



International
Labour
Office



Green Jobs Assessment in Lebanon

Preliminary Assessment
Waste Management

Executive Summary¹

The purpose of this report is to make a preliminary assessment of green jobs potentials in the waste management sector in Lebanon, including solid waste management, hazardous waste management and wastewater treatment. This report provides an overview of waste management in Lebanon, considers potentials for greening the sector, and estimates current and future green jobs in waste management.

The current state of the waste management sector in Lebanon is far from ideal. Collection activities are fairly advanced when it comes to municipal solid waste, but insufficient for wastewater, and totally lacking for hazardous waste. Currently only two-thirds of the total generated solid waste undergoes some form of treatment, while the remainder is discarded in open dumpsites or directly into nature. Moreover, wastewater treatment is insufficient and Lebanon currently lacks any effective strategy or system¹ for dealing with most hazardous waste.

Incrementally, the sector is nonetheless changing. In recent years green activities such as sorting, composting and recycling have become more common, advanced medical waste treatment is being developed, and several international organisations, NGOs and private enterprises have launched initiatives to green the sector and reduce its environmental impact. Also large-scale governmental initiatives to close down and rehabilitate dumpsites and construct new waste management facilities and wastewater treatment plants are currently being planned or implemented, which will have a considerable impact in greening the waste management sector in Lebanon.

In this report, green jobs in waste management are defined as jobs providing decent work that seek to decrease waste loads and the use of virgin resources through reuse, recycling and recovery, and reduce the environmental impact of the waste sector by containing or treating substances that are harmful to the natural environment and public health. According to the findings of the report, the current numbers of green jobs in waste management in Lebanon are about 3,400. These jobs are mainly found in solid waste management (waste collection, sorting, composting, recycling and sanitary landfilling), hazardous waste management (medical waste treatment) and wastewater treatment (sewerage and operation of secondary wastewater treatment plants).

If set plans for developing the waste management sector in Lebanon are successfully implemented over the coming decade the number of green jobs in the sector is expected to increase considerably in the future. By the year 2020 about 1,900 – 2,500 new green jobs are expected to be generated in waste collection, recycling and in several planned solid waste management facilities for sorting and composting and biogas generation, as well as in wastewater treatment. Furthermore, if main strategies for the waste management sector are implemented, including strategies for municipal solid waste management, waste-to-energy, and the closure and rehabilitation of open dumpsites in Lebanon, another 640 permanent and about 400 temporary jobs could be created, as well as several thousands short-term employment opportunities in the construction of new facilities and in supply of equipment and materials.

In order to create an enabling environment for greening the sector, the recommendations provided in the assessment include emphasising job creation and skills in policy strategies, supporting small and medium sized enterprises in green waste management activities and promoting decent work throughout the waste management sector.

¹ This assessment has been prepared by Johan Ahlbäck, UNV Green Jobs. The author would like to thank Shaza G. Jondi UN Reform Analyst and Focal Point for Green Jobs at the ILO Regional Office for Arab States (ROAS) for her inputs and comments.

1. Introduction

Globally, the waste management sector is facing numerous challenges. Most noticeably, the sheer quantity of waste generated is steadily increasing. At present, a staggering 3.4-4 billion tonnes of municipal and industrial solid waste and up to 300 million tons of hazardous waste is annually produced worldwide². The composition of waste streams is also becoming more complex and varied, containing increasing amounts of plastics, chemicals, electronics as well as toxic materials, placing increasing demands on waste management systems in different countries. As the volumes and complexity increase, the risks – including human health risks, ecosystem degradation, contamination of soils and water, as well as greenhouse gas emissions – posed by the waste sector also become more serious. These risks are most obvious in developing countries where waste collection and treatment is typically insufficient or even absent³.

The waste sector in Lebanon is presently facing all of these challenges. The waste stream is steadily increasing in volume, especially with regards to municipal solid waste and wastewater, but also with regards to industrial and hazardous waste. Waste treatment varies drastically from one area to the next. Of all municipal solid waste generated in Lebanon, 53% is currently landfilled, 8% is recycled and 9% is composted, while up to 30% is disposed of in open dumps. The number and capacity of wastewater treatment facilities is severely insufficient, whereas large amounts of wastewater and raw sewage are discarded directly into rivers and the sea. Currently, Lebanon lacks any comprehensive strategy or efficient system to handle industrial and hazardous waste. As a result, the waste management system is rapidly reaching its capacity and operational limits, while the direct environmental and human health consequences are becoming increasingly alarming.

Internationally, developments are indicating an increased emphasis on greening the waste management sector. Greening waste management refers to a shift from less-preferred waste treatment and disposal methods, such as indiscriminate dumping or unsanitary land-filling towards more-preferred solutions, especially waste reduction, reuse, recycling and recovery. Greening waste management not only mitigates the negative environmental and public health effects of the sector, but also opens up new economic markets and opportunities and generates employment.

In recent years several initiatives towards greening the waste management sector in Lebanon have been supported by the government, international organisations, NGOs and private sector enterprises. This includes building new facilities for sorting and composting throughout the country, private sector activity in recycling, developments towards an advanced medical waste treatment system, as well as large-scale construction plans to improve wastewater management. Governmental policy strategies to improve municipal waste management, explore opportunities in waste-to-energy solutions, and the closure and rehabilitation of open dumpsites, are also further contributing to the greening of the waste management sector.

² From Waste to Resource – An Abstract of World Waste Survey Chalmin and Gaillochet 2009

³ Green Economy Report – Waste UNEP 2011a

These developments will have a considerable effect on the generation of green jobs in waste management in Lebanon. In greening the waste management sector new environmentally sustainable employment opportunities in a range of different occupations are expected to open up in waste collection, recycling, sorting, composting, sanitary landfilling and biogas, medical waste treatment as well as sewerage and wastewater treatment. To take advantage of on these new opportunities, there is however a need to invest and create an enabling environment for greening the sector by emphasising job creation and skills in policy strategies, supporting small and medium sized enterprises in green waste management activities with growth potentials, as well as improve labour conditions and promote decent work in both the formal and informal sector of waste management.

Objective and methodology

The objective of this report is to provide a preliminary assessment of current and future green jobs potentials in waste management in Lebanon. The assessment will focus on collection, treatment and disposal in solid waste management, hazardous waste management and wastewater treatment⁴. Through a desk review of previous studies and available data, as well as through interviews with experts and practitioners in the field⁵, the assessment seeks to present an overview of the sector, consider developments towards greening waste management by identifying challenges and opportunities, and study the implications of greening the sector on employment creation. In assessing green jobs in waste management, the report will firstly study currently practiced green waste management activities in Lebanon and estimate the employment numbers involved in these. Furthermore, the report will consider future developments and estimate the potential increase in green jobs in the sector by the year 2020. This will be done by studying current growth projections, recent and planned constructions of new facilities, as well as sector-specific policy strategies.

Structure

The assessment is structured as follows. In the next section an overview of waste management in Lebanon is provided, including current activities in the sector, projects, private sector participation and environmental impact. The third section discusses initiatives and developments towards greening waste management from an international perspective, focussing on economic, environmental and job related impacts. In the fourth section on policy and planning, developments in the sector are reviewed from the perspective of relevant strategies, legislation, institutional setup and financing mechanisms. The fifth section seeks to assess current and potential future green jobs in waste management in Lebanon and also discusses challenges regarding skills and training and decent work in the waste management sector. The final section summarizes the findings of the assessment and presents recommendations to further support green jobs creation in waste management in Lebanon.

