8 Solid Waste

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Photo Credit: CDR-LACECO

ABBREVIATIONS & ACRONYMS

AEC	arcenciel (NGO)
CDR	Council for Development and Reconstruction
COM	Council of Ministers
C&D	Construction and Demolition
EIA	Environmental Impact Assessment
EU	European Union
GBA	Greater Beirut Area
GOL	Government of Lebanon
HCW	Health Care Waste
HCWM	Health Care Waste Management
IMF	Independent Municipal Fund
ISWM	Integrated Solid Waste Management
OMSAR	Office of the Minister of State for Administrative Reform
OMW	Olive Mill Wastewater
MOA	Ministry of Agriculture
MOF	Ministry of Finance
MOE	Ministry of Environment
MOIM	Ministry of Interior and Municipalities
MOPWT	Ministry of Public Works and Transport
MSW	Municipal Solid Waste
UNDP	United Nations Development Programme
SEA	Strategic Environmental Assessment
SEEL	Supporting the Judiciary System in the Enforcement of Environmental Legislation
SELDAS	Strengthening/State of Environmental Legislation Development and Application System in Lebanon
SWM	Solid Waste Management
SWTP	Solid Waste Treatment Plant
WTE	Waste to Energy

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Population growth, urbanization and dwindling land areas are exacerbating solid waste management (SWM) issues in Lebanon to the brink of a national crisis. Nationwide, an estimated 51 percent of all municipal solid waste (MSW) is landfilled, 32 percent is dumped, and the remaining 17 percent is recovered through sorting and composting (SWEEP-NET 2010). While government- and donor-funded studies and master plans related to municipal SWM have started to show modest results, very little has been achieved insofar as managing industrial waste, including hazardous waste, as well as other types of waste such as construction and demolition waste. Political indecision has so far prevented the implementation of a comprehensive plan for SWM in Lebanon.

This chapter describes the drivers of change impacting SWM, the institutions and other key players affecting the sector, current practices including collection, treatment and disposal, and concludes with an analysis of policy options for improved SWM in Lebanon.

8.1 DRIVING FORCES

Waste generation is related to human activities, lifestyles, and environmental awareness. Rapid urbanization, growing consumption, and limited environmental awareness are having a compounding effect on waste generation. Inadequate solid waste legislation and enforcement, and the lack of political consensus on critical SWM issues, have led successive governments to adopt and prolong emergency measures. Consequently, environmental management solutions in Lebanon are not always the best ecologically but often the most politically-acceptable.

8.1.1 Population

With a resident population of 4.2 million (inclusive of an estimated 416,600 Palestinian refugees), and an average waste generation rate of 0.95 kg/capita/day (1.1 kg/d in urban areas, 0.7 kg/d in rural areas), Lebanon generates about 1.57 Million tons of waste per year (SWEEP-NET 2010, CAS 2008, and UNRWA 2008a) *–see Box 8.1 and Figure 8.1 for generation quantities*. Waste generation is expected to increase by 1.65 percent annually to reach 2.3 Million tons by 2030, notwithstanding potential waste recovery from sorting and composting facilities (WB/METAP, 2004). Waste disposal is particularly difficult in Lebanon because of its rugged terrain and limited surface area.

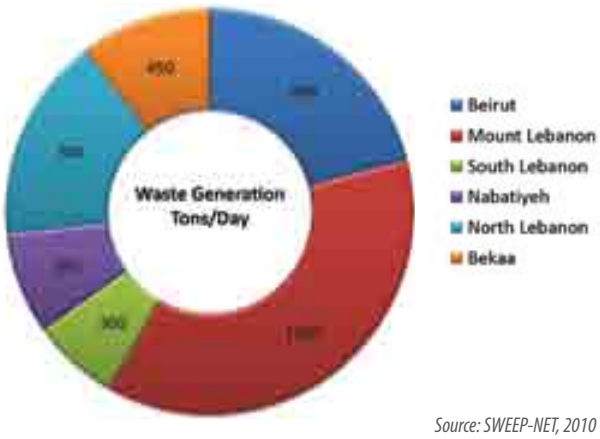
Insecurity affects waste collection services (here, during July 2006)

Box 8.1 MSW generation rate

MSW generation rates vary based on region and data source. For example: the 2001 SOER used 0.92 Kg/c/d for Lebanon (1.1Kg in Beirut and 0.85Kg for rural areas). In their 2004 Country Report, METAP used 0.5 to 0.7 KG/c/d for rural areas and 0.75 to 1.1 KG for urban areas. OMSAR used 0.5-0.6 Kg/c/d for rural areas and MOE uses 1.1Kg/c/d for urban areas and 0.7 for rural areas, with a national average of 0.96Kg/c/d. Generally, in Lebanon, urban centers produce 1.1 kg/c/d (Beirut and most of Mount Lebanon) while rural areas produce 0.7kg/c/d (North, South, Nabatiyeh and Bekaa). These rates include waste generated by tourists, restaurants and hotels.

Source: Adapted from SWEEP-NET, 2010

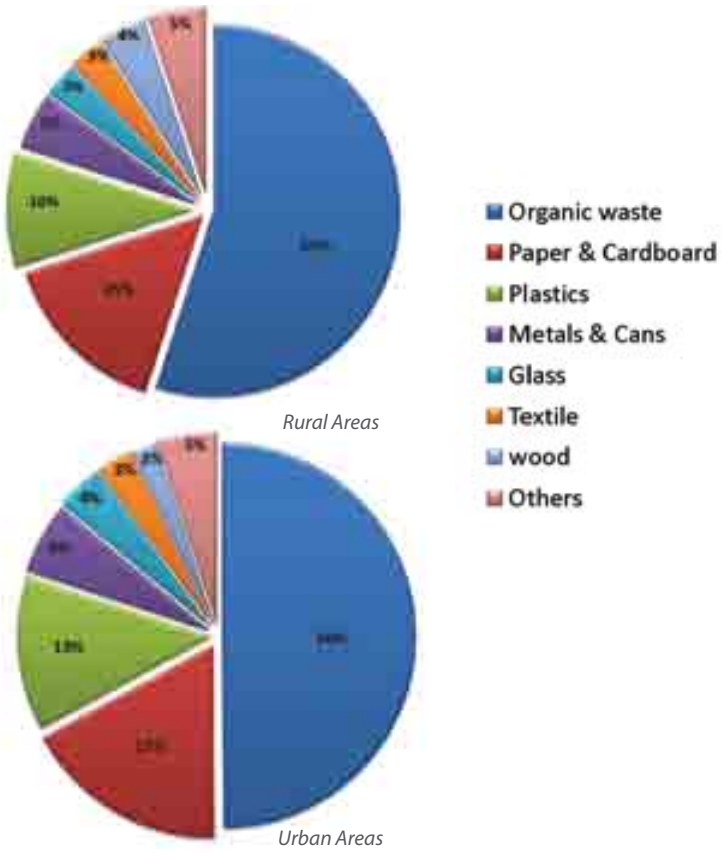
Figure 8.1 MSW Generation by Mohafaza



Source: SWEEP-NET, 2010

Waste composition varies with a person's lifestyle and economic status. The organic fraction of solid waste in Lebanon is very high, primarily because of exuberant hospitality and the makeup of Lebanese cuisine. The composition of solid waste also changes according to area (cities and commercial centers produce much more paper and plastics than rural areas) and season (during summer, the consumption of fresh produce such as fruits and vegetables goes up markedly, which affects the organic and moisture content of the waste stream). *See tentative solid waste composition in Figure 8.2.*

Figure 8.2 Solid waste composition in Lebanon



Source: SWEEP NET, 2010

Seafront open dumps pollute and spoil public beaches (here in Saida)

8.1.2 Awareness & Lifestyle

Environmental education and awareness help reduce waste generation through source separation and reuse. In the absence of serious and sustained environmental education programs in schools, universities and mass media channels, people tend to consume unabatedly, reuse less, and throw more. Social trends and marketing gimmicks resulted in excessive packaging and use of non-degradable materials that end up in dumpsters and landfills. Aggressive promotions entice consumers to buy more and fix or reuse old appliances less. Prevalent Not-In-My-Backyard (NIMBY) sentiments by the general public have so far delayed or scrapped master plans involving landfills and Solid Waste Treatment (SWT) facilities near towns and villages.

8.1.3 Political Indecision

SWM solutions require long-term vision and political commitment and consensus. So far, in the absence of both, the Government of Lebanon (GOL) has been relying on emergency response measures. The foremost example is the Emergency Plan for SWM in Beirut and Mount Lebanon (except for the caza of Jbeil), in

effect since 1997. The plan contracted Sukkar Engineering Group (today Averda Group)[1] to collect, treat, and landfill solid waste from an area serving about 2 million people. The plan was partially implemented despite controversies linked to (1) system costs, and (2) the effectiveness of sorting and composting plants. The Council of Ministers (COM) extended the management contracts for Sukleen (collection only) and Sukomi (treatment and disposal), several times since 1997 –the last contract extension, to span four years, was enacted by the COM in April 2010 and will extend through 2013.

Outside GBA, municipalities and federations are responsible for the collection, treatment and disposal of municipal waste and assume all related costs. Austerity measures by the GOL have prevented many municipalities to plan for and invest in proper solid waste systems. They typically receive their budgetary allowances from the Independent Municipal Fund (IMF) several years behind schedule and therefore tend to resort to quick solutions and fixes, including open dumping. Several international development organizations (European Union, Italian Cooperation, Spanish Agency, USAID, etc.) have stepped in by providing direct technical and financial support to individual municipalities and groups of municipalities. Such support is needed and welcomed but, at some level, delays or distracts government efforts to draw up a national plan for SWM and divert resources to ensure plan implementation.

8.1.4 Inadequate Legislation

Lebanon has legislation related to SWM but these are oftentimes outdated or incomplete. Several legal instruments do not address solid waste directly but approach solid waste concomitantly with other public issues including the protection of public health, natural sites, the Mediterranean Sea, etc. Other instruments were enacted spontaneously and with little regard for implementation. For example, Decree No. 9093 (dated 15 November 2002; amendment to Decree No. 1917/1979) stipulates that municipalities will receive financial rewards for hosting SWM facilities, including landfills, within their jurisdiction –this decree, sound at the surface, could never be implemented for a variety of reasons discussed later in this chapter.

8.2 CURRENT SITUATION

8.2.1 Key Players and Actors

The GOL, as part of its Ministerial Declaration (dated 8 December 2009), committed itself to protect the environment by finding alternatives to open dumping, and solutions for SWM (Article 16). On the energy front, the declaration also pledged to implement energy conservation measures such as adopting waste-to-energy technologies for urban areas and major cities. Pursuant to the declaration, MOE incorporated SWM as one of 10 priority themes into its Work Program for 2010-2012, working in partnership with relevant ministries (MOIM, MOF, MOPWT, MOPH, MOA, and OMSAR) and CDR. The Work Program also promotes Integrated Solid Waste Management (ISWM) covering municipal, industrial and hazardous waste, and calls for managing uncontrolled dumpsites and defining guidelines for the treatment of special waste such as e-waste (Theme No. 6). Below is a quick overview of key players and actors in the solid waste sector (for both non-hazardous and hazardous waste). See cost of environmental degradation from illegal dumping and waste burning in Box 8.2.

Box 8.2 Cost of environmental degradation from illegal dumping and waste burning

A study conducted by the World Bank in 2004 on the state of environmental degradation in Lebanon, quantified the cost of degradation caused by pollution from illegal dumping and waste burning to be around $10 Million per year, and rising.

Source: Cost of Environmental Degradation: The Case of Lebanon and Tunisia, World Bank, June 2004.

