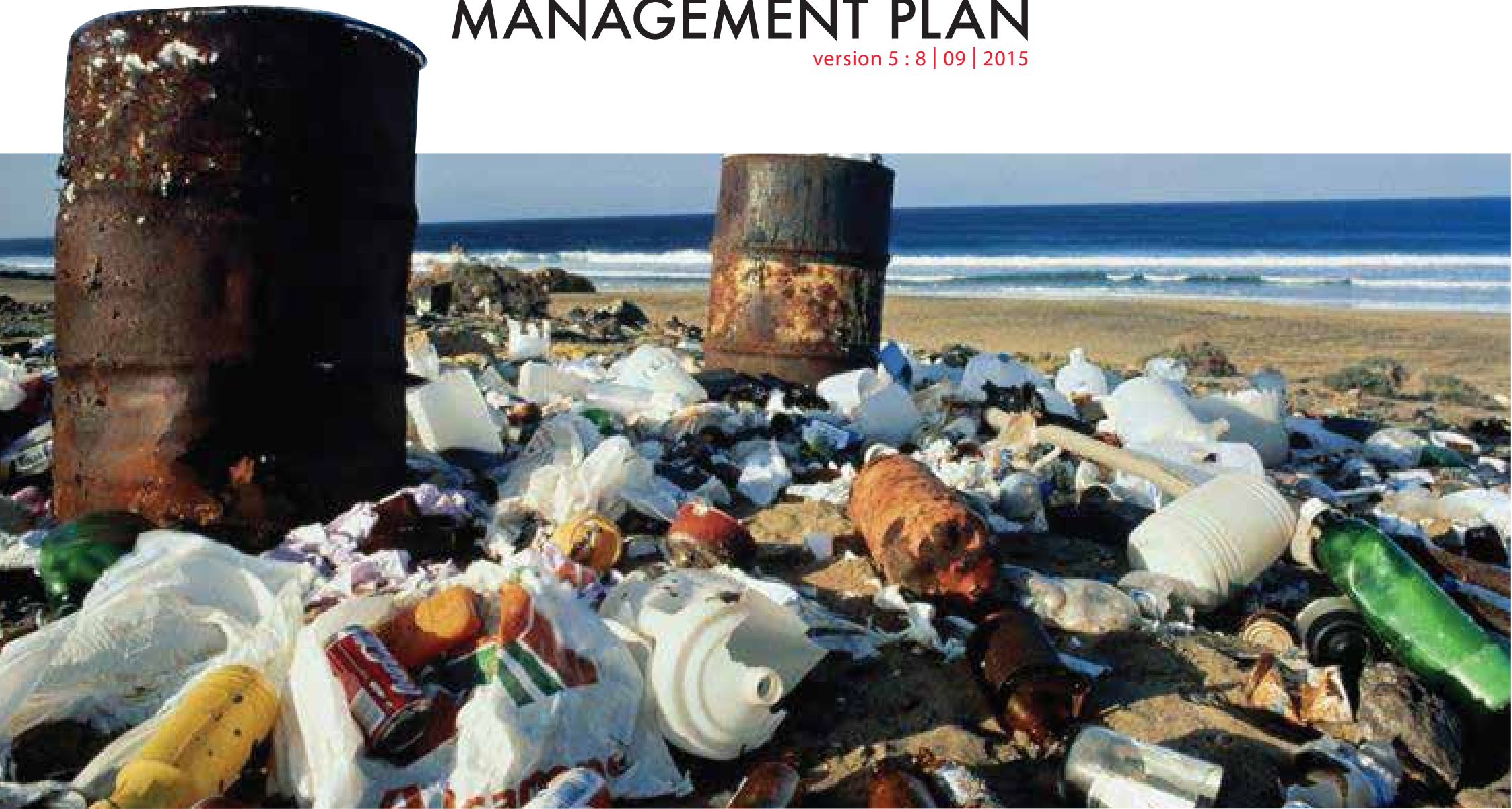


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MUNICIPAL WASTE MANAGEMENT PLAN