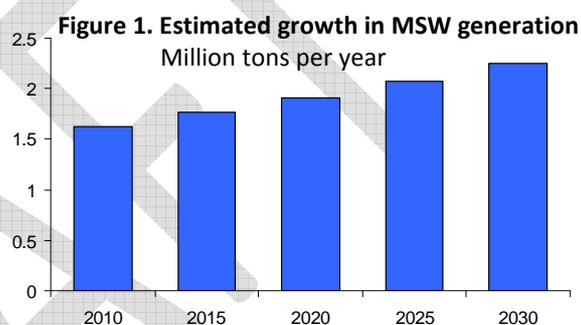
⁴ Principally, and especially with regards to efforts to prevent or minimize waste, the waste management sector could cover all sectors that generate waste, including industries, agriculture, municipalities and households. This however falls far beyond the ambitions of this assessment. Therefore the focus lies solely on waste management activities in collection, treatment and disposal.

⁵ Interviews with the following persons and organisations have been conducted in carrying out the assessment: Younis Hassib (GIZ), Farouk Mehrebi (OMSAR), Jacopo Monzini (Italian Cooperation), Bassan Sabbagh (MoE), Ahmad Zauk (IBC), Ziad Abichaker (Cedar Environmental) and Arc En Ciel. Data in this assessment has also been provided by Mohamad Baraki.

2. Waste Management in Lebanon

Waste Generation

The main elements of the waste sector in Lebanon can be divided into three categories: **solid waste**, including municipal and non-hazardous industrial solid waste; **hazardous waste**, including hazardous, medical and infectious waste; and **wastewater** and sewage. Municipal solid waste (MSW) makes up more than 80% of the total solid waste stream generated in Lebanon. The main sources of MSW are households, commercial establishments, restaurants, hotels, street markets and street cleaning operations. The composition of solid waste in Lebanon can be summarized as follows: organics 50 %, paper and cardboard 17%, plastics 13%, metals 6%, glass 4%, and others 10%. In 2001 Lebanon generated about 1.44 million tons of MSW. Projections point to a steady increase in the total waste generation. In 2009 this amount had risen to 1.57 million tons, and is further expected increase by an estimated 1.65% per year to reach 1.92 million tons by 2020. The increased MSW generation is mainly contributed to population growth, increased affluence and consumption, increased tourism and the steady return of Lebanese expatriates during the holidays and the summer season. At present, approximately 58% of all MSW is generated in Beirut and Mount Lebanon, followed by 16% in North Lebanon, 15% in South Lebanon and Nabatieh and 11% in the Bekaa⁶.



Other main sources of solid waste generation are manufacturing industries, construction, quarrying and agriculture. These account for approximately 16% of the total waste stream, amounting to about 188,000 tons of industrial solid waste generated annually, most of it being construction and demolition waste, food and beverage manufacturing waste, sludge from cement and asbestos manufacturing as well as an estimated 7,000 tons of end-of-life vehicles and 1,875,000 used car tires⁷.

In 2001, an estimated 3,338 tons of hazardous waste was generated per year, including industrial waste containing heavy metals, industrial oily wastes, paints, resins and adhesive residues, waste from pesticides manufacturing and tanneries, as well as polychlorinated biphenyls⁸. There are no current reliable estimates of the total amount of hazardous waste generated in Lebanon today. However, it is very likely that hazardous wastes from industries, agriculture and households, including electronic waste containing heavy metals, have increased substantially over the last decade. Adding to the hazardous waste stream, Lebanon annually generates 20,000 tons of medical waste, of which 5,000 tons is considered infectious⁹. In addition 40,000 tons of slaughterhouse waste is also produced every year¹⁰. Most of these types of wastes require specific treatment in order to avoid health risks, disease outbreak and environmental degradation.

⁶ METAP Country Report Lebanon GTZ-ERM-GKW 2004

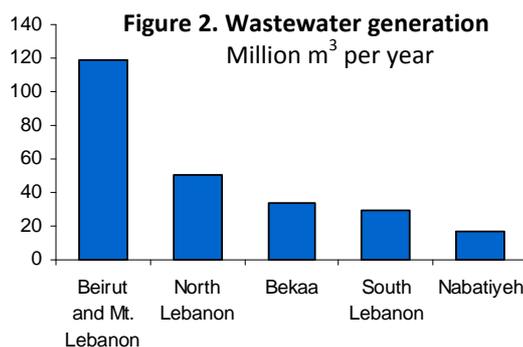
⁷ State of the Environment 2001. MoE

⁸ Ibid.

⁹ Sweep-Net Country Profile Lebanon <http://www.sweep-net.org/content/lebanon>

¹⁰ State and Trends of the Lebanese Environment MoE 2011

As for wastewater, in 2010 Lebanon generated an estimated 248.2 million m³ of municipal wastewater and raw sewage, with a total biological oxygen demand (BOD) load of 119,348 tons. By 2030 the equivalent annual figures are expected to increase to 448.3 m³ of raw sewage and 165,563 tons of BOD. The main bulk of wastewater is generated in Beirut and Mount Lebanon, almost 120 million m³ per year, while the other regions generate considerably less. In



addition to municipal wastewater, industries further generate an estimated 43 million m³ of wastewater per year, while almost 500 olive mills discharge their wastewater during olive pressing season. Wastewater also adds to the total solid waste stream, as once treated it generates sludge which needs to be disposed of. Consequently, if the total amount of wastewater generated annually in Lebanon would be properly treated, it would equal a total quantity of about 95,000 tons of dry matter per year¹¹.

Solid Waste Management

Solid waste collection coverage in Lebanon is generally considered very high, reaching 99 to 100% of the population in both urban and rural areas. Waste collection is mainly contracted to private companies, such as Sukleen in the Greater Beirut Area and Mount Lebanon, Lavajet in Tripoli, and NTCC in Saida and Jezzine, or is managed by municipalities and local contractors in other areas of the country. The quality of collection services varies. In Greater Beirut and parts of Mount Lebanon, the quality is considered to be of a very high level, however at a considerable cost, while in other main cities the quality is considered relatively acceptable, but at substantially lower costs. Although upholding high coverage, the quality of waste collection in rural areas is poorer as contractors often lack sufficient equipment while municipalities may not always have adequate enforcement capacity¹².

Once collected, an estimated 30% of all municipal solid waste (MSW) ends up in open or uncontrolled dumpsites scattered around the entire country. At present, there are 504 MSW dumps in Lebanon, with a total volume of approximately 5 million m³. Additionally, there are also 166 construction and demolition waste (CDW) dumps in different areas in Lebanon, with a total volume of about 1,7 m³. Several of the dumpsites are situated in sensitive areas with high fault and lineament density, and in proximity of rivers, streams and springs as well as urban centres and communities. The open burning of MSW is practiced frequently at several of the dumpsites¹³.