Ministry of Environment

According to MOE's new organizational structure (Decree No. 2275, dated 15 June 2009), solid waste issues fall under the Service of Urban Environment (Department of Urban Environmental Pollution Control). Notwithstanding resources availability, the Department should (1) review all studies and tender documents related to solid waste and wastewater treatment plants, (2) participate in committees for the reception of works linked to SWT facilities and landfills, (3) prepare and formulate Master plan for the management of MSW and (4) define environmental limit values for the disposal of non-hazardous solid waste (and liquid waste) in water bodies and on soil. MOE has prepared environmental guidelines for the construction and operation of sorting and composting plants, and sanitary landfills, as well as compost guidelines (unpublished)[2]. Most importantly, MOE prepared in 2005 a draft law on ISWM –*see analysis in Section 8.3.1*. In 2006, MOE coordinated with CDR the preparation of a national municipal SWM plan and was also

[1] Holding company of SUKLEEN (collection services) and SUKOMI (treatment & disposal services)

[2] Ordinance on the Quality Assurance and Utilization of Compost in Agriculture, Horticulture and Landscaping. MOE, 2004.

involved in the preparation of the 2010 Waste-To-Energy (WTE) Plan.

Ministry of Interior and Municipalities
According to Decree-Law No. 8735 (dated 23 August 1974) on the maintenance of public cleanliness, municipalities are responsible for the collection and disposal of household wastes, and the location of waste disposal sites should be approved by the health council of the Mohafaza. The Municipal Law of 1977 (legislative decree No. 118, Article 49) authorizes municipal councils to build solid waste disposal facilities. Municipalities report to the local governor and the MOIM, which manages the allocation and distribution of funds from the IMF, under the control of the MOF. Outside the GBA, municipalities use IMF resources to pay for SWM services including street sweeping, waste collection, and disposal. MOIM Decree No. 9093 (dated 15 November 2002) provides financial incentives to municipalities for hosting SWM facilities or landfills. In particular, municipalities who agree to host a sanitary landfill or a SWM facility would according to the decree receive five-folds their annual allocation from the IMF and 10-folds this allocation in case the facility serves 10 municipalities or more. To date, the decree has never been implemented. Several municipalities (Tripoli, Zahle, etc.) have developed their own MSWM services and are providing this service quite successfully and cost-effectively --*see Section 8.2.4*

Ministry of Public Health
The ministry aims to improve population health by ensuring equal access to reliable health services. Based on Decree 8377 dated 13/12/1961 and Law 546 dated 20/10/2003, the Ministry is responsible for licensing health institutions including hospitals and clinics. MOPH is therefore indirectly responsible for health care waste. The ministry, through regional Health Councils, is indirectly involved in the permitting of small-scale waste treatment facilities. Additionally, the Syndicate of Private Hospitals plays a major role in the evaluation, classification and accreditation of hospitals.

Council for Development and Reconstruction
The CDR lends support to the COM and manages infrastructure projects financed through international loan agreements. Whereas Law 501 (dated 6 June 1996) charged CDR with the implementation of the WB-funded Solid Waste Environmental Management Program (SWEMP), the program was terminated and the loan was withdrawn after extensive delays and strong public opposition to proposed landfill sites. CDR continues to be in charge of the implementation of the Emergency Plan for SWM in GBA and has also developed proposals for improving SWM services in other cities such as Tripoli and Zahle. In 2003, the COM requested CDR to devise a national municipal SWM plan (Decision No. 16 dated 14/08/2003) but the plan was aborted after strong public opposition -- *see details in Section 8.3*

Office of the Minister of State for Administrative Reform
The Office of the Minister of State for Administrative Reform (OMSAR) is a governmental organization that seeks to develop the institutional and technical capacities of ministries, other government and public agencies, and municipalities. Under the EU-funded program *Assistance to the Rehabilitation of the Lebanese Administration* (ARLA), OMSAR launched a municipal SWM program to improve the provision of solid waste services in rural areas. A new unit was created within OMSAR to manage the implementation of the €14.2 million EU-funded program (to build and equip the facilities) and related investments worth $15 million from the national treasury (to operate and maintain the facilities).

8.2.2 Treaties and Conventions Related to Solid Waste

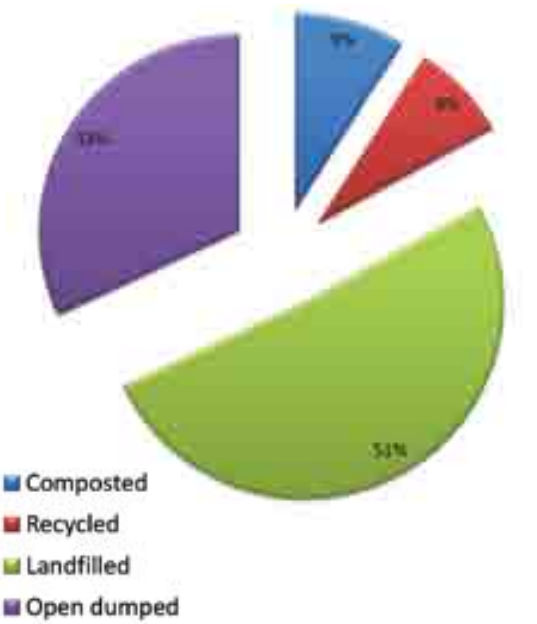
Lebanon has signed several conventions related to waste disposal (hazardous and non-hazardous) and pollution including the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter (1973), the Barcelona Convention for Protection against Pollution in the Mediterranean Sea (1976) and the Protocol for the Protection of the Mediterranean Sea against Pollution from Land-based Sources in Athens (1980). In 1994, Lebanon ratified the Basel Convention regulating the trans-boundary movement of hazardous wastes and their disposal, and requiring Lebanon to provide disposal facilities for the sound management of hazardous wastes. In 2001, Lebanon signed the Stockholm Convention on reducing and eliminating the release of persistent organic pollutants (POPs), which can be produced from thermal processes involving organic matter and chlorine (hazardous waste). The Convention also requires the GOL to improve waste management, cease open burning of solid waste, minimize the generation of municipal and medical waste through source recovery, reuse, recycling, waste separation, and promoting products that generate less waste.

8.2.3 Policy Setting

The following section describes key regulations and policy issues related to solid waste. Each legal text cited here is also listed chronologically at the end of the chapter. For a more complete analysis of environmental legislation related to solid waste, please refer to Chapter 13 of SELDAS (EU/UOB/MOE/ELARD, 2005). For a review of environmental jurisprudence cases related to solid waste in Lebanon and other countries, please refer to Chapter 13 of SEEL (MOJ/MOE/UNDP, 2010).

Over the last 15 years, Lebanon experienced a string of SWM plans, of which three plans deserve mention and analysis in this report: (1) Emergency Plan for SWM dated 1997, (2) Master Plan for SWM dated 2006, and (3) Waste-to-Energy Plan dated 2010. Despite notable progress in SWM, at least 80 percent of Lebanon's solid waste still ends up in landfills and open dumps- *see Figure 8.3* (SWEEP-NET, 2010).

Figure 8.3 Fate of MSW in Lebanon



Source: SWEEP-Net, 2010

Emergency Plan for SWM (1997-Present)

The Emergency Plan for SWM (COM Decision No. 58, dated 2/1/1997), still in force today, provides a framework for SWM in Beirut and most of Mount Lebanon (Kesrouan, Metn, Baabda, Aley, and Shouf) excluding the caza of Jbeil. Pursuant to the plan, the GOL shut down the Bourj Hammoud and Normandy dumpsites and established a waste management system comprised of the following main components:

- Sorting and baling in two facilities: Quarantina (1100 T/d) and Amrousieh (600T/d),
- Composting of organic material at the Coral facility (300T/d),
- Temporary storage of bulky and recyclable materials at the warehouse facility located near the Bourj Hammoud dump,
- Disposal of sorted MSW at the Naameh Landfill Site,
- Disposal of inert and bulky items at the Bsalim Landfill.

The contracts with Averda Group included quantity-based deliverables (i.e., compost produced and recyclables salvaged). This has created the need to negotiate adjustments to Contractor invoices, since the total amount of waste treated annually exceeded the assumptions laid forth in the Plan. In particular, the Plan assumed that the Contractor would collect 1,700 tons per day, recover 160 tons per day of recyclable material (or 9.41 percent) and compost 300 tons per day of organic waste (or 17.6 percent). Instead of aiming for percent recovery targets, the contract was geared towards the tonnage of compost and recyclables.

Master Plan for SWM (2006)

Following an explicit request from the COM (Decision 1/4952 dated 18 August 2005), MOE and CDR prepared jointly a 10-year municipal SWM plan to cover the rest of Lebanon. The plan (2006-2016) recognizes four service areas --(1) North & Akkar, (2) Beirut & Mount Lebanon, (3) Bekaa & Baalbak-Hermel, and (4) South & Nabatiyeh – and proposes an integrated approach to SWM involving collection and sorting, recycling, composting, and landfilling. It foresees that each service area will be equipped with sanitary landfills (6-7 landfills in total) and that every *Caza* will have its own waste treatment facility for sorting and composting (about 12-14 plants in total). Although the plan was approved by the COM in June 2006, the subsequent war in July 2006 drained government resources and sapped political will to implement it. Lack of public funding and consensus on the location of proposed facilities further eroded all prospects for implementation. Table 8.1 summarizes key elements of the plan.

Table 8.1 Municipal Solid Waste Management Master Plan (2006)

Service Area	MSW Generation (t/d)	Sanitary Landfills		Composting Plants		Sorting Plants	
		No	Proposed Location	No	Proposed Location	No	Proposed Location
Group 1: North Lebanon & Akkar	712	1	Srar	1	Srar	1	Srar
Group 2: Bekaa & Baalbeck-Hermel	425	2	Zahle & Teybeh	2	Zahle & Teybeh	2	Zahle & Teybeh
Group 3: South Lebanon & Nabatiye	626	2	Mazraat Bsfour & Shakraa Barashit	2	Mazraat Bsfour & Shakraa Barashit	2	Mazraat Bsfour & Shakraa Barashit
Group 4: Beirut & Mount Lebanon	2,300	1 or 2	Jiyeh (Dahr el Mghara) or Khreybeh	1 or 2	Jiyeh (Dahr el Mghara) or Khreybeh	1 or 2	Jiyeh (Dahr el Mghara) or Khreybeh
Lebanon	**4,063**	**6-7**	-	**6-7**	-	**6-7**	-

Waste-to-Energy Plan (2010)

The 2006 master plan achieved very little in the period 2006-2010. The GOL did not build any of the proposed treatment plants and landfills but several small-scale facilities that complement the master plan were implemented with grant funding from partner agencies (EU-OMSAR, EU-IMG, etc.). Recognizing this impasse, and acting pursuant to the Ministerial Declaration, the COM issued Decision 55 (dated 1/9/2010) to amend and complement the 2006 master plan. The 10-point Decision advocates Waste-To-Energy (WTE) technologies in large cities, and renews the government's commitment to the 2006 master plan in the rest of country while also exploring the feasibility of WTE systems. *See summary of 10-point plan in Box 8.3.*

Box 8.3 Summary of Waste-To-Energy Plan 2010

The COM endorses the recommendations of the inter-ministerial committee for SWM, summarized below:

1. Adopt waste-to-energy technologies in large cities
2. Adopt the 2006 master plan in the rest of the country
3. Engage the private sector in the provision of SWM services
4. Mandate MOE and CDR to reconcile and merge the two plans (2006 and 2010)
5. Mandate MOEW to draft regulations for waste-to-energy generation by the private sector
6. Incentivize municipalities that will host waste treatment facilities
7. Mandate CDR, in coordination with MOE, to contract an international consulting firm to select the most appropriate and proven technologies (through due diligence), prepare related tender documents and supervise operations
8. Mandate MOE to hire an international consulting firm to monitor system performance
9. Mandate MOE to hire a local consulting firm to promote awareness of waste-to-energy
10. Vest authority in the Prime Minister to oversee implementation and secure finances

Source: COM Decision 55 (dated 1/9/2010)

