareness
- Elaborating awareness tools

Sorting at source

- Distribution and installation of bins with awareness messages

Collection

- Quality control related to sorting & collection problems

Secondary sorting of dry & clean waste

- Support the creation of a secondary sorting center
- Support the creation of recovery centers for clothes, toys, furniture

Composting

- Support for the creation of a composting center
- Support in the choice of composting technology
- Support to the composting operation
- Contact with composting experts

Landfilling / Quarry rehabilitation, & use in landfills

- Contact landfilling specialists

P.S. arcenciel cannot currently collect waste from new organizations and municipalities

engage in development

VI. Some suggestions at a political level

1. Liberalize the waste management market: promote decentralization by leaving the choice of subcontracting to municipalities and allow them to select the service operator
2. Standardize the sector: specific permits are granted to operators involved in the waste management sector, depending on the compliance of their activities to pre-established standards
3. **Adopt weight-based billing**
Based on the weighing completed at the waste management centers & landfills, and this is to encourage municipalities to minimize their waste & reduce landfilling

VII. Crisis exit plan

1. Regaining trust
 - Adopt a positive attitude
 - Create a steering committee, even informal
 - Cancel the decision 1/2015
2. Suggest a definitive national strategy, and confirmed by legal texts, based on:
 - Waste sorting and recovery
 - Market liberalization
 - Decentralization including a typology of waste and treatment techniques
3. This strategy should necessarily tend to 0 landfill and 0 incineration
Energy recovery should be limited to biogas and RDF
4. Ensure legislative and legal security to future actors and investors
5. Create a background for launching social enterprises
6. Open the market by dividing the sector in different markets
7. Accredite operators / municipalities according to predetermined standards and establish monitoring and enforcement systems

engage in development

8. Provide municipalities with training and technical-financial support for waste management and PPP
9. Give municipalities the control of their budget and transfer to the independent fund municipal revenue collection on bills of mobile telephony under the VAT
10. Partnering in clusters or zones of service 10.000 to 100.000 inhabitants
11. Gather awareness and training the population

VIII. Some awareness tools

Sorting guide

In case of emergency



arcenciel.aec

What's recycling ?

Recycling is a waste treatment process in which materials derived from waste are reintroduced to produce equivalent or different types of products. It reduces waste volumes, and thus pollution and conserves natural resources by reusing raw materials.



arcenciel.aec

What's sorting ?

The objective of selective sorting is to separate waste by their nature: metal, plastic, paper and organic... It allows separating waste into different categories to be valorized. Waste segregation from their production and by the producer himself, facilitates recycling.



arcenciel.aec

What's composting ?

It is a biological process that turns organic waste into a dark rich soil. This substance is called compost, and is a natural fertilizer used for agriculture in order to strengthen the ground.



arcenciel.aec

Organic waste



Tea and coffee residue



Food leftovers



arcenciel.aec

Recyclables & others

Recyclables



Plastic



Metal



Paper

Non recyclables



Other waste



arcenciel.aec

And then ...

The sorted waste is sent to recycling and the financial income is reinvested by **arcenciel** in social actions.

the WHEEL of RECYCLING



arcenciel.aec

The stages of recycling



- 1- Selective sorting
- 2- Collection
- 3- Secondary sorting
- 4- Grinding
- 5- Cleaning
- 6- Extrusion
- 7- Production factory

Reduce

1

Do not throw away food, try to finish your plate. Don't order what you can't eat.



2

Don't print unless it's necessary.



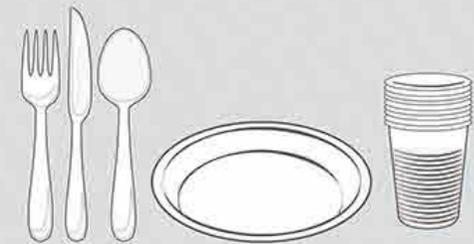
3

Buy products with less packaging, and choose reusable or refillable ones over single-use items.



4

Minimize the use of disposable utensils.



engage in development

Reuse

1

Save plastic bags from grocery stores and use them as garbage bags for your trash cans.



2

Reuse glass jars to store food, nails, screws and other useful household items.



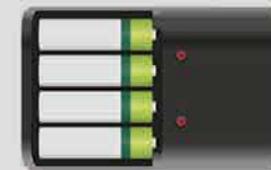
3

Donate old blankets, shoes, and clothes, some people will be happy to have them.



4

Buy rechargeable batteries.



What to Recycle?



- * Plastic bottles:
 - water
 - detergents
 - shampoo & shower gel
 - soda

01
Plastic



- * Newspapers & magazines
- * Papers
- * Cardboard boxes

02
Paper



- * Tins
- * Cans
- * Aluminium foil

03
Metal



- * Nylon bags
- * Cling Film

04
Nylon

THANK YOU

YOU ARE A HERO



**PLEASE COMPRESS
TO REDUCE VOLUME**

arcenciel.aec

+ 961 1 495 561

environnement@arcenciel.org

www.arcenciel.org

arcenciel

arcenciel.aec

WE WILL NOT STOP
OUR MARCH,
WE ARE COMMITTED TO
ENGAGE IN DEVELOPMENT



مشروع ممول من الاتحاد الأوروبي

Disclaimer: This guide has been produced with the financial support of the AFD in the TER-OM project. Its content remains the sole responsibility of arcenciel and do not necessarily reflect the view of the AFD.