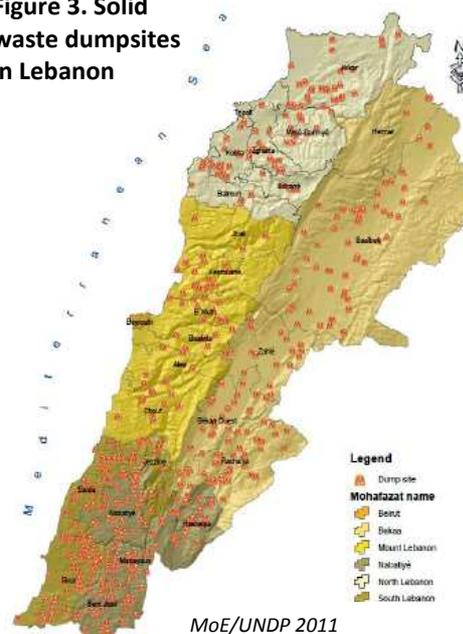
¹¹ Republic of Lebanon – Country Environmental Analysis World Bank 2011

¹² Country Report on the Solid Waste Management in Lebanon SWEET-NET 2010

¹³ Provision of consultancy services for the preparation of a master plan for the closure and rehabilitation of uncontrolled dumps throughout the country of Lebanon – Final Report MoE/UNDP 2011

The largest MSW dumpsite in Lebanon located in Saida, also known as the “Garbage Mountain”, holds a total volume of 1,2 million m³ of waste that forms a hill of around 45 meters high and 150 meters long – with direct contact with the sea. The accumulated waste is a mixture of MSW, organic and agricultural waste, industrial waste including chemicals, as well as hospital and slaughterhouse waste. Small pockets of methane gas that are formed in the internal parts of the dumpsite regularly create fires and uncontrolled burning. The dumpsite also spreads diseases and exposes the local community to a number of serious health risks, causes extensive coastal degradation and water and soil contamination, and is also a considerable contributor to greenhouse gas emissions. Currently, Saida dumpsite receives approximately 300 tons of MSW per day¹⁴. Open dumpsites like the garbage mountain in Saida have long been destined for closure, but apart from a small number of exceptions, such operations have thus far been fairly limited¹⁵.

Figure 3. Solid waste dumpsites in Lebanon



The main disposal method in Lebanon is landfilling, which covers an estimated 53% of generated MSW. A landfill is essentially a closed dump where solid and semisolid wastes are confined to a specific area, usually in a giant hole in the ground, compacted and covered over daily with a layer of soil. The waste in so called sanitary landfills is separated from the surrounding environment through thick layers of dense clay, sealed plastic liner and sand and gravel to prevent leachate. Modern sanitary landfills are also often equipped with pipes and drains to remove leachate and methane gas that develop in the landfill, and often combined with other waste treatment amenities, such as sorting, composting, recycling and waste-to-energy facilities¹⁶.

Currently there are three main landfills operational in Lebanon: the Naameh and Bsalim landfills serving Beirut and Mount Lebanon, and Zahle landfill located in the Bekaa valley. Waste disposal at Naameh began in October 1997. The site, located 3-4 km inland, has been receiving about 1,800 to 2,000 tonnes of MSW per day, well over its originally planned capacity, wherefore the landfill has been expanded already twice. The Zahle landfill, created in 2004 to receive all the solid waste generated in the Casa of Zahle, has a total capacity of

¹⁴ SWEEP-NET 2010

¹⁵ Main examples of dumpsite closures include Normandy, Borj Hamoud and Zahle. The Normandy seafront dumpsite, the only waste disposal site in Beirut during the war and at that time the largest in the country – approximately 5 million m³ – was permanently closed in 1995, after which a USD 50 million rehabilitation project has sought to decontaminate and stabilize the site, creating more than 100 hectares of reclaimed lands earmarked for public use and real estate. In 1997-2000 the Borj Hammoud dumpsite outside Beirut was closed, whereas the 700 meter long and 60 meter high dumpsite, containing nearly 4 million m³ of solid waste, was covered with soil and provided with a gas venting system. Also the Zahle dumpsite in the Bekaa was completely closed and rehabilitated in 2004 in connection with constructions of a sanitary landfill in the area. Recently, multiple investments and improvements have also been made to reduce the environmental impact of the dumpsite in Tripoli. These include building a gabion wall around the dump to contain the waste and prevent it from falling into the Sea, flaring about 1,000 m³ of methane gas per day, collecting leachate in a drainage ditch and recirculating it in the waste pile to accelerate decomposition, and applying a daily cover to reduce odour and deter rodents. (National training workshop on the draft law on integrated waste management – ELARD 2005; MoE 2011)

¹⁶ Environmental Science: Systems and Solutions 4th Edition. McKinney, Schoch and Yonavjak 2007

785,000 tons and includes a sorting plant and a leachate evaporation pond and can treat approximately 40,000 tons of MSW per year. The Bsalim landfill was mainly created for inert matters and bulky items and has a design capacity of 120 tons per day¹⁷. Another sanitary landfill site, with a total capacity of 150 tons per day, is currently being construction in Baalbeck with the support of the Italian Cooperation. The landfill, which will be combined with a sorting and composting facility as well as applications enabling biogas production, is expected to be operational in mid 2012¹⁸.

Approximately 8% of MSW in Lebanon is recycled. Collection of reusable and recyclable materials in Lebanon is mainly handled by informal scavengers in urban centres and around dumpsites. Although it is difficult to estimate the exact number, it is thought that somewhere between 2,000 and 4,000 scavengers operate in Lebanon. The main group of scavengers, so called "Arabatji", work for collection points and push carts collecting all types of recyclable items from neighbourhoods and households, waste canisters and directly from dumpsites. The main recyclables that are scavenged include cardboard, water bottles and other plastics, scrap iron, tin, copper from electric wires, car batteries and old tires, household equipment (fridges, washing machines, TV sets, etc.) as well as Styrofoam trays. Another group of scavenger, the so called "Tabbeeb", work for themselves, collecting mainly old clothes, shoes, ornaments, lamps, kitchenware, etc. and anything that they can sell at the souk. The majority of scavengers in Lebanon, especially Arabatji, are non-nationals, predominantly of Syrian origin, working on a seasonal basis.

Scavenging and recycling in Lebanon is a very organized and profitable business with a set hierarchy of scavengers, collection point owners and recycling plants. Collection points are scattered throughout urban centres and suburbs in empty lots and other empty wide spaces. These are "owned" by individuals who normally deal with a single recycling plant depending on the goods available for recycling. They have their own army of scavengers working for them, to whom they provide a homemade cart to haul scavenged goods along with food and shelter. The recycling plants, on the other hand, provide the collection point owners with pick-ups to transport recyclable items from the collection points to the recycling plants¹⁹.

There are a number of different recycling centres in Lebanon, mostly private companies, including the Lebanese Recycling Works in Roumieh (paper and plastic), SOLICAR in Wadi Shahrour (paper) as well as Liban Fonderies in Roumieh and Ohanis Kasarjian in Kfarschima (different kinds of metals). Expanding recycling businesses also include the SICOMO cardboard recycling mill in Bekaa, which recycles about 20,000 tons of paper per year in producing a variety of different cardboard products, as well as Rocky Plast in Jbeil, which recycles about 12,000 tons of different kinds of plastic for compounds in insulation sheeting, cables as well as building material. Also the NGO TERRE Liban, located in Baabda, handles recycling of paper, as well as undertakes awareness campaigns targeting young people and children to promote sorting at source and recycling in Lebanon²⁰.

What regards composting, it is estimated that approximately 9% of the MSW is composted in Lebanon, in which organic waste is converted into manure and fertilizer and sold to

¹⁷ SWEEP-NET 2010

¹⁸ Information provided by Jacopo Monzini (Italian Cooperation)

¹⁹ Policy and Institutional Assessment of SWM in Five Countries UNEP/Blue Plan/CEDARE 2000

²⁰ Paul Abi Rached presentation at Sweep-Net Regional Forum on Integrated Solid Waste Management, (April 12 -14, 2011, Beirut, Lebanon); SICOMO website: <http://www.sicomo.com.lb/>; Rocky Plast website: <http://www.rockyplast.com/index.php>

agricultural activities. It is considered that the high organic content of the MSW stream (appr. 50%) present favourable opportunities for increasing composting activities far beyond this. To be effective, however, composting requires extensive sorting efforts; otherwise the produced compost will be of poor quality, contaminated with broken glass, plastic shreds, and heavy metals²¹. Currently, the main sorting facilities in Lebanon are in Quarantina and Amroussieh, at Zahle sanitary landfill, while a smaller facility is also located in Arab Selim. These have a combined capacity of sorting about 2,500 tons of MSW per day²².