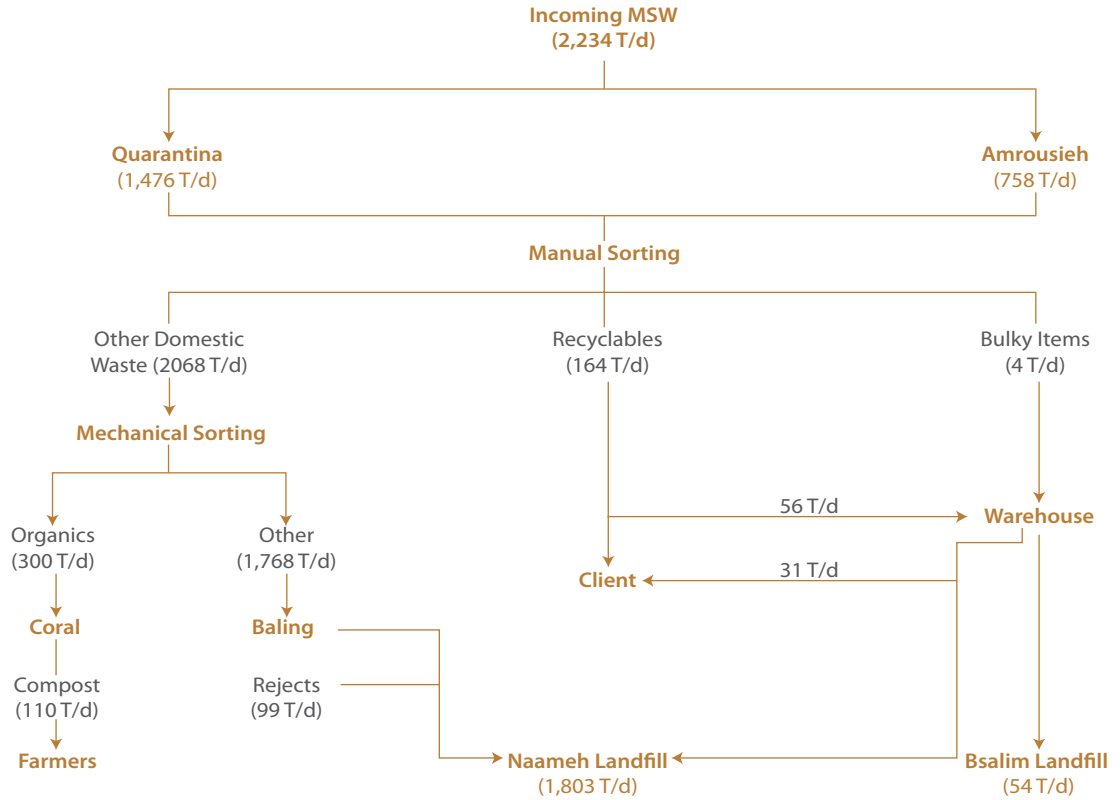
Although recycling and composting remain the first priority for managing solid waste based on the SWM hierarchy principles, the new priority in some developed countries (especially in European countries), after recycling, is the recovery of energy and metals by controlled combustion such as WTE processes. Like all technologies, WTE technologies present solid waste management costs and benefits. On the benefit site, the newest generation of WTE allows to (1) use waste as a supposedly clean renewable energy fuel to generate electricity (with at least 30% efficiency), (2) optimize land use by reducing reliance on landfills, and (3) reduce the carbon footprint (0.366 kg of CO_2/Kwh of electricity generated) as compared to power plants (0.594 kg of CO_2/Kwh) or landfill cells (1.037 kg of CO_2/Kwh). WTE also present cross-sector synergies as it would help forego a number of planned investments for treatment of sludge, hazardous waste, etc. On the cost side, the process requires pricey smoke depollution systems to capture and destroy gas pollutants including dioxins (the most dangerous and complicated compound to abate) (World Bank, 2010).

8.2.4 Municipal Solid Waste Management

Overall Management in Beirut and Mount Lebanon

In Beirut and Mount Lebanon (excluding the Caza of Jbail), SWM is still based on the 1997 Emergency Plan. Waste collection from curbside containers and other designated disposal areas is provided by Sukleen and transported to two sorting plants in Aamrousieh and Quarantina respectively. The (original) Emergency Plan assumed that Sukleen would collect 1,700 tons per day (equivalent to 620,000 t/y); and recover 160 tons per day of recyclables (9.41 percent of incoming waste). As the geographic coverage of Sukleen expanded, the design capacity of 1,700 tons per day was quickly exceeded to reach about 2,300 tons per day in 2010 and waste recovery rates dropped to around 6-7 percent (SWEEP-NET, 2010). Recyclables include cardboard (about 40-45 percent), plastics (27-29 percent), and other items (tins, wood, tires, glass, and aluminum).

Figure 8.4 Emergency Plan for SWM in Beirut and Mount Lebanon (in effect since 1997)



Source: CDR-LACECO, 2010 (data based on 2008 figures)

Commingled municipal waste in Beirut and Mount Lebanon includes green waste and cardboard

About 300 tons of organic waste (about 13 percent of incoming waste) is processed in the Coral compost plant producing 110 tons of finished compost. The remaining waste fraction (about 1,800 t/d or 82 percent of waste stream) is baled, wrapped and hauled for final disposal at the Naameh Landfill. Bulky items are sent to the Bsalim Landfill site (see flow chart of MSWM system in Figure 8.4 for year 2008). As reported in the 2001 SOER, and notwithstanding compost quality, the GOL faulted in the implementation of the Emergency Plan by not providing an additional composting plant. The current compost plant (Coral) is small and cannot handle more than 300 tons per day (equivalent to 109,500 t/y), about 17.6 percent of the waste stream envisioned in the CDR-SUKOMI contract.

Overall Management outside Beirut and Mount Lebanon

Outside Beirut and Mount Lebanon (excluding the Caza of Jbail), municipalities continue to assume lead responsibility for carrying out SWM operations (sweeping, collection and disposal), pursuant to Municipal Law No. 118 (dated 30 June 1977). Municipalities either use their own waste collection vehicles and workers or outsource the service to private contractors. Towns with no municipal councils typically piggyback on the collection and disposal system of neighboring municipalities based on mutual agreement, or illicitly. Recycling and composting outside Beirut and Mount Lebanon is estimated at 5 and 13 percent of the waste stream, respectively (SWEEP-NET, 2010).

A number of municipalities have received assistance (technical and financial) from international development organizations to improve SWM services by building small and medium-sized solid waste sorting and composting facilities. For example:

1. With grant funding from the EU, OMSAR is managing the implementation of a €14.2 Million SWM program. The program has to date financed 18 SWM activities targeting 177 municipalities representing about 1.15 Million people. The cost of each activity varied between €100,000 and €1.4 million. The type of assistance provided was determined through Expressions of Interest submitted by individual municipalities or groups of municipalities. Some municipalities received waste containers; others received waste collection vehicles, and/or sorting and composting facilities. The program also financed one sterilization center for medical waste in Abbassiyeh (south Lebanon). In 2010, the program committed the GOL to operate and maintain the newly completed facilities using public treasury funds (Decree 3860 dated 19/4/2010). The Decree has in principle secured O&M funding for three years and for three facilities (Ain Baal in Sour, Ansar in Nabatieh, and Khiyam in Marjayoun) and could be amended in the future to include additional facilities when they come online. *See overview of investment under EU-OMSAR in Box 8.4.*
2. The Italian Development Cooperation also financed many activities in the solid waste sector. In particular, the Cooperation worked with the Coordinating Committee for Voluntary Service (COSV) to improve SWM systems in four municipalities in South Lebanon (Kfar Sir, Khirbet Selm, Aytaroun, and Bint Jbail) through ROSS and ROSS II emergency program fund. Assistance ranged from facility rehabilitation/ reconstruction, to training in operation and management. More recently, the Cooperation (Italian Government) signed a €2.5 Million agreement with MOE to improve SMW services in Baalbeck. The agreement covers dumpsite closure and rehabilitation, as well as the construction of a new sanitary landfill for the caza of Baalbek, and OMSAR will complement this initiative by financing the construction of a sorting and composting facility.
3. The United States Agency for International Development (USAID) financed the construction of a number of small-scale plants, mostly in South Lebanon. These plants achieved little success for many reasons including technical (contractors did not use proven technologies), operational (limited resources to ensure preventive maintenance, power shortages, etc.), and security (physical damages during July 2006 war).

Municipal Solid Waste is mostly commingled (no source separation). Material recovery is therefore carried out at the end of the waste collection scheme at a centralized Material Recovery Facility and/or composting plant. This reduces the quality of recyclables (due to cross contamination from other waste particles as well as leachate), and leads to low recovery rates (less than 10 percent at the national level). Actual material recovery may be higher than reported rates, thanks to an organized network of scavengers who remove waste from

dumpsters and dumpsites before collection by municipal services and mechanized waste contractors. *See detailed overview of current and proposed SWM facilities in Lebanon in* ***Annex 1*** *and* ***Map 9*** *--excluding the WTE facilities proposed under the 2010 plan.*

Solid Waste Disposal: Sanitary Landfills

Lebanon has two sanitary landfills (Naameh and Zahle) and one landfill for inert materials (Bsalim). Combined, the three landfills receive solid waste from about half of Lebanon's population (2 million people). A short description of Lebanon's landfills follows.

Naameh Sanitary Landfill is located in the Shouf *caza* in an old quarry site, across a seasonal watercourse, about 15km south of Beirut and 4km from the coastline. The landfill would according to its original design cover 120,000 m^2 and receive 2 million tons of waste in two cells denoted Cell 1 and Cell 2. In April 2001, the two cells reached capacity and CDR requested SUKOMI to build Cell 3 covering an area of 62,000 m^2 [3]. This cell was further divided into Cells 3A, 3B, and 3C, which reached their full capacity in 2005 and were expanded in 2006 by an additional 25,000 m^2 [4]. In 2008 and concurrently with the extension of SUKOMI's contract period through 2011[5] SUKOMI built two new cells denoted 3D1 and 3D2, which would extend the landfill service period until July 2010 (CDR-LACECO, 2010). The landfill was expanded again in April 2010, in anticipation of a new SWM strategy for Lebanon.

Expanding the landfill required expensive land expropriations and (quite expectedly) faced stiff public opposition and protests by local residents. Since it came into operation in 1998, the Naameh Landfill has been receiving much more waste than originally planned. Whereas the Emergency Plan had estimated that it would receive 1,240 t/d (73% of incoming waste), and no more than 690 t/d (40% of incoming waste) after the planned expansion of the composting facility, the Naameh Landfill received on average 1,955 t/d in 2000; 2,208 t/d in 2004, 2,234 t/d in 2008 and 2,300 t/d in 2010. It is very unlikely that Lebanon will be able to accommodate a second Naameh Landfill on its territory. The cost of waste collection, treatment and disposal at the Naameh Landfill is approximately $150 per tonne of waste *–see Box 8.5 for the cost of municipal waste management in Lebanon.*

Bsalim Landfill for inert materials is located in a former quarry on the northern side of Nahr El Mot valley in the Metn caza. The quarry was selected by the CDR for the disposal of inert fill and bulky items as part of the restoration of the quarry and as part of the global management strategy for the GBA. The quarry site consists of semi-vertical cliffs extending almost 150m and covers an area of about 45,000 m^2. The operation activity started in April 1998 and they were interrupted severely in: (1) 31 May 1999 under Court direction, (2) 20 January 2000 due to storm that washed out the access road, (3) on the night of 5 March 2000 due to a serious rock fall on the site and (4) 3 October 2000 under Court direction. The interruptions were

The Bourj Hammoud dumpsite (closed since 1997) is an eyesore for Beirut seafront

Box 8.4 EU-OMSAR investment in solid waste facilities and services

The EU-OMSAR program supplied equipment, built waste management facilities and implemented a targeted awareness campaign on waste sorting at source. In particular, the program supplied:

(1) 13,663 container of different sizes (1,100 liters, 1,000 liters, 660 liters, 240 liters, 50 liters)
(2) 52 solid waste collection vehicles (Compactor trucks, pickups, skid steer loaders, etc)
(3) Specialized solid waste management equipment (Compost turning machines, baling presses, shredders, bagging equipment, generators, etc)

The program also built the following facilities:

(4) 5 sorting and composting facilities (capacities 150 t/d, 61 t/d, 26 t/d, 15 t/d and 10 t/d), 1 sorting facility (77 t/d) and a medical waste sterilization center (300 kg/day) –completed
(5) 3 sorting and composting facilities (120 t/d, 10 t/d and 15 t/d), 1 sorting facility (150 t/d) --ongoing
(6) 2 Sorting and composting facilities (120 t/d and 60 t/d) --planned in 2011

See details in Annex 1 - Overview of Proposed and Actual SWM Systems in Lebanon

Source: OMSAR 2011

[3] CDR Decision no.183/2001/A, dated 13 February 2001

[4] COM Decision no. 1 dated 28 June 2006

[5] CDR Decision no. 491/2008/A dated 19 June 2008

Sorting line at the Zahle solid waste treatment plant (Bekaa Valley)

temporary and operations resumed shortly thereafter. The landfill is devised into three cells with a total volume capacity of one million m^3 and expected to accommodate about 730,000 tons of waste. Materials that are accepted at this landfill include: subsoil, topsoil, rock, stone, clay, sand, tree branches, tiles and slates, brick and concrete, timber and wood, silica, glass and pottery, cement, shredded wood and shredded tires (CDR-LACECO, 2010).