version 5 : 8 | 09 | 2015



Introduction

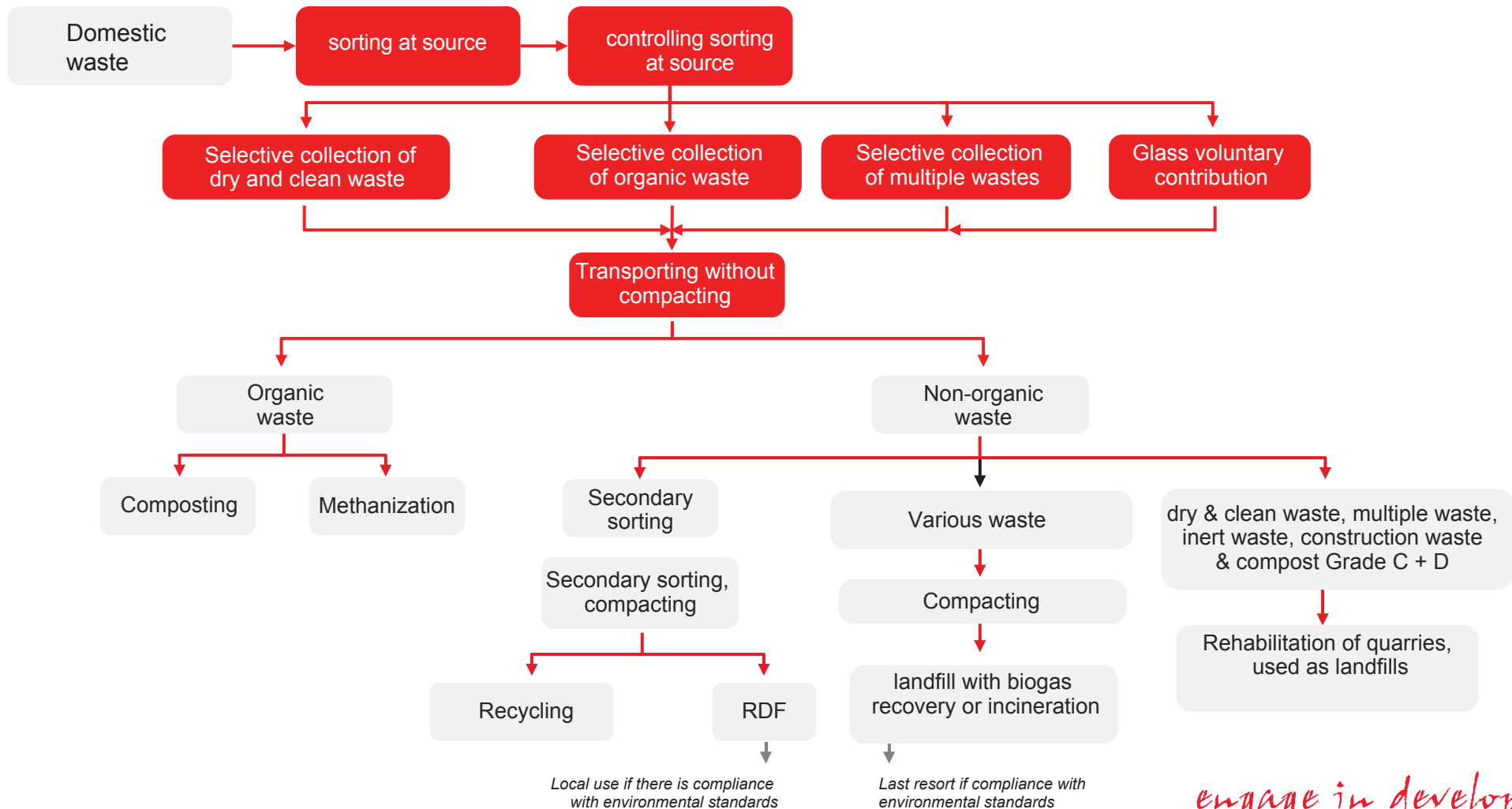
This guide was developed in an emergency context, in a period of crisis related to solid waste management in Lebanon. This tool is primarily intended for municipalities, mainly concerned with waste management, to give them management tools to face the crisis. It gives an idea about the various components 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.