The main composting plant in Lebanon is the Coral facility in Quarantina, with a daily capacity of about 300 tons per day. Recently up to eight smaller combined sorting and composting plants have been built within the OMSAR-EU project while the constructions of further two have been started. The Italian Cooperation have also rehabilitated a number of smaller composting plants in Nabatiyeh, while the private waste management operator Cedar Environmental is further planning to construct four medium-sized composting plants in the Caza of Sour. Once all these facilities are completed and operational, the total capacity for composting in Lebanon is expected to nearly double²³.

Waste and composting can also be deployed in generating biogas. For example, an anaerobic digester for this purpose has recently been constructed in Saida. The facility, which has a capacity to treat up to 300 tons of MSW per day, separates MSW into organic and non-organic components, and treats the organic component in an anaerobic digester to produce methane gas and organic fertilizer. The methane gas is to be used in co-generation to have electric power (design capacity 2.12 MW) that runs the plant with surplus for export. Although constructions are finalized, the plant is still not operational, pending a final agreement between the operator and the local municipalities²⁴. Further, the Italian NGO COSV is currently also building a biogas digester at the planned sanitary landfill in Baalbeck, in cooperation with Italian Cooperation and OMSAR. The digester will extract methane to produce energy from biomass, and is expected to provide sufficient amounts of electricity to meet the needs of the entire waste management site²⁵.

Hazardous Waste Treatment

Hazardous wastes comprise of solid, liquid or gaseous wastes that pose substantial threats to the public or the environment. These often include substances that are chemically reactive, corrosive, flammable, explosive, or toxic to living organisms. Hazardous waste also includes medical and infectious waste as well as other waste that contain harmful substances. Engineers and scientist have long struggled with the problem of what to do with hazardous wastes. Common solutions have involved isolating such wastes from the environment in permanent waste disposal sites, transforming the material into stable, cement-like blocks that resist leachate that can be buried or otherwise disposed of, or through incineration at very high temperatures.

²¹ State of the Environment 2001. MoE

²² MoE 2011

²³ Country Report on the Solid Waste Management in Lebanon SWEEP-NET 2010; Farouk El Merhebi presentation at Sweep-Net Regional Forum on Integrated Solid Waste Management April 12 -14, 2011 –Beirut, Lebanon

²⁴ IBC Website: http://ibcinc-enviro.com/main/page_msw_saida.html

²⁵ Jacopo Monzini (Italian Cooperation); COSV website: www.cosv.org/ambiente/?lang=en

Currently, there are no specific facilities or coordinated systems in place for the safe disposal, recycling or any other form of treatment of the majority of hazardous wastes produced by industries, agriculture or in households in Lebanon. This hazardous waste includes several kinds of heavy metals, pesticides, pathogens and various potent toxic substances. At present, these are either co-disposed with the MSW stream in the country's landfills and open dumpsites or otherwise just discarded in the environment or the sea, either directly or through sewage networks²⁶.

Hazardous wastes also incorporate electronic waste (e-waste or techno trash), including computers and circuit boards, batteries, scanners, cameras, mobile phones, etc. that contain heavy metals, such as arsenic, mercury, polyvinyl chlorides (PVC) and polychlorinated biphenyls (PCB). Generally, most electronic waste enters the MSW stream in Lebanon without any sorting and ends up in dumpsites or landfills, thus cross-contaminating organic waste and affecting compost quality, or polluting soils and water²⁷. Considering that the recycling of electronic waste and recovery of valuable metals is a major potential growth market internationally, the current haphazard disposal methods applied for e-waste in Lebanon also represent considerable economic losses.

Treatment of medical and infectious waste has only in recent years been introduced in Lebanon, mainly carried out by health care facilities and private service providers. According to approved MoE licences only 6 out of 30 public hospitals and 42 out of 129 private hospitals in Lebanon treat their infectious wastes through microwaving or autoclaving either at on-site or off-site facilities²⁸. The NGO Arc de Ciel (AEC) is the main service provider in this field and operates five off-site autoclaving treatment centres distributed in different parts of the country. Also, within the framework of the OMSAR-EU project, a centre for medical waste treatment has recently been built in the village of Abbassieh in South Lebanon allowing neighbouring hospitals to safely dispose of contaminated waste through autoclaving. Combined, both the on-site and off-site medical waste treatment facilities in Lebanon treat an estimated 7,382 kg of medical waste daily. The remaining medical waste generated elsewhere in Lebanon, however, does not undergo any special treatment, but instead is mixed with MSW or discarded directly into the environment²⁹.

Wastewater Treatment

The wastewater sector in Lebanon suffers from severe lack of infrastructure. According to available statistics from 2004, only about 52% of buildings in Lebanon have access to the public sanitation network. Beirut has the highest rate of connections (94.2%), followed by Bekaa (72%), Mount Lebanon (53.7%), South Lebanon and Nabatiyeh (51.6%), while North Lebanon and Akkar (44.7%) have the lowest. The areas and buildings not connected to the sewage network often use septic tanks, cesspools or drain wastewater in dry wells or bore-holes³⁰. Large portions of the existing sewage networks are old, damaged and undersized, while a majority of dwellings and businesses connected to the network are not actually connected to a treatment plant. Rather, the bulk of their raw sewage is discharged, without adequate treatment or monitoring, into rivers, lakes or directly into the Mediterranean Sea.

²⁶ MoE 2001

²⁷ MoE 2011

²⁸ SWEEP-NET 2010

²⁹ MoE 2011

³⁰ Census of Buildings and Establishments 2004 Central Administration of Statistics

Currently, there are an estimated 53 outfalls along the 240 km coastline, discharging an estimated 162 million m³ of mostly untreated sewage into the sea. Up to 16 sewage outfalls are located in Greater Beirut between Dbayeh (North of Beirut) and Ghadir (South of Beirut) some of which are located near popular leisure and tourist attractions, including the most highly frequented public beach Ramlet el Baida and the beachfront boulevard in Rouche³¹.

At present, five larger or medium-sized pre-treatment and secondary wastewater treatment plants (serving more than 5000 people) are operational in Lebanon. Additionally some 90 very small-scale and community-based facilities exist in Lebanon (no reliable data for these latter facilities is available). The combined total designed treatment capacity of the larger and medium-sized facilities is 47 million m³ per year. This is equivalent of about 19% of all domestic wastewater generated annually in Lebanon³². Although this amount is rather modest, it should be noted that it represents a considerable increase from previous years, as for example in 1991 only 4 million m³ of wastewater was treated during the whole year³³.

The main pre-treatment plants currently operational in Lebanon are the Ghadir and Saida plants. Construction of the Ghadir plant started already in 1974, but it did not become operational until 1997. It primarily serves the Southern suburbs of Beirut and its surroundings, while also receiving influents from sewage trucks from areas not connected to the plant. The treatment plant currently treats an estimated 50,000 m³ per day, serving approximately 250,000 inhabitants. After preliminary treatment, the effluents are discharged through a submerged pipeline which extends 2,6 km into the sea. Work on the Saida pre-treatment plant started in 2001. The plant, which serves an approximate 390,000 inhabitants, treats an estimated 55,000 m³ of wastewater per day through screening and sedimentation, after which the effluents are also discharged into the sea. The main secondary wastewater plant is located in Baalbeck and has a total design capacity of treating 18,000 m³ of wastewater per day through an activated sludge process. The Baalbeck plant, completed already in 2002, has however experienced significant delays, first because wastewater networks had not been completed, and more recently because the plant is not receiving the minimum required inflow to ensure good operation. Currently, the plant is operating at only 10% of design capacity³⁴. Other operational secondary treatment plants include Fourzol and Aitanit. Both these plants use a trickling filter and have a combined treatment capacity of 6,000 m³ per day.