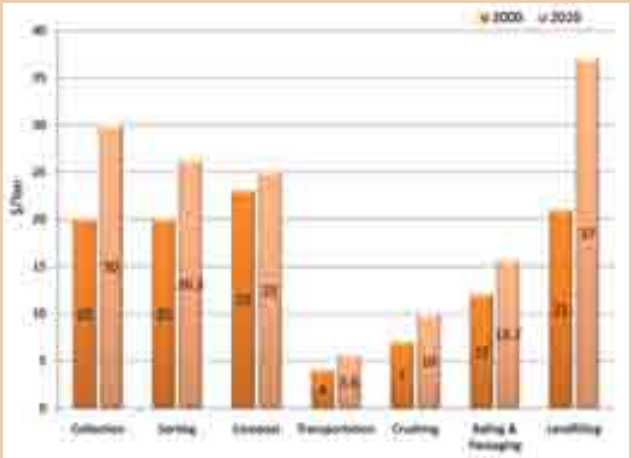
Zahle Sanitary Landfill is located in the Bekaa Valley in the *caza* of Zahle. It was designed and built in 1998 under the World Bank-funded "Solid Waste Environmental Management Project" to receive 150 tons per day, serving 15 out of 29 municipalities in the Caza of Zahle. This is equivalent to eight percent of the waste generated outside Beirut and Mount Lebanon. In 2001, CDR contracted SERDIM/SCS to operate the Zahle Landfill and rehabilitate the 30-year old dumpsite by transferring its contents to one cell. Landfill operation and maintenance costs are financed by the public treasury and the Federation of Municipalities in Zahle. In 2006, USAID Lebanon signed a $2.4 Million agreement with the Municipality of Zahle to expand the existing sorting plant and build a composting plant adjacent to the landfill. The sorting plant was completed in 2007 and started operating in 2008 by recovering 300 tons of waste daily. The compost plant (90t/d) has yet to go online. The landfill today comprises five cells (average height 24 meters) and receives about 43,000 tons per year (118 t/d). The cost of waste treatment and disposal at the Zahle SWM facility is $40/t.

Solid Waste Disposal: Open Dumping

Outside Beirut and most of Mount Lebanon, waste dumping and burning is prevalent. About 410,000 tons of MSW are dumped in the environment every year including household waste, bulky items, as well as medical, industrial, and slaughterhouse waste (MSC-IPP 2005). Based on the findings of a field report prepared by the MSC-IPP project in 2005, MOE has identified 27 priority dumpsites that require immediate attention (see list in Box 8.6). Then in 2010, as part the MOE-UNDP contract for the Preparation of a Master plan for the Closure and Rehabilitation of Uncontrolled Dumps, the Consultant (ELARD) counted about 670 open dumps (including 504 municipal and 166 construction and demolition waste) throughout the country. Dumpsite closure and rehabilitation will require colossal resources, coordination and

Box 8.5 Cost of Municipal Waste Management in Lebanon

Evolution of cost for collection services & waste treatment by Sukleen & Sukomi



Source: Le Commerce Du Levant, No 5610, November 2010 (based on World Bank 2004 & Reporter Interview CDR 2010) and Cost Recovery for Solid Waste Management in Lebanon, MOE-METAP/ELARD, 2005

Waste collection prices Unit rate ($/t)	
Saida	24
Tripoli	22
Zahle	18
Beirut	26.6
Beirut (bulky items)	17.6
Mount Lebanon	34.6

Landfilling prices Unit rate ($/t)	
Tripoli	29
Zahle Landfil	22
Naameh	38-54
Bsalim	31

Source: COM decision 3 dated 20/10/10

Box 8.6 Priority Dumpsites in Lebanon

Ashash, Deir el-Ghazel el-Jerd, El-Fekha, En-Nabi Chit, Fnaideq/Qammouaa, Ghazieh, Hamat/Batroun, Hbaline, Hermel, Jdaide/ Bebnine, Jebaa, Jebjannine, Kayyal, Kfar Habou, Kfartebnit, Kousba, Miziara, Mzar-Sannine, Qab Elias, Ras el-Ain, Saadnayel, Saida, Sarafand, Srar, Srifa, Taalbaya, Terbol el-Jerd (see distribution in Map 9).

Source MOE SWM Plan, March 2010

commitment from all parties concerned. The cost of environmental degradation from waste dumping and burning is estimated to be $10 million per year, and rising. ***Annex 1*** summarizes waste disposal practices by Mohafaza and Caza. This section examines more closely the status of two problematic seafront dumpsites.

***Tripoli Controlled Dump*.** Located on the Tripoli seafront, the dumpsite serves the city of Tripoli as well as the neighboring towns of Al-Mina, Beddawi and Qalamoun with an estimated population of 400,000. CDR contracted in 1999 BATCO, a local waste contractor, to improve waste disposal practices and manage the dumpsite by retrofitting it with gas extraction wells and flaring units. In 2003, CDR commissioned Dar al Handasah (Nazih Taleb) to prepare a study to expand the dumpsite and extend its service life[6]. The approved study recommended building a waste sorting and composting plant (requiring the expropriation of 13,000m^2) and building a gabion wall around the dump (9-10m high) to contain the waste and prevent breakage into the sea (see Figure 8.5).[7] CDR executed the sea wall in 2006 and the EU-funded SWM program tendered the construction of a 150-ton sorting plant in 2009.

The dumpsite currently covers 63,000m^2 and receives 350-400 tons per day of mixed waste including household waste, animal / slaughterhouse waste, agriculture waste, and some construction and demolition waste. Operation and Maintenance costs are covered by the Federation of Municipalities of Al Fayhaa. Although it is not a proper sanitary landfill, multiple investments and improvements have significantly reduced the environmental load of the dump by flaring about 1,000m^3 of methane gas per day, collecting leachate in a drainage ditch that extends around the dump perimeter and re-circulating it in the waste pile to accelerate decomposition, and by applying a daily cover to reduce odors and deter rodents. An on-site primary treatment unit will in the future pre-treat the leachate before discharge into a nearby wastewater treatment plant.

Saida Dump is located on the seafront, only 200 meters from nearby residences and commercial units. Managed by the Municipality of Saida, the dumpsite receives about 150 tons of solid waste per day from 15 municipalities (or 250,000 people). Originally established in 1982 to receive rubble and demolition waste from destroyed buildings, the dumpsite has received all kinds of waste since, an estimated 775,000m^3 so far (60 percent rubble and 40 percent municipal waste). The waste mountain stretches 32 meters high, covers 29,182m^2 and is an enduring eyesore to local residents and tourists. The environmental repercussions are severe; occupational hazards related to incoming health care waste, recurring waste slides into the Mediterranean Sea, and stench have invited countless complaints from local fishermen and residents.

Figure 8.5 Location of Tripoli controlled seafront dump

Source: Google Earth Imagery 2009

The dumpsite has drawn a lot of media attention as well as calls for action from government officials, philanthropic organizations and the private sector. In particular, the Prince Walid Bin Talal Humanitarian Foundation in 2004 pledged $ 5M to help clean up the dump. In 2010, IBC (a private waste contractor) completed the construction of a Mechanical and Biological Treatment Plant located about 200m south of the dumpsite. Designed to handle organic waste, the plant will go online when a service agreement is reached between the Municipality of Saida and the waste contractor (who has reportedly requested a hefty tipping fee). Meanwhile, the COM has decided to rehabilitate the dumpsite by (a) building a seawall around the dumpsite and for which the KSA has already pledged $20M, and (b) treating the waste on-site using public treasury funds and remaining funding from the Foundation. Earlier plans to relocate the dumpsite to an inactive quarry have been scrapped. The lingering problem after dumpsite closure and rehabilitation and the formal inauguration of the biological treatment plant is what to do with the inorganic waste fraction that cannot be recycled.

[6] COM decision no. 28, dated 17 June 2003

[7] COM decision no. 13, dated 15 August 2005

Saida seafront dumpsite in South Lebanon

See overview of waste disposal practices in Lebanon including landfills and dumpsites in Table 8.2.

Table 8.2 Overview of municipal waste disposal practices in Lebanon

Mohafaza (population)	*Caza*	*Waste Disposal*
North Lebanon (488,147)	Batroun	Open Dumping (Edde, Hamat, etc.)
	Bcharre	Open Dumping (Srar/Akkar, other)
	El-Koura	Open Dumping (Hamat, other)
	Minieh-Dannieh	Open Dumping
	Tripoli	Tripoli controlled dump (Tripoli, El-Mina, Bohsas, Beddawi, and Qalamoun) and open dumping elsewhere
	Zgharta	Open Dumping (Srar/Akkar, Mejdlaya, other)
Akkar (280,562)	Akkar	Open Dumping (Srar, other)
Beirut (389,661)	Beirut	Naameh and Bsalim landfills
Mount Lebanon (1,501,282)	Aley	Naameh and Bsalim landfills + limited open dumping (5 towns)
	Baabda	Naameh and Bsalim landfills + limited open dumping (1 town)
	Chouf	Naameh and Bsalim landfills
	Kesrouan	Naameh and Bsalim landfills + limited open dumping (12 towns)
	Metn	Naameh and Bsalim landfills+ limited open dumping (6 towns)
	Jbeil	Open dumping (Hbaline, other)
Bekaa (221,920)	Rachaiya	Open dumping
	West Bekaa	Open dumping
	Zahle	Zahle Landfill (15 towns) + open dumping (about 14 towns)
Baalbak-Hermel (277,518)	Baalbak	Open dumping (Kayyal, other)
	Hermel	Open dumping
South Lebanon (401,075)	Jezzine	Open dumping (Kfar Tebnit, Ras el Ain, other)
	Saida	Open dumping (Saida, Zahrani, Sarafand, other)
	Sour	Open dumping (Ras el Ain, Srifa, other)
Nabatiyeh (221,920)	Bint Jbayl	Open dumping
	Hasbaiya	Open dumping
	Marjeyoun	Open dumping
	Nabatiyeh	Open dumping (Ras el Ain, other)

Source: Adapted from MSC-IPP Report, 2005

8.2.5 Industrial Waste

Generally speaking, industrial waste is all waste produced by industrial establishments classified according to Decree 5243/2001. Lebanon's estimated 22,000 industrial establishments (see statistics in Chapter 4) generate a very diverse solid waste stream, and contribute about six percent to the total solid waste stream in Lebanon (WB-METAP 2004). A sizeable fraction of the industrial waste stream is non-hazardous (packaging, Styrofoam, wood pallets, food residues, etc.). The remainder fraction however is potentially hazardous, as defined by the Basel Convention. The composition of Lebanon's industrial waste is poorly documented and efforts to manage industrial waste are insignificant and sketchy (industrial wastewater is addressed in Chapter 3 on Water Resources). In 2002, and within the framework of a METAP Project funded by the Italian Government, the MOE prepared three draft decrees on industrial waste management: (1) licensing and permitting for industrial facilities to dispose off industrial and hazardous waste, (2) classification and management of industrial and hazardous waste and (3) healthcare waste classification. The first two drafts are not approved yet. Only the third one is approved and enacted by Decree 13389/2004. In its 2010-2012 work program, MOE included preparing "guidelines for the treatment of specific types of waste, for example, oil waste, used batteries and electronic equipment, organic pollutants and expired goods" as a priority action.