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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



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

- Over 50% of wastes in Lebanon are organic, with a low calorific value. If incinerated it will consume lots 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 create jobs opportunities

II. The division of roles & responsibilities

a. The role of the municipality & its agent

- Ensuring awareness with outsourcing option
- Ensure cleaning the streets with outsourcing option
- Fund the bin's prices
- Collect waste with outsourcing option
- Partnering within municipalities' union from 10,000 up 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
- Outsourcing the treatment to an operator and control 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 centers

b. The role of the service provider

- Provide treatment centers in accordance with arcenciel's standards
- Ensure waste management services in accordance with arcenciel'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 but in specific bins (voluntary waste drop-off receptacles) Hazardous waste can 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 other wastes (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 other) 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 other waste 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 driver per vehicle		
INVESTMENT COST (US\$)	412,500 \$	OPERATIONAL COST PER YEAR (US\$)	634,323 \$
TOOLS	Possibility of using a GPS system for the vehicle		

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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		
	Control and weighing waste at reception for billing and waste sorting assessment		
	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 : <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: 1400 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\$)	302,500 \$	OPERATIONAL COST PER YEAR (US\$)	98,439 \$
TOOLS	List of recycling plants		

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e. Composting

STANDARDS	Development of a composting area (controlled tunnel ventilation built on a concrete floor with 2% slope)	
	If excessive sorting errors, take photos and return the waste to the municipality	
	1 volume of biowaste composting for 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 Suction and air treatment with biofilters (peat ...) and activated carbon)	
	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	

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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	0.9 m ³ /T
BUDGET (US\$)	21.66 USD/ton
TOOLS	Consultants contact list

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IV. Cost

Component	Cost	Unit
awareness	0.53 - 1.00	USD / inhabitant
sorting at source	2.37	USD / ton
collection	43.45	USD / ton
secondary sorting	15.65	USD / ton
composting	10.56	USD / ton
landfilling	21.66	USD / ton

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V. Some practical information

a. Companies involved in the recycling process (as a suggestion)

Aluminium, Metal, Steel, Copper, Zinc, Bronze & Lead				
Company	Region	Municipality	Transportation provided by the company	Contact
Aluxal	Beirut	Chouwaifat	No	05-480406
Ets. Carlo pour le commerce et l'industrie	Beirut	Bouchrieh	No	03-888006/01-500293
Sidem	Mt Lebanon	Zouk Mosbeh	No	09-220163/1
Sharmetal	Beirut	Roundabout Shatila	Possible	01-823675/6/7/8
Ohannes Kassardjian	Mt Lebanon	Kfarchima	No	05-462462
Yahia El Hariri	South	Saida	Possible	07-732190/ 03-247790
Ahmad Khalife	South	El Zahrani	Yes	07-222106/ 03-243514
Ahmad Chaib	Nabatyieh	Toul	Yes	03-314608
Liban fonderie	Beirut	Nahr El Mot	Possible	01-897619
ACT 4 Tomorrow	Mt Lebanon	Kornet Chehwan	Possible	04-914515/ 03/225557
Abou Ahmad El Achhab & Hanine	Bekaa	Baalbeck	Possible	03/201324
Al Araibi	Bekaa	Taanayel	Possible	08-510194
Baldati(nefroz.com)	Mt Lebanon	Elissar	Possible	04-922999
L'ecoute	Beirut	Moussaitbeh	Possible	03-655386/ 70-391908
Lebanese Companies For Raw Materials	North	Tripoli	Possible	03-281434
Mohammed Tawil	Beirut	Chouwaifat	Possible	05-482090
Runwaste	Beirut	Beirut	Possible	03-901251
Zero Waste Act	Beirut	Badaro	Yes	03-381381/ 03-508108
Oreibi	Bekaa	Taanayel	Possible	08-510194
Garabed Babahekian	Beirut	Borj Hammoud	No	01-261029/ 854770/ 444064/ 261216

PET Polyethylene terephthalate (water bottles)				
Company	Region	Municipality	Transportation provided by the company	Contact
Panda Plast	Bekaa	Zahle	Yes	01-650888 / 01-650660
Somoplast	Bekaa	Zahle	No	08-930718
Hussein Daher	Beirut	Ouzai	Yes	03-498663
Lebanese Recycling Works	Beirut	Roumieh	Possible	01-890383
Issam Kassem Ets. for commerce and industry	Bekaa	Niha/Timnin	Yes	08-911119
Lefico	Bekaa	Taadod el Ryak	Possible	08-921222
Plastic Wood	Beirut	Sin El Fil	Possible	01-491152
Baza Plast	South	Tyre	Yes	07-376376 / 03-780282
Yahia El Hariri	South	Saida	Possible	07-732190 / 03-247790
Ahmad Chaib	Nabatyieh	Toul	Yes	03-314608
Assia Plast	South	Tyre	Possible	71792651