Recently major wastewater plants have been constructed in Tripoli, Batroun, Chekka, Jbeil and Nabatiyeh, however, these are not yet connected to the sewage network. Additionally, several secondary wastewater treatment plants are currently planned or under construction, both along the coast as well as inland. Once these have been completed and are fully operational, the entire sewage network is estimated to allow the treatment of around 80 % of generated wastewater in Lebanon by 2020, or an equivalent of 1 million m³ per day³⁵.

Wastewater reclamation or “grey water” recycling is practiced to limited extent in Lebanon, however quality standards vary drastically. For example, according to the Mediterranean

³¹ Republic of Lebanon Water Sector: Public Expenditure Review World bank 2011; NAP for the reduction of pollution into the Mediterranean Sea from land based source UNEP/GEF/MoE 2005; MoE 2011

³² Interview with Younis Hassib – German International Cooperation (GIZ)

³³ Background paper of the Mediterranean De-pollution Initiative “HORIZON 2020” DG Environment 2005

³⁴ World Bank 2011; MoE 2011

³⁵ MoE 2011; CDR Progress Report October 2010; World Bank 2011; Geara et.al. 2010

Environmental Technical Assistance Program, a considerable amount of wastewater generated in Lebanon is currently used without any form of treatment directly for agriculture. At present only smaller community-based plants or household based units carry out wastewater reclamation with sufficient treatment standards for irrigation purposes. One such is located in Jabboule and was constructed in 1998 by the Cooperative Housing Foundation (CHF) to provide wastewater treatment through aeration followed by sand filtration for a population of 600 people at a capacity of 90 m³ per day, and was designed to run until 2020. It receives only domestic wastewater since there is no industry on the watershed. The treated effluent generated by the Jabboule plant is used to irrigate the land adjacent to the plant which is planted with fruit trees (mainly grape vines)³⁶.

Projects

International development assistance and donor funding in the waste management sector in Lebanon has been significant over the past decades. Whereas some initiatives have faced serious challenges, others have been more successful. In solid waste management this has covered the construction of landfills, sorting and composting facilities, the procurement of collection equipment, and, to a limited extent, the rehabilitation of dumpsites. In wastewater management, international assistance has aimed at implementing the objectives of the National Emergency Rehabilitation Programme (NERP), mainly funded through the World Bank. The most significant past activities in the waste sector include the World Bank financed Emergency Reconstruction and Rehabilitation Project (ERRP) and the Solid Waste Environmental Management Project (SWEMP).

The ERRP was carried out between 1993 and 2002, supported by the World Bank and EIB at a total cost of USD 293 million. The project aimed at assisting the government in a number of fields, including water supply and wastewater treatment as well as solid waste management. With regards to water supply and wastewater treatment, the project was successful in repairing and rehabilitating small water and wastewater systems throughout the country, while less successful in rehabilitating larger wastewater treatment plants, and overall considered a failure in the field of solid waste management³⁷.

The SWEMP project was launched in 1995 to complement the solid waste component in ERRP. The project had originally very ambitious objectives to provide solid waste collection and treatment to the whole country, including providing 180 compactor trucks and 5,200 waste collection containers, building 15 major sanitary landfills, three composting facilities and a medical waste treatment plant. Early on, however, the project experienced severe challenges due to government changes in sector strategy and intense local resistance regarding the final locations of landfill sites. These challenges eventually led to the

³⁶ METAP 2001; MEDAWARE et al, 2004; Wastewater Utilization in Lebanon: Problems and Constraints MEDAWARE 2005

³⁷ At the end of the initial implementation period, 97 communities were provided with safe and reliable water systems and 98 with small sewage and treatment systems. After the liberation of South Lebanon in 2000, five additional water and sewage systems were rehabilitated, to the benefit of about 140 communities. The project was however less successful in rehabilitating larger wastewater treatment plants in Baalbeck, Metn and Barouk. Today, only the Baalbeck treatment plant is operational – at substantially reduced capacity. In solid waste management, the project faced various obstacles from the outset, including lack of funds in municipalities that precluded purchase of lands for sanitary landfilling, local resistance and substantive changes in government strategies. Falling far behind the original targets, the achievements at the end of the project were limited to the procurement and repair of waste collection equipment.

withdrawal of main donors, reducing the total project budget from USD 135 million to only USD 11.2 million. At the closure of the project in 2003, the achievements were limited to the construction of only one landfill site, and the project was generally considered a failure³⁸.

Within the Mediterranean Environmental Technical Assistance Program (METAP), supported by the World Bank and EU, the Regional Solid Waste Management Project (RSWMP) was initiated in a number of Mediterranean countries including Lebanon. The main objective of the RSWMP was to assist these countries to promote the adoption of sustainable Integrated Solid Waste Management (ISWM) practices through capacity building, strengthened policy, legal and institutional frameworks, enhanced private sector participation and public awareness. Through RSWMP Lebanon has been provided with extensive research, studies and expertise in developing a municipal SWM strategy and legislation for the country³⁹.

Currently, an ambitious SWM project is being implemented by the Office of Minister of State for Administrative Reform (OMSAR) in Lebanon. The project, which has a total funding of EUR 14.2 million provided by the European Commission over the period 2004 – 2013, seeks to support municipalities throughout the country in improving collection and treatment of MSW. The main elements of the project are to build 12 SWM facilities, with a combined treatment capacity of up to 7,000 tons per day, including one sterilization facility for medical waste. Several of the SWM facilities have already been built and once they are all operational, they will serve 175 municipalities and an approximate 1 million people around the country. The project has also supplied municipalities with a range of collection equipment, including 13,663 containers ranging from 1,100 litres to 50 litres, 56 solid waste collection vehicles (compactor trucks, pick-ups, wheel loader, skid steer loaders, waste transfer trucks, etc.) as well as other specialized solid waste management equipment (compost turning machines, baling presses, shredders, bagging equipment, generators, etc.)⁴⁰. OMSAR has succeeded in providing further funding of USD 15 million from the national treasury for operations and maintenance of the constructed SWM facilities for the first three years, after which the municipalities are supposed to take over the facilities⁴¹.

Also NGOs have been active in supporting the development of the waste management sector in Lebanon. In 1995 the Lebanese NGO TERRE Liban launched its first campaign “Papivore Malin” to promote sorting at source, waste collection activities in schools and paper recycling. In 2007, with financial support from UNICEF, the campaign expanded to cover all primary and intermediary public schools in Lebanon and was renamed the National campaign for Initiating Sorting and Recycling (NISR). Within the NISR-campaign, TERRE Liban has provided 30 training sessions for 946 civic education teachers and targeted over 300,000

³⁸ Project Performance Assessment Report Emergency Reconstruction and Rehabilitation Project and Solid Waste and Environmental Management Project – World Bank 2007

³⁹ At the end of the project in 2007, the SWEEP-NET centre was established in Tunisia, aimed at further promoting and developing ISWM in the member countries. The centre currently provides information-sharing in ISWM, advocacy and policy support, and promotes the introduction of planning tools, financing mechanisms and technologies that are environmentally sustainable. SWEEP-NET website: <http://www.sweep-net.org/>

⁴⁰ The OMSAR-EU project has also launched an ambitious awareness campaign to promote proper waste management and sorting at source both directed at the general public as well as municipal staff personnel. To date, around 70 public workshops and field visits have been conducted targeting more than 3,000 people, while around 180 municipal staff members have received training in specialized workshops

⁴¹ OMSAR Website: <http://www.omsar.gov.lb>

students and pupils. With the help of a truck provided by UNICEF, TERRE Liban has further also managed to collect up to 59,818 kg of paper during 2010 destined for recycling⁴².