8.2.5.1 Non-Hazardous waste

Slaughterhouse Waste

Lebanon produces about 40,000 tons of slaughterhouse waste per year (METAP/Tebodin, 1998), most of which is generated in up to 10 centralized slaughterhouses located in Beirut (Karantina), Bourj Hammoud, Tripoli, Baalbak, Saida, Sour, Jezzine and Nabatiyeh (see overview in Table 8.4). None of the slaughterhouses currently provide adequate treatment of their waste (blood, internal organs, and bones). They were either primitively designed or built as temporary facilities to be replaced by proper slaughterhouses subject to funding and the acquisition of more suitable lands.

These slaughterhouses are usually run by the municipal service or by an external operator under contract to the municipality or the governor. They are rarely equipped with cold storage facilities to ensure food safety and lack basic climate control and ventilation systems for odor control. So far, the only attempt to manage slaughter waste in Lebanon is in Beirut, where the municipality contracted Cedar Environmental, a Lebanese waste contractor, to treat the waste onsite under very difficult work conditions using a double-cycle composting plant. With a nominal capacity of 30 tonnes per week (excluding blood), the plant produces an organic substrate. Achieving compliance with corresponding EU standards for the sterilization of slaughter waste would require that the waste be exposed to temperatures of at least 133°C for more than 20 minutes. A study commissioned by the Environment Fund for Lebanon (GiZ) has determined that the cost of building a modern waste treatment facility for the Beirut slaughterhouse is about $7 million (Pondus, 2009).

Table 8.3 Overview of major slaughterhouses in Lebanon

Slaughterhouse	*Waste Quantities*	*Treatment*
Beirut (Karantina)	Max. Weekly Qt. 30 t/w Max Daily Qt. 10 t/d Normal Daily Qt. 3 to 4 t/d	Double cycle composting plant which handles all organs including stomach/ intestines and bones. Liquid parts are not treated because of the slaughterhouse configuration.
Nabatieh (Kfar Joz – Wadi El Kfour)	Not Available	Not Available
Bourj Hammoud (Industrial Area)	No data on waste Qt. but on animals: 400 sheep/month and 200 cows/month	Drainage system discharges liquid waste (including blood) into the public sewer system. The Municipality of Bourj Hammoud contracted operations to a private company (OBESAR). Records of waste quantities not available.
Saida	Not Available	Not Available
Jezzine	6 t/w	Waste are sent to Saida open dump
Baalbek	Not Available	Not Available
Tripoli (Near Tripoli port)	Avg. Qty 5.1 t/m (2007)	No treatment – Solid waste (bones & contents) are sent to Tripoli Landfill – No treatment of liquid waste
Sour (Sour Entry near El Bass Roundabout)	No data on waste qty. but on animals: 20-30 sheep/day and 5-10 cows/day	Built in 2005, the slaughterhouse came online in 2010. Waste is sent to open dumps without prior treatment. Blood is filtered on site then discharged into the sewer system.
Zahle (Haouch El Oumara)	Not Available	An old slaughterhouse is out of operation. A new facility was built but is not online. Slaughtering continues in small-scale private slaughterhouses.

Source: Compiled by ECODIT for 2010 SOER

Lebanon's poultry industry is quite developed, producing slaughter waste and poultry litter. To date, only one poultry house is equipped with its own rendering plant to process waste (TANMIA); a second slaughter house is building a waste facility which is expected to go online in 2012 (HAWA Chicken). Smaller poultry houses and farms are not treating their waste stream but recycle some of the litter onsite.

Olive Oil Waste

There are 492 olive mills in Lebanon (MOE, 2006). The production of olive oil generates two types of waste: Olive Mill Wastewater (OMW) and pomace (a solid residue also known as olive cake). Although OMW is usually disposed off in streams and sewers, affecting water quality during the harvest season, both OMW and pomace are addressed in this chapter as one type of non-hazardous industrial waste. The improper management of OMW has adverse environmental impacts due to its high organic and phenolic content affecting soil and water resources. To manage this waste stream, Lebanon hosted the regional project *Integrated Waste Management for the Olive Oil Pressing Industries in Lebanon, Syria and Jordan* (2005 and 2008). Funded by the EU, and implemented under the Short and Medium Term Priority Environmental Action Program II (SMAP II), the MOE hosted the project to introduce and mainstream an integrated system for olive oil waste management in all three collaborating countries (http://olivepress.moe.gov.lb).

Selected achievements include:

1) Conducted an exhaustive survey of olive mills (492) and their complementary industries (about 36 including soap, coal, packaging and composting) to promote the exchange of by-products through an online database.
2) Estimated the cost of environmental degradation from the olive oil production sector. In 2006, this cost amounted to $13.3 million include lost fishing revenues, water treatment costs and damages to natural amenities and landscape.
3) Upgraded 10 olive oil facilities that use different pressing techniques to serve as pilots (e.g., Aoun olive oil press in Majd Al Maaouch (Chouf), Boulos Estabilisments for industry and trading in Jadayel (Jbail), Olive trade in Bayno (Akkar), Jean Nmeir olive oil press in Zahle). The project financed cleaner production method and treatment units.
4) Defined environmental limit values for waste from the olive oil industry, as well as environmental guidelines for using treated OMW in irrigation. These limit values and guidelines were published through MOE decisions 100/1/2010, 101/1/2010 and 102/1/2010. The total cost of compliance with the prescribed environmental requirements was estimated at $60,000-$275,000 per olive mill depending on facility size and technology.

8.2.5.2 Hazardous wastes

The Basel Convention (ratified by the GOL in 1994) defines and describes hazardous waste as follows: Annex I (categories of wastes to be controlled), Annex II (categories of wastes requiring special consideration), Annex III (list of hazardous characteristics), Annex VIII (list A) and Annex IX (list B). Generally, hazardous wastes are materials that pose a substantial present or potential hazard to human health or living organisms (Tchobanoglous *et al.*, 1993). Such materials are considered hazardous because they have one or more of the following properties: explosive, flammable, reactive, oxidizing, irritant, harmful, toxic, carcinogenic, corrosive, infectious, teratogenic, mutagenic, and ecotoxic. Hazardous waste cannot and should not be disposed of with the municipal waste stream. They require special handling, management and treatment.

Healthcare waste management

Healthcare Waste

Healthcare Waste (HCW) is waste generated from healthcare facilities such as hospitals, laboratories, and clinics. Decree 13389/2004 classifies healthcare wastes into four categories: (1) non-hazardous waste, (2) hazardous waste include infectious and non-infectious, (3) special waste include pharmaceuticals, chemical waste, cytotoxic and pathological, and (4) radioactive waste.

It is difficult to estimate the quantities of infectious hazardous HCW generated from all sources including laboratories and clinics. Focusing on hospitals only can produce meaningful estimates. Assuming 60 percent occupancy and an average generation rate of 1.0-1.5 Kg per bed per day[8] Lebanon's 174 public and private hospitals (about 13,668 hospital beds) produce daily about 8.2-12.3 tons of health care risk waste (about 3,000-4,500 tons per year). This estimate is lower than previous projections, which indicated that Lebanon would by 2010 produce 69 tons of HCW per day (25,200 tons per year) divided into risk waste (14t/d) and non-risk waste (55t/d) (ERM, 1999).

In the last decade (2001-2010), Lebanon has made noteworthy strides towards improving the management of infectious hazardous HCW. The first breakthrough was the enactment of Decree 8006 (dated 11/6/2002) on HCW categories and disposal methods; amended by Decree No. 13389 (dated 18/9/2004). The decree classified healthcare waste into different types, indicated the proper management and disposal of each type, and prompted several hospitals and organizations to start managing their HCW in an environmentally-appropriate manner. In particular, arcenciel (a local NGO, AEC) and EnvSys (a private waste contractor) started in 2003 to collect and treat infectious hazardous waste from hospitals and clinics. With grant funding and good management skills, AEC was able to expand its service area rapidly and reduce the unit rate for waste treatment to $0.6/kg. EnvSys closed business shortly after.

[8]Lower rate (1 kg/c/d) is based on MOE and upper rate (1.5 kg/c/d) is based on arcenciel

Currently, about two percent of private medical laboratories, 33 percent of private hospitals and 20 percent of public hospitals treat their HCW in *on-site* and *offsite* units (inside and outside hospital premises respectively). These units don't have formal permits yet but operate under temporary approvals from the MOE, renewed annually. Once the corresponding Environmental Impact Assessment (EIA) studies have been approved, the facility will receive an environmental permit from the MOE and an administrative permit from the *Mohafez*. Overall, in 2010 AEC was treating 55-60 percent of the total HCW stream (about 90% of the waste stream in Beirut), collected from 81 public and private hospitals. See national overview in Table 8.4. Some establishments including AUB/AUH and MERSACO (pharmaceutical importer) are exporting hazardous waste under Basel Convention.

Table 8.4 Overview of HCWM treatment units in Lebanon

Location	*Source of Funding*	*Operator*	*Treatment Type*	*HCW Treated Daily (kg/d)*	*No. of Hospitals served**	*No. Of beds served (actual)*	*Other Notes*
Clemenceau Medical Center in Beirut	Self	CMC & USM (private)	Microwave/ On-site	315	1/-	94	Operational
Haykal Hospital in Koura (North Lb)	Self	Haykal hospital	Microwave & Autoclave/ On-site	82	1/-	160	Operational
Hotel Dieu de France in Beirut	Self	Arcenciel	Autoclave/ On-site	385	1/3	343	Currently receives HCW from Hotel Dieu only
Zgharta (adjacent to Saydet Zgharta hospital)	AECID (Spanish)	Arcenciel	Autoclave/ Off-site	783	22/-	1,889	Operational. License pending EIA approval
Jisr el-Wati (within the premises of AEC center)	EU (LIFE)	Arcenciel	Autoclave/ Off-site	3,235	37/48	3,371	Operational. License pending EIA approval
Zahle (near Zahle landfill area)	Self	Arcenciel	Autoclave/ Off-site	332	12/-	929	Operational. License pending EIA approval
Saida (adjacent to existing WWTP in Saida seafront)	AECID	Arcenciel	Autoclave/ Off-site	1800	9/-	733	Operational. License pending EIA approval
Abbassieh HCW treatment center (South Lebanon)	EU-OMSAR	Mirage (Private)	Autoclave/ Off-site	450	3/-	325	Operational

Note: Number of hospitals served show actual number and number of hospitals according to permit

Source: Data provided by MOE and AEC (2010)

Infectious hazardous waste from facilities not reported in Table 8.4 is most likely comingled with the MSW stream. Impacts on water, soil, air and public health are potentially significant. Uncontrolled and unlicensed incineration of HCW continues in many hospitals releasing persistent organic pollutants (POPs) and other pollutants. Mercury is still used in some medical devices, such as thermometers, although efforts are underway to promote the use of mercury-free devices.

Key players and actors in HCW management include MOE (they develop environmental guidelines and review EIA studies, issue environmental approvals and permits, monitor and inspect facilities, etc.) and MOPH (they oversee public hospitals, manage the accreditation program, and examine health impacts related to HCW activities). In 2002, MOE published an "Environmental Auditing Manual for Hospitals" in Lebanon to encourage and facilitate compliance with government legislation (namely Decrees 8006/2002 and 13389/2004). In 2009, MOE launched the GEF-funded and UNDP-implemented project *Demonstrating and Promoting Best Techniques and Practices for Reducing Healthcare Waste to Avoid Release of Dioxins and Mercury* (2009-2012). The project will establish model facilities and programs to demonstrate best practices in HCWM, deploy and evaluate non-incineration HCW treatment technologies, introduce mercury-free devices in model facilities, develop and disseminate training material, and provide policy support to the GOL in relation to HCWM.