PVC Polyvinyl chloride (cables, vegetable boxes...)				
Company	Region	Municipality	Transportation provided by the company	Contact
Panda Plast	Bekaa	Zahle	Yes	01-650888 / 01-650660
Mazar Plast	Bekaa	Qab Elias	Possible	08-500623 / 03-843929
Issam Kassem Ets. for commerce and industry	Bekaa	Niha/Timnin	Yes	08-911119
Plastic Chem Company	South	Zahrani	Possible	07-223535 / 03-337788
Assia Plast	South	Tyre	Possible	71792651
Lebanese Recycling Works	Beirut	Roumieh	Possible	01-890383
Yahia El Hariri	South	Saida	Possible	07-732190 / 03-247790

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HDPE High-density polyethylene (Thick Plastic)				
Company	Region	Municipality	Transportation provided by the company	Contact
Baza Plast	South	Tyre	Yes	07-376376 / 03-780282
Kamaplast	South	Saida	No	07-222200
Alpha Plast Est. trading	Beirut	Bourj el Barajneh	No	01-471507 / 03-750290
Panda Plast	Bekaa	Zahle	Yes	01-650888 / 01-650660
Mazar Plast	Bekaa	Qab Elias	Possible	08-500623 / 03-843929
Publitex Co	Mt Lebanon	Baakline	Possible	03-607678
Rocky Plast	Mt Lebanon	Jbeil	Yes	03-634400
Somoplast	Bekaa	Zahle	Yes	08-930718
Plastic Chem Company	South	Zahrani	Possible	07-223535 / 03-337788
Assia Plast	South	Tyre	Possible	71-792651
Hussein Daher	Beirut	Ouzai	Yes	03-498663
Yahia El Hariri	South	Saida	Possible	07-732190/ 03-247790
Issam Kassem Ets. for commerce and industry	Bekaa	Niha/Timnin	Yes	08-911119
Lebanese Recycling Works	Beirut	Roumieh	Possible	01-890383
Pakplast	Bekaa	Zahle	No	09-224605

PP Polypropylene (disposable plastic)				
Company	Region	Municipality	Transportation provided by the company	Contact
Alpha Plast Est. trading	Beirut	Bourj el Barajneh	No	01-471507 / 03-750290
Panda Plast	Bekaa	Zahle	Yes	01-650888 / 01-650660
Mazar Plast	Bekaa	Qab Elias	Possible	08-500623 / 03-843929
Pakplast	Bekaa	Zahle	Yes	09-224605
Publitex Co	Mt Lebanon	Baakline	Possible	03-607678
Rocky Plast	Mt Lebanon	Jbeil	No	03-634400
Somoplast	Bekaa	Zahle	No	08-930718
Baza Plast	South	Tyre	Yes	07-376376 / 03-780282
Issam Kassem Ets. for commerce and industry	Bekaa	Niha/Timnin	Yes	08-911119
Yahia El Hariri	South	Saida	Possible	07-732190 / 03-247790
Kamaplast	South	Saida	No	07-222200
Hussein Daher	Beirut	Ouzai	Yes	03-498663
Assia Plast	South	Tyre	Possible	71792651
Lebanese Recycling Works	Beirut	Roumieh	Possible	01-890383
Kilzi & Co. S.A.R.L.	Beirut	Fanar	Possible	01-872133/4/5 03-896669

PS Polystyrene (disposable plastic)				
Company	Region	Municipality	Transportation provided by the company	Contact
Baza Plast	South	Tyre	Yes	07-376376 / 03-780282
Kilzi & Co. S.A.R.L.	Beirut	Fanar	Possible	01-872133/4/5 03-896669
Panda Plast	Bekaa	Zahle	Yes	01-650888 / 01-650660
Issam Kassem Ets. for commerce and industry	Bekaa	Niha/Timnin	Yes	08-911119
Publitex Co	Mt Lebanon	Baakline	Possible	03-607678
Yahia El Hariri	South	Saida	Possible	07-732190 / 03-247790