Another Lebanese NGO, Beatoona, also launched a project in 2008 to support e-waste and battery recycling in Lebanese schools, with the aim to raise awareness among students, teachers, and their families of the environmental and health risks involved in increasing loads of electronic waste in Lebanon. To date, the project has collected batteries from 75 schools (about 20,000 students) and mobilized more than 60 computer stores and over 200 schools, other NGOs and private institutions to function as collection points for e-waste that could then be recycled. In 2011, Beatoona also prepared a draft decree that would establish guidelines to monitor and collect e-waste from the ministries⁴³.

In 2002 the NGO Lebanese Appropriate Technology Association (LATA), in cooperation with the Middle East Center for Transfer of Appropriate Technology (MECTAT), also started implementation of a project on greywater treatment and reuse in Lebanon⁴⁴. During the first phase of this project, 211 households in the Bekaa and South Lebanon were equipped with treatment units allowing greywater recycling. Through collecting greywater in small barrels, an anaerobic treatment over 2 to 3 days allowed the water to be pumped into a drip irrigation network installed in the garden. During the second phase of the project from 2008 onwards, 100 more household based treatment units as well as 5 larger units in mosques and schools were installed in the Jbeil district. Based on a greywater recovery rate up to 50 or 60%, about 100 to 150m³ of irrigation water was provided for each household participating in the project, which is sufficient for a home garden, contributing to a more efficient use of irrigation water at the local level⁴⁵.

Private Sector Participation

Apart from international organisations and NGOs, the private sector has also been considerably involved in the waste management sector in Lebanon ever since the ending of the civil war⁴⁶. In 1994 Sukleen was awarded the contract of managing waste collection in Beirut. This contract has then been periodically extended while the area for collection has expanded to cover its current size in the Greater Beirut Area and Mount Lebanon. Private companies, such as Lavanet and NTCC, are also the main operators in waste collection in other main cities. Sukleen's sister-company SUKOMI⁴⁷ handles sorting, composting and landfilling for the Greater Beirut Area, while Batco and NTCC manage the disposal of waste in dumpsites in Tripoli and Saida.

Local private waste management companies, such as IBC and CEDAR Environmental, have also been involved in the construction and operation of composting plants, while major international contractors have taken a lead in the closure and rehabilitation of dumpsites.

⁴² Paul Abi Rached 2011

⁴³ MoE 2011

⁴⁴ The project received funding from the Canadian International Development Research Center (IDRC) until 2008, and since 2008 from the Italian Cooperation.

⁴⁵ Identification and Removal of Bottlenecks for Extended Use of Wastewater for Irrigation Purpose Euromed 2009. Al-bia Wal-Tanima Environment Magazine: http://www.mectat.com.lb/metopics/GreywaterSouthLeb/Greywater_south.htm

⁴⁶ UNEP, Blue Plan, CEDARE 2000

⁴⁷ Both Sukleen and SUKOMI, previously operated by the Lebanese waste operator Sukkar Engineering Group, are today owned by AVERDA.

For example, the rehabilitation of the Normandy dumpsite was contracted to the US-based Radians through SOLIDERE that is responsible for the development of the Central Beirut District. Currently, virtually all recycling operations in the country are carried out by private enterprises, either formal or informal⁴⁸.

Other private sector companies, such as Total, Biodiesel Lebanon as well as the mobile phone manufacturer Nokia, have also recently gotten involved in the waste management sector, especially in resource recovery and recycling. Total Lebanon, in partnership with Ecolib, launched a nationwide project in 2007 to recover and process used oils from petrol stations. The used oil is collected regularly, to be treated and used as an alternative fuel for industries. Similarly, Biodiesel Lebanon, located in Nahr El Mot, collects used cooking oil from restaurants, hotels and catering companies. The cooking oil is then transformed into biodiesel and glycerine that can be sold as fuel. In 2010, Nokia launched its “Take Back Program”, aiming to raise awareness and promote recycling of mobile phones by providing drop off centres for old devices. Once sufficient numbers have been collected, they will be shipped to Europe where up to 80% will be recycled into new products, such as kettles, park benches, dental fillings, and other products⁴⁹.

Private sector involvement is generally considered a key element to increase efficiency in waste management in Lebanon, both at the technical and financial level. Therefore, increased governmental support for greater private sector participation in a range of different waste management activities has recently been announced. These include the construction, operation, maintenance and repair, modernization, control, monitoring and post-closure care of waste management facilities, as well as different institutional responsibilities regarding privatization of current waste management operations and reliable procurement procedures for future private sector led waste management projects⁵⁰.

Impact on the environment including climate change and pollution

The environmental consequences of the current state of the waste management sector in Lebanon are increasingly serious. Whereas the haphazard disposal of solid municipal and industrial waste in open dumpsites or insufficient landfills contributes to a mix of air, soil and water pollution, the lack of a functioning hazardous waste system is presenting increasing threats to public health and the environment, while the inadequate wastewater system is severely polluting surface and groundwater as well as coastal waters and beaches. More broadly, the Lebanese waste sector is also contributing to global warming through the emission of greenhouse gases (GHG) as well as to the rapidly deteriorating condition of the Mediterranean Sea.

The waste sector, including solid waste, wastewater and medical waste incineration, is the largest emitter of methane gases (CH₄) in Lebanon, accounting for 87.5% of the total CH₄ emissions in the country. Furthermore, the waste sector also produces about 9% of all the Nitrous Oxide (N₂O) emissions in the country. According to Lebanon’s Second National Communication to the UNFCCC, the waste sector generated in total 1,739.36 Gg CO₂ eq in the year 2000, or 9.4% of the total GHG emissions for that year. By the year 2004, the total

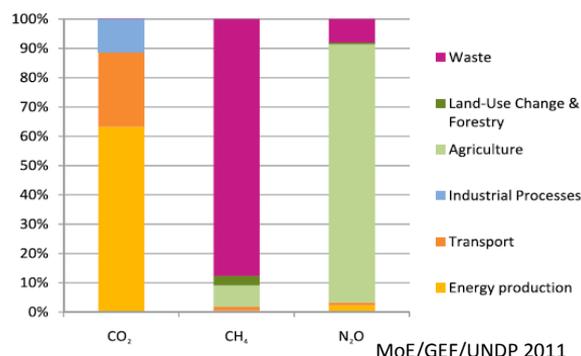
⁴⁸ SWEEP-NET 2010

⁴⁹ MoE 2011

⁵⁰ SWEEP-NET 2010

estimated GHG emissions for the waste sector had increased to 2,227 Gg CO₂ eq, representing an increase of 146% from 1994.

Figure 4. Greenhouse gas emissions by sector



The absolute bulk of GHG emissions in the waste sector result from solid waste disposal on land, which constituted for 94.3% of the sector's GHG emissions in 2000. This is mainly generated from managed semi-aerobic sites, such as the landfills in Nahmeh and Zahle, open dumpsites, especially at Sour, Saida and Tripoli, and other disposal methods on land. Although open burning of MSW is commonly practiced at open dumpsites in Lebanon, generally resulting in substantial GHG emissions, reliable data for these practices are unavailable. Emissions from wastewater handling were estimated at 93.6 Gg CO₂ eq in 2000, mainly resulting from the biodegradation of wastewater in natural water bodies or collected in septic tanks. Medical waste treatment and the incineration of clinical waste further contributed 3 Gg CO₂ eq in 2000⁵¹.