Poly-Chlorinated Biphenols (PCBs)

A Persistent Organic Pollutant, PCBs are a class of man-made compounds that were manufactured and used extensively before 1985 in both closed and open applications. Closed applications include electrical equipment such as transformers and capacitors, whereas open applications are much more diverse and include paints, printing inks, pesticides, hydraulic fluids, lubricants, synthetic rubber, floor tiles, brake linings, adhesives, and corking sealants, to name a few. PCBs are chemically stable and non-flammable. A suspected carcinogen, PCBs have also been demonstrated to cause serious non-cancer health effects on people and animals including effects on the immune, reproductive, nervous and endocrine systems.

Lebanon ratified the 2002 Stockholm Convention on the phase out of POPs including PCBs by 2025. In 2004, MOE conducted a preliminary inventory of POPs including PCBs in the electricity sector (closed applications only) and prepared in 2006 a National Implementation Plan for the phase-out of POPs (MOE-UNDP, 2006). The PCB inventory was updated and expanded in 2010 in support of an upcoming GEF Full Sized Project for PCB management and disposal. According to the updated inventory, Lebanon has 185 tons of PCB-containing power transformers and capacitors in the production and transmission sectors (of which 141 tons are out-of-service), plus an estimated 2,500 PCB-contaminated transformers in the distribution sector. The largest quantities of PCB oil are located in the Jieh power plant. PCB hotpots (evidence or high risk of leakage) are the Zouk power plant and the Bauchrieh warehouse and repairshop (WB-COWI, 2011). *See summary of inventories on dioxins and furans in Table 4.3 in Chapter 4 Air Quality.*


PCB-contaminated transformers in Bauchrieh (Metn)

Waste Oil and Sludge

Waste oil from the transport (lubrication oil) and food sectors (cooking oil) are problematic and hazardous. Inappropriate burning and disposal represent a serious pollution risk to water, soil and air. Waste oil is often used for indoor heating which represents a serious threat to public health. See private sector initiatives in the treatment of used lubrication and cooking oil in Box 8.7. Sludge accumulation in fuel storage tanks poses another disposal problem for fuel importers and the Ministry of Energy and

Water's Petroleum Directorate and Electricité du Liban. See more about sludge disposal in *Chapters 9 Energy Crisis.*

Box 8.7 Used oil treatment

In 2007, TOTAL Lebanon in partnership with Ecolib launched a nationwide project to recover and process used oils from petrol stations. The used oil is collected regularly, to be treated and valued as an alternative fuel for industries. These oils are burned at temperatures exceeding 1400 ° C. The recovery and processing of waste oils is now effective in all TOTAL stations and gradually offered to customers of general trade.

Source: www.outremer.total.com

Established in 2006, *Biodiesel Lebanon* started operating in summer 2007. Located in Nahr El Mot, the company has its own collection system and collects used cooking oil from restaurants, hotels and catering companies; about 200 tons per month from Beirut and Mount Lebanon. The cooking oil is transformed into biodiesel and glycerin.

Source: Pers. comm. Fady Faddoul, Managing Director of Biodiesel Lebanon SAL, January 2011.

8.2.6 Other Waste

In addition to municipal and industrial waste, Lebanon produces other waste streams such as electronic waste, construction and demolition waste, and special waste.

Electronic Waste

Lebanon, like the rest of the world, is experiencing a quantum leap in electronic waste, also known as *e-waste*. E-waste includes computers and peripherals, batteries, printers, faxes, scanners, cameras, mobile phones and accessories, and network components. Generally, and in the absence of a national strategy, most e-waste enters the MSW stream and ends up in dumpsites or landfills. Such disposal is problematic because e-waste contains heavy metals, (Polyvinyl Chloride (PVC) and Polychlorinated Biphenyls (PCB) that will seep into the ground or cross-contaminate organic waste, thereby affecting compost quality (in case of a composting plant) and/or pollute soil and water (in case of dumping). The disposal of e-waste also represents lost resources as computers and mobile phones can be recycled to make new products *--see for example Ecycle-me Project by Beeatoona and Nokia Take Back program with AFDC in Box 8.8.* See Table 8.5 for e-waste sources and heavy metal content.

Demolition waste in Zalka (Metn)

Box 8.8 *e*-waste reduction initiatives

In 2008, the Lebanese NGO Beeatoona launched an "E-waste and Battery Recycling for a Better Environment" project in Lebanese schools, with the aim of raising awareness among students, teachers, and their families on environmental and health risks associated with hazardous disposal of electronic waste and household batteries. In Phase 1 (ended in March 2009), the project collected batteries from 75 schools in Lebanon (about 20,000 students). In Phase 2 (launched in July 2009), Beeatoona expanded the project to "Ecycle-me", encouraging computer retail shops, companies, banks, and students, to sort and collect their e-waste through school programs and public-private partnerships. The project has to date mobilized more than 60 computer stores to serve as collection points, more than 200 schools, and several NGOs and private institutions. After collection, the waste is dismantled and stored in a warehouse in Dora for subsequent shipment to waste disposal/recycling facilities abroad. Warehousing is proving difficult because export procedures are complicated and time-consuming as they must comply with the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal. In January 2011, Beeatoona prepared a draft decree that would establish guidelines to monitor and collect e-waste from ministries. This draft decree awaits MOE review. See list of collection points at http://www.ecycle-me.org/component/Projects/Collection.asp

Source: Beeatoona 2010

In June 2010, Nokia launched its "Take Back Program" in partnership with the Association for Forest Development and Conservation (AFDC), which aims to raise environmental awareness and provide practical solutions for recycling mobile phones and accessories in Lebanon. The program requires users to drop off their old devices to Nokia Care Centers or AFDC centers. After collecting sufficient numbers, Nokia will ship the phones to Europe where up to 80 percent of the device will be recycled to help make new products such as kitchen kettles, park benches, dental fillings or even musical instruments. The primary audience for Nokia/AFDC includes universities and private companies.

Source: AFDC 2010 and www.iloubnan.info

Table 8.5 Sources of e-waste and heavy metal content

Heavy Metal	Electronic equipment
Arsenic	Microwaves, electronic circuit board, switches, relays
Cadmium	Batteries, mobile phone
Chromium	Hardener in plastics, a dye in pigments and coating for metal parts
Copper	Copper wire, printed circuit board tracks
Lead	Solder, computer or TV monitor, batteries
Nickel	Rechargeable batteries
Silver	Mobile phone
Beryllium	Motherboards, connectors
Mercury	Batteries, flat screens, switches
PVC	Screens, keyboards, mouse, laptops, flash memory

Source: Beeatoona leaflet on e-cycle, November 2010

Illegal discharge of construction and demolition waste in valley in Baskinta (Metn)

Construction and Demolition Waste

Construction waste include stones, bricks, plaster, lumber, plumbing, heating and electrical parts. Demolition waste includes waste from demolished (or damaged) buildings, uprooted roads and streets, sidewalks, bridges and other structures. Construction and Demolition waste (C&D waste) are inert materials and should be disposed off separately from the municipal waste stream as they are unsuitable for disposal in landfills or incinerators.

Lebanon has a grave disposal problem of C&D waste. Decree 8735/1974 bans the disposal of bulky and C&D waste on street sides, in public areas, water streams, on the public maritime domain or in residential areas. It also recommends the disposal of C&D waste in construction sites or in depressions. In practice however, there is very little control on the fate of C&D waste in the country. Earth moving trucks commonly tip their bucket on roadsides and down ravines, producing trails of rubbles and lasting eyesores. Illegal dumping usually happens at night, but also in broad daylight. In Beirut and Mount Lebanon, the Bsalim landfill receives some C&D waste. The rehabilitated Normandy dumpsite received C&D up and until 2009.

Lebanon has experienced several security events that have generated astonishing volumes of C&D waste, well beyond the normal rates of generation. The war in July 2006 caused extensive destruction to infrastructure, residential buildings, and commercial establishments. Physical damages were primarily concentrated in three areas (Beirut southern suburbs, districts of the South, and Baalbek-Hermel region) where significant quantities of C&D waste resulted from military operations (see waste estimates in Table 8.6).

Box 8.9 Treatment and cost of C&D waste from July 2006 war

UNDP developed several options and scenarios for the treatment and disposal of C&D. The UNDP report assessed two main treatment scenarios: (1) treatment in a fixed recycling facility, and (2) on-site treatment with mobile equipment. Each of the treatment alternatives was also assessed for different disposal options. In general, four alternative disposal options for demolition waste were considered: (1) landfilling in an inert waste landfill (Bsalim), (2) backfilling for quarry rehabilitation, (3) donating to landfills to be used as daily cover, and (4) donating to SOLIDERE for sea reclamation. According to the various scenarios, the estimated cost for the treatment and disposal of C&D waste ranged from $US4 to $33 million (Avg = $17 million) for 1 million m3 of rubble in the Beirut Southern Suburbs and between $US8 and $65.5 million (Avg = $35 million) for 1.8 million m3 of rubble in the South and Baalbek El Hermel regions.

Source: UNDP-ELARD, 2007

Table 8.6 Quantities of Construction and Demolition Waste of July 2006 War

Region	Quantity (Million m^3)	
	UNDP 2007	*Presidency of the Council of Ministers 2007*
Southern Suburbs of Beirut	1.02 – 1.87	1.43
Districts of the South	0.95 – 1.75	3.32
Baalbek-Hermel	0.54 – 0.99	1
Total	2.03 – 3.72	5.75

Source: UNDP-ELARD, 2007 and Presidency of the Council of Ministers (PCM), 2007

In Beirut's Southern Suburbs, the demolition waste was hauled to four makeshift sites, two in low-lying areas near the sea, one on the Choueifat road, and one along the Airport Road in Bourj Al Barajneh. **In the South**, some municipalities reused the waste to fill depressions in the roads or to use at other building sites. In severely hit towns (Khiam, Bint Jbail), authorities piled the waste on empty lands. Some of the waste in Aytaroun and Maroun el Ras was diverted to an abandoned dried-up pond on Aytaroun. **In Baalbek-Hermel**, the waste was dumped in an abandoned quarry and several other locations in the suburbs of Baalbek (UNDP-ELARD, 2007). See Box 8.9 for estimated cost of C&D waste treatment after the war.

The fighting in the Nahr-El-Bared Camp in North Lebanon (May 2007) produced an estimated 0.6 million cubic meters of demolition waste. Based on an agreement with the United Nations Relief and Works Agency (UNRWA), UNDP implemented a rubble removal project where debris from 5,000 housing units were cleared and transported to a nearby site, sorted, crushed, and screened prior to recovery for reconstruction activities (UNRWA, 2008b).

Bulky Waste

Bulky items are large worn-out or broken household, commercial, and industrial items such as furniture, white goods, lamps, bookcases, filing cabinets, and other similar items (Tchobanoglous *et al.,* 1993). In Beirut and Mount Lebanon, bulky items are hauled to Bsalim landfill (Nahr el Mott) pursuant to the Emergency Plan, where they are used to backfill a former quarry. With a floor area of 45,000m^2 and a design capacity of about one million m^3, the site receives broken furniture, other wood, large objects and shredded tires. Many waste fractions are banned including household waste, HCW, electrical equipment, vehicle parts, and chemical products and residues. *See more about Bsalim Landfill in* ***Section 8.2.4***. There is no formal plan for managing and storing bulky waste in other parts of the country.

Expired Goods and Medicine

There are no reliable estimates of expired goods and medicine in the country. Local authorities (customs, municipalities, regional health councils, etc.) often discover stocks of expired goods and medicine and face major difficulties in finding disposal solutions for them. The MOE has prepared environmental guidelines for destroying expired goods but there are no specialized facilities that can treat the waste. In the absence of such facilities, it can be assumed that expired drugs end up in landfills and/or open dumpsites around the country. The MOE is reviewing an EIA study for co-processing expired drugs including cytotoxic waste in cement kilns (Holcim).