LDPE Low-density polyethylene (plastic bags)				
Company	Region	Municipality	Transportation provided by the company	Contact
Panda Plast	Bekaa	Zahle	Yes	01-650888 / 01-650660
Mazar Plast	Bekaa	Qab Elias	Possible	08-500623 / 03-843929
Plastic Chem Company	South	Zahrani	Possible	07-223535 / 03-337788
Pakplast	Bekaa	Zahle	No	09-224605
Publitex Co	Mt Lebanon	Baakline	Possible	03-607678
Assia Plast	South	Tyre	Possible	71792651
Rocky Plast	Mt Lebanon	Jbeil	No	03-634400
Somoplast	Bekaa	Zahle	No	08-930718
Baza Plast	South	Tyre	Yes	07-376376 / 03-780282
Issam Kassem Ets. for commerce and industry	Bekaa	Niha/Timnin	Yes	08-911119
Yahia El Hariri	South	Saida	Possible	07-732190 / 03-247790
Hussein Daher	Beirut	Ouzai	Yes	03-498663
Lebanese Recycling Works	Beirut	Roumieh	Possible	01-890383

GLASS				
Company	Region	Municipality	Transportation provided by the company	Contact
United Glass Products Co	North	Baddawi Industrial City	No	06-389107 / 03-230247
Soliver	Beirut	Chouwaifat	No	05-803903
Al Zoujaj Al Yadawi	South	Sarafand	No	03-906091
ACT 4 Tomorrow	Mt Lebanon	Kornet Chehwan	Possible	04-914515 / 03-225557
Baldati(nefroz.com)	Mt Lebanon	Elissar	Possible	04-922999
L'ecoute	Beirut	Moussaitbeh	Possible	03-655386 / 70-391908
Maliban	Bekaa	Chtoura	Possible	08-511991 / 08-511990 / 03-212782
Terre Liban	Beirut	Baabda	No	05-923060
Zero Waste Act	Beirut	Badaro	Yes	03-381381/ 03-508108

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Company	Region	Municipality	Transportation provided by the company	Contact
Elie Sawma	Beirut	Dekwaneh	Yes	01-689105 / 03-666520
Hsain Daher	Beirut	Beirut	Yes	03-498663
Mimoza	Bekaa	Qaa El Eim	Yes	08-803052
Sicomo	Bekaa	Qab Elias	Possible	08-500550
Unipack/Tissue Mill	Mt Lebanon	Halat	Possible	09-477191
Sipco	Mt Lebanon	Kfarchima	No	05-431048
Solicar	Mt Lebanon	Wadi Shahrour	Yes	05-940248
Terre Liban	Beirut	Baabda	No	05-923060
Zero Waste Act	Beirut	Badaro	Yes	03-381381 / 03-508108
L'ecoute	Beirut	Moussaitbeh	Possible	03-655386 / 70-391908
Lebanese Recycling Works	Mt Lebanon	Roumieh	Possible	01-890383
Baldati(nefroz.com)	Mt Lebanon	Elissar	Possible	04-922999

OTHERS

Textile

Company	Region	Municipality	Transportation provided by the company	Contact
Charbel Daou	Mt Lebanon	Mazraet Youcheh	No	04-913300
Elie Daou	Mt Lebanon	Mtaileb	No	03-620850

Electronics

Company	Region	Municipality	Transportation provided by the company	Contact
Beeatoona	Beirut	Dora	Yes	01-249653
L'ecoute	Beirut	Moussaitbeh	Possible	03-655386 / 70-391908
ACT 4 Tomorrow	Mt Lebanon	Kornet Chehwan	Possible	04-914515 / 03/225557
Baldati(nefroz.com)	Mt Lebanon	Elissar	Possible	04-922999

Tires

Company	Region	Municipality	Transportation provided by the company	Contact
OLA 3R	South	Toul	No	03-977041
Meps	Beirut	Choueifat	No	70-391908 / 03-655386

b. In emergency situations



1. Do not burn waste
2. Do not use pesticides excessively
3. Use lime on existing mounds to slow microbial growth & ward off pests

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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

VI. 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

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

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VII. Some suggestions at a political level

a. Le rôle de la municipalité et de son agent

1. Open the waste management market: subcontracting and the choice of the service provider belongs to the municipality
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 billing weight**
Based on the weighing completed at the waste management centers & landfills, and this is to encourage municipalities to minimize their waste & reduce landfilling

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   [arcenciel.aec](https://www.youtube.com/channel/UC...)

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



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.