Locally the solid waste sector, and especially the practice of open burning of MSW and old tires, generates a number of air pollutants and pathogens, including carbon oxides, nitrogen oxides as well as dioxins and furans, which are detrimental to human health and the environment. Open dumpsites also spread bacteria and vector-borne diseases through rats, flies and insects, and also produce foul odours that have a negative impact on the quality of life for the local residents while also discouraging tourism and recreational activities in the area⁵².

Open dumpsites and landfills in Lebanon further release substantial amounts of leachate that contaminate soils, rivers, groundwater and coastal waters. Leachate forms as water percolates through the waste refuse in a dumpsite or landfill, either from top through rainfall, or laterally due to groundwater flow intercepting the waste. Essentially it is a liquid solution containing any chemicals and particles that can be dissolved or leached from the waste. Depending on the waste contents, the leachate can be a very hazardous brew of toxins and heavy metals, often containing high levels of biological oxygen demand (BOD), and in some instances even live disease-producing micro-organisms⁵³. The Bourj Hammoud dumpsite, although closed since 1997, still releases an estimated 120,000 tons of leachate annually, including 36 tons of BOD and 360 tons of heavy metals per year, which seeps directly into the coastal waters surrounding Beirut and Jounieh. The Naameh dumpsite releases about 90,000 tons of leachate per year, which is then trucked to the Ghadir pre-treatment plant, mixed with raw sewage, and then discharged into the sea via the submerged sea outfall. In 2004, the Tripoli dumpsite was still releasing an estimated 24,000 tons of leachate annually, including 7.2 tons of BOD and 72 tons of heavy metals per year⁵⁴. To what extent recent constructions of a seawall and leachate ditch have managed to mitigate this has not been studied.

⁵¹ Lebanon's Second National Communication to the UNFCCC MoE, GEF, UNDP 2011 (unpublished)

⁵² MoE 2011

⁵³ McKinney, Schoch and Yonavjak 2007

⁵⁴ UNEP/GEF/MoE 2005

Hazardous wastes present risks to the environment and public health, and if dumped indiscriminately, often to both. Soils polluted by hazardous wastes and heavy metals may affect people who live on it, plants that put roots into it, and animals that move over it. Toxic substances that do not break down, or that bind tightly to the soil, may be taken up by growing plants and can later appear in animals that eat crops grown there, and in turn, also affect the people who eat the plants or animals. If rivers and lakes are polluted and become toxic enough, they may kill animal and plant life immediately or more slowly over a longer time period. Compounds such as dichlorodiphenyltrichloroethane (DDT), polychlorinated biphenyls (PCB), and dioxins are more soluble in fats than in water and therefore tend to build up in the fats within plants and animals. These substances may be present in very low concentrations in water but accumulate to higher concentrations within algae and insects, and build up to even higher levels in fish. Birds or people that feed on these fish are then exposed to very high levels of hazardous substances⁵⁵. Several health effects may affect people exposed to hazardous waste. These include cancers, respiratory and heart diseases, genetic defects, damages to the central nervous system and congenital anomalies. To date, however, no comprehensive studies have been carried out to assess the public health impacts of hazardous waste in Lebanon.

Regarding the wastewater sector, the large amounts of raw sewage discharged without any regulations or controls are also having an adverse effect on rivers, groundwater and coastal waters and beaches in Lebanon. Such contamination also has an effect on the availability of clean water for drinking, bathing and irrigation as well as on the economic sectors relying on these, such as agriculture, fisheries and tourism.

Particularly polluted rivers include the Litani, Kabir and Zahrani rivers, which all show high levels of BOD as well as bacteriological contamination resulting from sewage discharge, as well as traces of heavy metals, including arsenic, mercury and chromium, reflecting continued exposure to industrial wastewater. Other rivers contaminated by raw sewage also include the Abou Ali, Ibrahim and Antelias rivers, which have BOD levels, total coliform and E.coli values far beyond set requirements for drinking or bathing water. Water samples from aquifers in Lebanon have also shown high levels of nitrate and faecal coliforms, implying that contamination from raw sewage and leachate is affecting groundwater quality⁵⁶. Samples from main beaches in Lebanon such as Ramlet el Bayda and Saida beach, both of which have two proximate sewage outfalls respectively, have further shown considerable bacteriological contamination resulting from the discharge of raw sewage in the Mediterranean. Whereas the MoE set standard for faecal contamination in bathing water is 100 (CFU)/100ml⁵⁷, samples at the 95th percentile in Saida beach have shown values as high as 19,455 (CFU)/100ml, while samples in Ramlet el Bayda beach have shown even higher values; 55,742 (CFU)/100ml⁵⁸. If the contamination of groundwater, rivers and coastal waters from untreated raw sewage is continued unabated, their uses for drinking, bathing and irrigation may become severely compromised in the near future.

⁵⁵ McKinney, Schoch and Yonavjak 2007

⁵⁶ MoE 2011

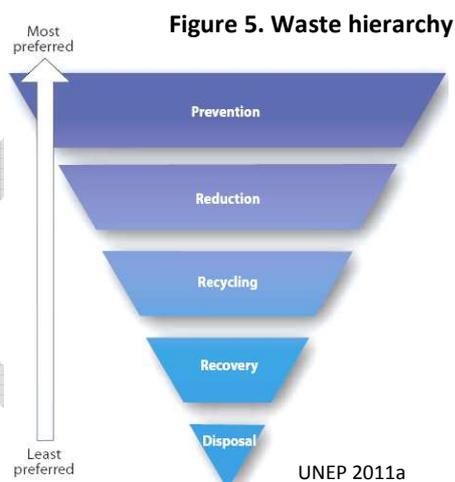
⁵⁷ MoE Decision 52/1 of 1996

⁵⁸ MoE 2011 based on National Centre for Marine Sciences and WHO 2011: Profile of Five Beaches in Lebanon

3. Greening Waste Management and International Developments

As advanced, emerging and developing economies worldwide are facing similar problems with regards to escalating and more complex waste streams, mounting pressures on waste management infrastructures, and the environmental and public health consequences thereof, increased attention has been given to “greening” the waste management sector. Supported by a broad range of different actors, including international organisations, individual countries as well as private sector enterprises, greening the waste sector is shown to provide a range of economic, environmental as well as social benefits.

Greening waste management refers to a shift from less-preferred waste treatment and disposal methods, such as indiscriminate dumping and basic incineration (without energy recovery), towards more-preferred solutions, especially waste reduction, reuse, recycling and recovery. Based on the internationally recognised approach of Integrated Solid Waste Management (ISWM), the strategy of greening is to move upstream in the waste management hierarchy towards more environmentally sustainable waste management options⁵⁹.



Both with regards to solid and hazardous wastes, crucial elements in greening waste management involves promoting waste reduction at source, investing in effective waste collection systems and sorting facilities, supporting reuse, recycling and composting activities, enabling energy recovery through waste-to-energy (WtE) solutions and, as a last resort, opting for confinement in sanitary landfills⁶⁰. In wastewater treatment, greening the sector implies investing in efficient wastewater collection and sewerage, maximising wastewater treatment capacity and quality (at minimum secondary wastewater treatment) and enabling wastewater reuse or reclamation⁶¹.

The overall long-term objective for greening the waste management sector, including solid and hazardous wastes as well as wastewater, is to establish an economy in which the use of materials and the generation of waste is reduced to a minimum, any unavoidable waste is recycled, composted or remanufactured, and any remaining waste is treated in a way that causes the least damage to the environment and human health and that enables the recovery of valuable resources.