Imported Waste

Decision 71/1 dated 19 May 1997 regulates the import of wastes to Lebanon. The decision presents two separate waste lists: allowed waste and banned waste. The MOE receives frequent applications and invoices for waste shipment imports to Lebanon. Waste importers must be classified industrial establishments and must produce a number of documents. According to MOE records, Lebanon imported 29,445 tons of waste in 2009 and about double this amount in 2010 (statistics provided by MOE). Imported wastes include shredded cardboard, sawdust, feathers and plastic and metals leftovers. The countries of origin include Jordan, Iraq, Turkey, Cyprus, Greece, Holland, Italy, France, Canada, and South Africa.

Used Tires

Used tires can be shredded into chips and used as a lightweight fill material for road sub-grades and for other civil and environmental engineering purposes. In Lebanon, there are currently no facilities for recovering used tires. Within Sukleen's service area, used tires are collected as part of the bulky waste stream and stored at the warehouse. A small portion is then resold to tire recycling customers while the remaining portion is shredded and sent to Bsalim landfill to be used as inert material. Outside Sukleen's service area, used tires are either (1) stockpiled in various locations (mainly near vehicles repair shops), (2) dumped haphazardly, (3) used as solid fuels for home heating, and/or (4) burned (see air pollution impacts in *Chapter 4 Air Quality*). During the rehabilitation of the Normandy landfill in Beirut,

the waste contractor shredded the used tires and used the byproduct as an inert fill material on site. Beirut residents have experienced fire accidents involving piles of tires.

Stockpiling and disposal of used tires in Bourj Hammoud

8.3 POLICY OUTLOOK AND THE WAY FORWARD

Sections 1 and 2 described the solid waste sector and analyzed the problems facing SWM in the country. This section presents an overview of policy options and needed actions to enhance SWM services in the country by enacting critical waste legislation, mainstreaming public awareness, minimizing waste generation, improving the performance of solid waste facilities, and improving solid waste disposal practices.

8.3.1 Enacting Waste Legislation

Over the past decade, Lebanon has developed important legislation (Law 444/2002, Decree 8006/2002 and Decree 13389/2004) and acceded to several new conventions (2001 Stockholm Convention). Additional legislation is needed to complete the SWM system, including:

Law on Integrated Solid Waste Management

MOE prepared in 2005 a draft law on Integrated Solid Waste Management (ISWM), as part of the EU-funded project *Regional Solid Waste Management Project (RSWMP) in Maghreb and Mashreq Countries*. The project was implemented through METAP and managed by the World Bank. The draft law was presented to COM in October 2005 and awaits approval and approval by parliament. The draft text places a premium on waste "prevention and reduction" in addition to "material reuse, recovery and power generation" and embraces private sector participation in the delivery of SWM services. Other pertinent provisions include:

- General principles related to ISWM (including waste treatment and disposal)
- Allocation of SWM responsibilities and overall institutional setting
- Information management, including data storage and record keeping
- Management of non-hazardous waste, including collection, storage, sorting, treatment, reuse, composting, power generation, and final disposal
- Management of hazardous waste, including updating classification of hazardous waste, management of medical waste, and prohibition of trans-boundary waste movement
- Financing, cost recovery, and incentives, including potential sources of financing, and cost recovery via tax exemptions and others
- Penalties and sanctions, and application of the "polluter pays principle".

Waste-to-Energy Legislation

If the government is earnestly committed to implementing Decision 55/2010 which advocates waste-to-energy technologies in urban areas and major cities, it needs to make significant headway on waste-to-energy legislation. In particular, facility operators (municipalities and/or waste contractors) would need authorization to produce and sell energy to EDL or private electricity concessions by feeding directly into their grid. On-site energy storage is still expensive and not a viable solution.

In addition, appropriate WTE technologies should be identified and assessed as part of a SEA study (see point 7 in Box 8.3). The SEA process should engage relevant and impartial experts in all stages of the WTE plan including literature review, SEA scoping, public consultation and workshops, as well as the assessment of technical and policy options. The SEA should present a complete cost estimation of the WTE plan including a comparison of costs between landfilling and WTE technologies.

Compost and Sludge Reuse Standards

There has been a lot of hype surrounding compost quality (especially compost produced from comingled MSW). There is an urgent need to finalize and endorse national guidelines for

compost quality to ensure future markets for the finished compost. Such guidelines typically recognize three types of compost categories (based on waste source and compost use) and will inform end users on how to apply compost while respecting minimum safety and handling standards.

8.3.2 Mainstreaming Public Awareness Programs

Implementing and sustaining an integrated approach to SWM requires community engagement. Raising public awareness on solid waste issues would greatly improve the performance of any SWM system, in urban centers as well as in rural villages and towns. ISWM should adopt proven technologies that are customized to the local situation and waste composition. Systems should be flexible to meet anticipated growth in waste generation and changes in waste composition (less organic/putrescible, more inorganic/recyclable material). Therefore, a critical component of any waste management program is public awareness and participation. People produce waste everyday and waste generation rates are rising. Communities must better understand waste management issues and the imminent waste crisis if we continue on the same path. Without such understanding, the success of even the best conceived waste management plan becomes questionable. Solid waste awareness campaigns should be legislated by the government and mainstreamed in both public and private schools through the Ministry of Education and Higher Education. The GOL should require media houses (radio and TV stations) to promote the campaigns free of charge. Awareness programs must be sustained over the long-run to create a gradual paradigm shift in how people perceive waste issues and handle waste at schools, in their homes, offices and other work places. *See OMSAR awareness campaign in Box 8.10*

Box 8.10 OMSAR solid waste awareness

In 2010-2011, OMSAR launched a solid waste awareness campaign urging consumers to rethink their purchasing practices by buying products with little or no packaging and buying more fresh fruits and vegetables rather than packaged/processed foods. The Campaign also seeks to reduce waste volumes and change attitudes and behavior by encouraging source separation. It targets nine cluster areas where OMSAR is implementing SWM projects with EU funding. The campaign slogan is "Think Before You Throw" (*Fakker qabel mat'kib).* For more information, visit www.omsar.gov.lb and sas.omsar.gov.lb

8.3.3 Waste Minimization

Source minimization or reduction is the first echelon in any ISWM hierarchy (See figure 8.6). It is the most effective and sustainable way to reduce waste quantities, as well as associated costs and environmental impacts. Waste reduction starts with the design, manufacture and packaging of products. It can also take place at the household level, or inside commercial and industrial facilities, through selective buying patterns and the reuse of products and materials.

Several organizations are advocating a so called "zero waste strategy" --a philosophy that encourages the redesign of resource life cycles so that all products are reused and the amount of waste sent to landfills is reduced. For instance, beverage containers (including glass bottles, PET bottles, and cans) are filled and distributed to the consumer. Conventional waste systems would see the bottle disposed in a landfill or incinerator. Under a zero waste method, the container can be saddled at the time of sale with a deposit, which is returned to the bearer upon redemption. The bottle (glass and PET) can be washed, refilled, and resold, while aluminum cans are smelted to produce new cans. This strategy helps waste reduction and incorporates manufactures, sellers and buyers in the waste reduction process.

Another waste minimization strategy is the introduction of a waste tax on selected products and goods. It is a tax applied to fees for the collection, transfer, storage, and disposal of products that will ultimately transform to waste. Waste taxes will generate revenues locally that can be reinvested into waste management technologies and services, and they will also act on the consumption behavior of the community. In Lebanon, the ministries of Environment and Finance, in coordination with the Parliamentarian Committee for Environment, are exploring the feasibility of introducing a green tax for safe collection and disposal of special waste including used engine oil, tires and batteries[9]. The tax would lure private sector interest in service delivery, by offsetting a portion of the collection and disposal costs. Private waste contractors may also demand conditional exclusivity to protect initial investment costs.

[9]Pers. comm. Edgard Chehab, Assistant Country Director, UNDP Environment & Energy Section, December 2010

Other small-scale but noteworthy initiatives in Lebanon include the recent introduction of biodegradable bags and eco-friendly bags. Several leading commercial outlets and malls

have started to provide such bags to their customers (some of them free of charge). Up-scaling this initiative could be achieved by introducing a green tax (or mandatory fee) on regular, non-degradable plastic bags, so commonly used and abused in Lebanon. Customers could then choose between regular plastic bags or a green shopping bag that can be reused many times.

Used paper and cardboard in bales destined for recycling in Lebanon

8.3.4 Improved Waste Treatment

Waste treatment is the second echelon in an ISWM hierarchy (See figure 8.6). It involves recycling and transformation. The first will reuse materials and reduce the demand on resources and the amount of waste requiring final disposal (see innovative initiative to collect plastic caps to help handicapped people in Box 8.11). The second will recover materials and convert them to products such as compost, biomass fuel pellets, shredded tires, etc. Other conversion Lebanon has come a long way in building solid waste treatment plants but these plants require additional resources, testing, and O&M training to be fully operational and reliable. Although the COM has approved master plans to build a number of facilities outside Beirut and Mount Lebanon, political will and finances are still lacking to follow the plan through. Supplementary facilities equipped with trained labors are needed to increase the amount of recyclables and organic waste. Waste recovery targets in Beirut and Mount Lebanon must improve by building a third sorting plant and by expanding the existing composting capacity and/or build a new compost facility, pursuant to the 1997 Emergency Plan.

Box 8.11 Bouchons-Roulants Project

In 2008, the Lebanese NGO Arc En Ciel (AEC) launched a new socio-environmental project "Bouchons Roulants" to encourage source separation, increase awareness of recycling, while helping physically disadvantaged individuals. AEC is relying on local communities (schools, private sector, and individuals) to collect plastic caps (Label 2-PEHD and Label 5-PP). AEC then resells the collected caps to recycling companies at $200 per ton and revenues are used to finance wheelchairs. The project has so far collected 19 tons of caps and built seven wheelchairs. They need approximately 500,000 caps to build one wheelchair. The target number of wheelchairs is 100.

Source: Pers. comm. with Rita Mouzannar, AEC

On a national level, the GOL should move towards granting limited exclusivity to waste contractors who handle special waste. That, in addition to waste taxation, will encourage the development of new treatment technologies of special waste including tires, electronic waste, biomass waste, healthcare waste, etc. Also, the GOL should seriously reconsider the terms and conditions of large-scale waste contracts. In particular, quantity-based contracts (Averda) has a perverse effect on system costs as it entices the waste contractor to increase waste collection (by expanding coverage, collecting special waste, maintaining open waste containers that store rainwater in winter, etc.). Quantity-based contracts encourage consumerism. Current and future contracts should be based on material recovery targets, whereby contractors must improve sorting and composting systems to meet those targets.

Most importantly, MOE should enforce the EIA cycle on proposed solid waste facilities but also expedite the review process by respecting review periods stipulated in the draft EIA decree. Excesive delays and slippage will deter prospective waste contractors and investors from preparing EIA studies in the first place. EIAs should place a premium on *proven* technologies and best environmental practices.

8.3.5 Improved Waste Disposal

Waste disposal is the lowest rank in the ISWM hierarchy (see Figure 8.6). Waste that cannot be recycled or recovered and has no further use will be landfilled or incinerated. Landfilling is the controlled disposal of solid waste in carefully engineered cells and it is by far the most commonly used disposal method worldwide. Waste-to-energy is a process of creating energy in the form of electricity or heat from the incineration of waste. Most waste-to-energy processes produce electricity directly

through combustion, or produce a combustible fuel commodity, such as methane, methanol, ethanol or synthetic fuels.

Lebanon has so far attempted landfilling in three locations (Naameh, Bsalim and Zahle). Landfilling has been difficult and controversial. In Naameh, the site has expanded well beyond its initial design capacity and invited stiff public opposition; in Zahle, the site is relatively secluded but has consumed prime agricultural lands, a precious natural resource in the Bekaa. The reliance on landfills generates a false sense of optimism and saps other initiatives and calls to find alternative treatment systems. Lebanon is too small to accommodate other large-scale landfills and must therefore do much more upstream, i.e., waste minimization and improved treatment and recovery of recyclables. If the GOL formally approves waste-to-energy technologies, it would have to review waste contracts and waste collection infrastructure. As a signatory to the Stockholm Convention, waste-to-energy technologies would need to comply with the most stringent emissions standards to prevent the formation and release of poly-chlorinated biphenyls (PCBs). Control parameters including incineration temperature and residence time should be controlled to reduce releases[10].

[10]Part V. General guidance on best available techniques and best environmental practices. Section B (Best Available Techniques), b (General Release Reduction Measures).

Figure 8.6 Integrated waste management hierarchy

Source: Prepared by ECODIT for 2010 SOER

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CITED LEGISLATION RELATED TO SOLID WASTE

نوع النص	الرقم	التاريخ	عنوان النص
مرسوم اشتراعي	٣٤٠	١٩٤٣/٠٣/٠١	قانون العقوبات
مرسوم	٨٣٧٧	١٩٦١/١٢/٣٠	تنظيم وزارة الصحة العامة
قرار	١/٤٢٥	١٩٧١/٠٩/٠٨	فرض استعمال أكياس بلاستيك لجمع النفايات
مرسوم	٨٧٣٥	١٩٧٤/٠٨/٢٣	المحافظة على النظافة العامة
مرسوم اشتراعي	١١٨	١٩٧٧/٠٦/٣٠	قانون البلديات
مرسوم	١٩١٧	١٩٧٩/٠٤/٠٦	تحديد أصول وقواعد توزيع أموال الصندوق البلدي المستقل المعدل بموجب: المرسوم رقم ١٧٨٣ تاريخ ١٩٩١/١٠/١٠ والمرسوم رقم ٧٤٢٥ تاريخ ١٩٩٥/١٠/٢٤ والمرسوم رقم ٣٠٣٨ تاريخ ٢٠٠٠/٥/١٩ والمرسوم رقم ٩٠٩٣ تاريخ ٢٠٠٢/١١/١٥ والمرسوم رقم ١١١٧ تاريخ ٢٠٠٨/٣/١٨
قانون	٨٨/٦٤	١٩٨٨/٠٨/١٢	المحافظة على البيئة ضد التلوث من النفايات الضارة والمواد الخطرة
قانون	٢١٦	١٩٩٣/٠٤/٠٢	إحداث وزارة البيئة
قانون	٣٨٧	١٩٩٤/١١/٠٤	الإجازة للحكومة ابرام معاهدة بازل بشأن التحكم في حركة النفايات الخطرة عبر الحدود والتخلص منها
قانون	٥٠١	١٩٩٦/٠٦/٠٦	الجازة للحكومة ابرام اتفاقية بين الجمهورية اللبنانية والبنك الدولي للانشاء والتعمير واتفاقية المشروع المتممة لها الموقعتين بتاريخ ١٩٩٥/٠٦/٠٩ (تمويل مشروع ادارة النفايات الصلبة البيئية)
قرار	١/٧١	١٩٩٧/٠٥/١٩	تنظيم استيراد النفايات
قرار مجلس الوزراء	٥٨	١٩٩٧/٠٩/٢٩	
مرسوم	٦٠٧٧	٢٠٠١/٠٨/١٦	ابرام مذكرة تفاهم وتعاون في مجال البيئة بين الجمهورية العربية السورية والجمهورية اللبنانية
قرار	١/٤	٢٠٠١/٠١/١٢	الشروط البيئية لرخص إنشاء و/أو استثمار مسالخ
قانون	٤٣٢	٢٠٠٢/٠٧/٢٩	الإجازة للحكومة الإنضمام إلى إتفاقية ستوكهولم للملوثات العضوية الثابتة
قانون	٤٤٤	٢٠٠٢/٠٧/٢٩	حماية البيئة
مرسوم	٨٠٠٦	٢٠٠٢/٠٦/١١	تحديد انواع نفايات المؤسسات الصحية وكيفية تصريفها
قرار مجلس الوزراء	١٦	٢٠٠٣/٠٨/١٤	
مرسوم	١٣٣٨٩	٢٠٠٤/٠٩/١٨	تعديل المرسوم رقم ٨٠٠٦تاريخ ٢٠٠٢/٦/١١ تحديد انواع نفايات المؤسسات الصحية وكيفية تصريفها
قرار مجلس الوزراء	١	٢٠٠٦/٠٦/٢٨	الخطة المقترحة لادارة النفايات المنزلية الصلبة وتوسعة مطمر الناعمة
مرسوم	٢٢٧٥	٢٠٠٩/٠٦/١٥	تنظيم الوحدات التابعة لوزارة البيئة وتحديد مهامها وملاكها وشروط التعيين الخاصة في بعض وظائفها
مرسوم	٣٨٦٠	١٩/٠٤/٢٠١٠	نقل إعتماد من إحتياط الموازنة العامة إلى موازنة رئاسة مجلس الوزراء – مكتب وزير الدولة لشؤون التنمية الإدارية لعام ٢٠١٠
قرار مجلس الوزراء	٥٥	٢٠١٠/٠٩/٠١	اقتراح خطة تتعلق بادارة النفايات الصلبة في المناطق اللبنانية كافة

State & Trends of the Lebanese Environment
Chapter 8 - Solid Waste

Map 9 - Solid Waste Facilities and Disposal Sites in Lebanon

This map was prepared by ECODIT based on MSC-IPP (2005), MOE-CDR Plan 2006 and OMSAR-EU Project. Every effort has been made to ensure the accuracy of the information displayed on this map. The international boundaries are approximate. MOE/UNDP/ECODIT do not assume any responsibility for any decision that may arise from the use of the map.

ANNEX 1 OVERVIEW OF PROPOSED AND ACTUAL SWM SYSTEMS IN LEBANON (EXCLUDING WTE PLANTS)

Mohafaza (population)	Caza	Waste Treatment Facilities					Waste Disposal	
		Location	Type	Tonnage	Managed by	Status	Landfill	Open Dumpsite
North Lebanon (768,709)	Batroun	Selaata	S-C	57 t/d	CDR-MOE	Not built	-	Edde, Hamat, other
	Bcharre	Berhalyoun	S-C	28 t/d	CDR-MOE	Not built	-	NA
	Koura	Kfar Hazir	S-C	62 t/d	CDR-MOE	Not built	-	Hamat, other
	Minieh-Dannieh	Minieh	S-C	61 t/d 37 t/d	OMSAR-EU	Under construction	-	Kfar Habou, Raouda, other
		Beddawi	S-C	400 t/d	CDR-MOE	Not built	-	
		Raouda	S-C	150 t/d	CDR-MOE	Not built	-	
	Tripoli	Al Fayhaa	S	150 t/d	OMSAR-EU	Under construction	Tripoli controlled dumpsite	Tripoli Dumpsite (closed)
	Zgharta	Mejdlaya	L– LB	70 t/d	CDR-MOE	Not built	-	Mejdlaya, Mizyara, other
	Akkar	Srar	S-C-L–LB	322 t/d	CDR-MOE	Not built	-	Srar, Jdeidit El Kayteh, Fnaydeq, Qammouaa, other
		Michmich	S-C	10 t/d 6 t/d	OMSAR-EU	Under construction	-	
Beirut (389,661)	Beirut	Aamrousieh	S	758 t/d	Averda	Operational	NSL, BL for inert mat.	Normandy (rehabilitated by SOLIDERE)
		Qarantina	S	1,476 t/d	Averda	Operational		
		Coral (Qarantina)	C	300 t/d	Averda	Operational		
Mount Lebanon (1,501,282)	Aley	Choueifat	S-C	NA	CDR-MOE	Not built	NSL, BL for inert mat.	Limited open dumping
		Aley	SW Services	-	OMSAR-EU	Delivered	NSL, BL for inert mat.	
	Baabda	-	-	-	-	-	NSL, BL for inert mat.	Limited open dumping
	Chouf	Dahr El Mghara	S-C-L–LB	296 t/d	CDR-MOE	Not built	NSL, BL for inert mat.	Limited open dumping
		Swayjani Community	S	26 t/d 15 t/d	OMSAR-EU	Completed		Rehabilitation and closure of Slayeb open dump
		Aali Chouf Community	SW Services	-	OMSAR-EU	Delivered		Limited open dumping
	Kesrouan	Zouk Mosbeh	S-C	NA	CDR-MOE	Not built	NSL, BL for inert mat.	Limited open dumping
	Metn	Bsalim	LB	NA	CDR-MOE	Not built	NSL, BL for inert mat.	Limited open dumping, Bourj Hammoud Dumpsite (closed without rehabilitation)
	Jbeil	Mounsef	L	NA	CDR-MOE	Not built	-	Hbaline, other
		Hbaline	S-C	102 t/d	CDR-MOE	Not built	-	
		Hbaline	S	77 t/d	OMSAR-EU	Completed	-	

Legend:
S Sorting; **C** Composting; **L** Landfill; **LB** Landfill Bulky; **BL** Bsalim Landfill, **NSL** Naameh Sanitary Landfill, **Pont. Mission** Pontifical Mission;

Source: Compiled by ECODIT based on data provided by MOE, CDR and OMSAR

Mohafaza (population)	Caza	Waste Treatment Facilities					Waste Disposal	
		Location	Type	Tonnage	Managed by	Status	Landfill	Open Dumpsite
Bekaa (499,438)	Rachaiya	Rachaiya	S-C	NA	CDR-MOE	Not built	-	Joub Jannin, other
	West Bekaa	Dakweh	S-C	83 t/d	CDR-MOE	Not built	-	Joub Jannin, other
		El Marj	SW Services	-	OMSAR-EU	Delivered	-	
	Zahle	Haouch El Oumara	S-C-L–LB	221 t/d	CDR-MOE	Operational	Zahle Landfill serves 15 towns	Qousaya, Terbol, Taalabay, Saadnayel, Qabb Elias, other
	Baalbak	Baalbeck	L	290 t/d	Italian	Pending EIA approval	-	Kayyal, Ras Baalbak, Nabi Chit, other
		Baalbeck	S-C	60 t/d 45 t/d	OMSAR-EU	Pending EIA approval	-	
	Hermel	Hermel	S-C	46 t/d	CDR-MOE	Not built	-	Hermel, other
South Lebanon (401,075)	Jezzine	Jezzine	SW Services	-	OMSAR-EU	Delivered	-	Saida, Jbaa, other
	Saida	-	-	-	-	-	-	Saida, Qennerit, Qrayet, Sarafand other
	Sour	Aabbassieh	S-C	257 t/d	CDR-MOE	Not built	-	Ras el Ain, Neftakhiyeh, Jouaiya other
		Sour	S-C	150 t/d 100 t/d	OMSAR-EU	Construction Completed	-	
		Aabbassieh	Medical Waste Treatment	300 kg/d	OMSAR-EU	Operational	-	
Nabatiyeh (221,920)	Bint Jbayl	Chacra-Baraachit	S-C-L–LB	150 t/d	CDR-MOE	Not built	-	Chacra, Aitaroun, other
		Kherbet Selm	S-C	NA	Pont. Mission -Italian	Operational	-	
		Kherbet Selm	SW Services	-	OMSAR-EU	Delivered	-	
		Aitaroun	S-C	10 t/d	Pont. Mission-Italian	Operational	-	
		Chacra	S-C	5 t/d	Pont. Mission	Operational	-	
		Bint Jbeil	S-C	10 t/d	Pont. Mission	Operational	-	
	Hasbaiya	Hasbaiya	S-C-L–LB	39 t/d	CDR-MOE	Not built	-	NA
	Marjeyoun	Khiyam	S-C	15 t/d 10 t/d	OMSAR-EU	Operational	-	Chacra, Aitaroun, Kfar Tebnit, other
		Qabrikha	C	NA	OMSAR-EU	Under construction	-	
		Taybeh	S-C	10 t/d	YMCA	Operational	-	
		Qlaiaa	S-C	5 t/d	Pont. Mission	Operational	-	
	Nabatiyeh	Ansar	S-C-L–LB	160 t/d	CDR-MOE	Not built	-	Jbaa, Kfar Tibnit, Mazraat Bsaffour, Mazraat Qalaat El Mais, other
		Ansar	S-C	10 t/d 7 t/d	OMSAR-EU	Operational	-	
		Nabatiyeh El Tahta	S-C	120 t/d 90 t/d	OMSAR-EU	Under construction	-	
		Kfar Sir	S	7.5 t/d	YMCA	Operational	-	