Greening the waste management sector involves several economic and environmental benefits. In recycling alone, considerable economic and environmental savings can be made in mining and manufacturing of virgin resources, more efficient use of water and energy, as

⁵⁹ UNEP 2011a

⁶⁰ Waste and Climate Change: Global Trends and Strategy Framework UNEP 2010

⁶¹ Green Economy Report: Water UNEP 2011b

well as reduced green-house gas emissions (see table 2). Other benefits of greening waste management also include auxiliary compost and energy production from solid waste, irrigation water, compost and fertilizers from treated wastewater effluents and sludge, as well as avoidance of environmental degradation and public health hazards and the consequential costs thereof.

Material	Energy savings (%)	Water savings (%)	GHG savings (kg CO ₂ -eq/ton)
Aluminium	90-95	NA	95
Ferrous	74	NA	63
Steel	62-74	40	NA
Paper	40	58	177
Plastic	80-90	NA	41
Glass	20	50	30

Source: UNEP 2011a; McKinney, Schoch and Yonavjak 2007

Despite limitations in available data, there are many indications that the market for waste management is growing. This growth is driven by the overall increase in waste generation, rising political awareness of the need to better manage waste to avoid environmental and public health hazards, growing urbanisation accompanied by increased interests and demands for improved living environments including better waste management, as well as growing economic opportunities for the private sector in the waste sector. The increasing scarcity of natural resources and the rising costs of extracting raw materials, developments in formal and informal trade in recyclables, and the emergence of new waste management technologies, are further also contributing to the growth of the waste market. All these developments have opened up significant opportunities for greening the waste sector⁶².

Excluding the informal sector, the total market value of economic activities associated with the waste sector globally, including everything from collection to recycling and disposal, is currently estimated at some USD 410 billion per year. This has opened an expanding market for waste recovery, ranging from recycling and trade in secondary materials, especially ferrous and non-ferrous scrap, paper and plastics, to compost production and WtE facilities. In total, these forms of waste recovery currently represent global volumes of about one billion tons per year – roughly equivalent of 25 % of all solid waste generated annually worldwide⁶³. The waste-to-energy market alone was estimated at USD 19.9 billion in 2008 and expected to further grow by 30% by the year 2014⁶⁴.

New markets have also appeared in recycling electronic waste. According to estimates, some 20 to 50 million tons of e-waste is generated globally per year, including old computers, mobile phones, TVs, refrigerators, and other electrical and electronic devices. This occurs especially in advance industrial economies, but emerging and developing economies, particularly China, India, Brazil and South Africa, are quickly catching up. Although substantial efforts have to be made in establishing efficient collection and sorting systems for e-waste, and in introducing proper recycling methods and technologies to avoid environmental and health hazards associated with recycling heavy metals, the potentials in this market are considerable. For example, in recycling only one ton of electronic scrap from computers, more gold can be recovered than from 17 tons of gold ore, and up to 40 times more concentrated copper than that is found in copper ore. Moreover, one ton of mobile phones (approximately 6,000 handsets) contain about 3.5kg of silver, 340g of gold, 140g of palladium and 130kg of copper, with a combined market value of about USD 15,000⁶⁵.

⁶² UNEP 2011a

⁶³ Chalmin and Gaillochet 2009

⁶⁴ Argus Research Company, Independent International Investment Research Plc and Pival Research Group 2010

⁶⁵ Recycling: From E-waste to Resources UNEP/UNU 2009; Facts and Figures on E-waste and Recycling ETBC 2010

The greening of the waste management sector is also facilitated by the emergence of new technologies required for collection, reprocessing and recycling waste, extracting energy from organic waste and efficient biogas capture from landfills, as well as for efficient treatment and reclamation of wastewater. Whereas the wider availability of compactor trucks, fore-and-aft tippers and container hoists has improved waste collection in several countries, the recovery of energy from waste has been further enabled by breakthroughs in WtE technologies. Especially in developing countries, technologies such as mechanical and biological treatment (MBT) and biomethanation are opening new opportunities in processing organic wet waste, while techniques such as vermin-composting and rapid composting have led to conversion of organic waste into agricultural manure at a pace faster than natural decomposition. Aided with advanced technologies, new markets are also appearing in the conversion of high-calorific waste into refuse derived fuel⁶⁶. In wastewater management, new methods and technologies are not only improving treatment quality but also allowing for the reclamation of wastewater, whereas so called “grey water” can be used for irrigation, groundwater recharge and as cooling water in industrial processes⁶⁷.

International experiences also indicate that greening waste management has a positive effect on job creation. Additional investments in greening the sector can provide several new employment opportunities in a range of different occupations in solid waste management, hazardous waste management as well as wastewater treatment. Although a transition towards greener waste management, and increased reuse, recycling and recovery, can involve losses of other jobs elsewhere in the economy, such as in dumpsite operations and incineration as well as the extraction of virgin materials and associated utilities, the overall net employment effect of greening the sector nonetheless appears to be clearly positive⁶⁸.

⁶⁶ UNEP 2011a

⁶⁷ UNEP 2011b

⁶⁸ The employment potential in greening the waste management sector in Lebanon is further discussed and analysed in section 5.

4. Policy and Planning

During the recent decades, several major policy strategies have been undertaken to reform the waste management sector in Lebanon. These strategies have usually been supported by large-scale infrastructure plans for building needed waste management networks and facilities. Overall, the policy aim is clearly geared towards greening the sector and restructuring waste management towards more efficient and environmentally sustainable disposal and treatment options. In solid waste management, this is reflected in several initiatives promoting increased sorting, composting and recycling, closure and rehabilitation of open dumpsites as well as increased focus on waste-to-energy options, while in wastewater treatment there is an overall strategy to introduce secondary wastewater treatment plants and improved sewerage throughout the country. In hazardous waste treatment, however, policy strategies have thus far remained limited.

If policy strategies towards greening waste management in Lebanon are to succeed, several challenges have to be overcome. Especially legislation in waste management is currently weak and incomprehensive and often neither followed nor enforced, the institutional framework remains uncoordinated and confusing, while there is room to improve financing mechanisms and take advantage of new funding sources for greening waste management. There is also a need to further focus on employment creation in waste management, as large-scale infrastructure plans for SWM facilities and wastewater plants in Lebanon have regularly focused only on technical and economic issues, and most often completely disregarded job creation potentials and the skills and working conditions of the labour force that are expected to work in these.

Policy Strategies in Waste Management

Within solid waste management, the most central policy initiatives and strategies that can be mentioned includes the Emergency plan for SWM in the Greater Beirut Area from 1997, the Municipal SWM Strategy covering the entire country from 2006, subsequent plans to complement the SWM Strategy in 2010, and the most recent Master plan for the closure and rehabilitation of uncontrolled dumps from 2011.

In 1997, the Council for Development and Reconstruction (CDR), in consultation with MoE, adopted the Emergency Plan for SWM⁶⁹. The plan, which is still in force today, aims at providing a framework for collection and disposal of solid waste in the Greater Beirut Area. Central aspects of the plan included the closing of the Bourj Hammoud and Normandy dumpsites, revamping waste collection activities, constructing several waste management facilities for sorting, composting, landfilling, and setting quantitative targets for collection, recovery of recyclable materials and composting⁷⁰. Although the implementation of planned

⁶⁹ COM Decision No. 58 2/1/1997

⁷⁰ Under the Emergency Plan, the quantitative targets are to collect 1,700 tons of MSW per day, and recovering 160 tons of recyclable materials and composting 300 tons of organic waste per day. The facilities constructed under the Emergency Plan have include Quarantina and Amrousieh sorting plants, Coral composting plant, and Naameh and Bsalim landfills.

activities has largely been successful, the Emergency Plan has not managed to reach set objectives of increasing the share of recycling and composting in Lebanon⁷¹.

In 2006, MoE and CDR prepared a waste management strategy for the entire country⁷². Although it was approved by the Council of Ministers in June 2006 and sets out clear objectives for the period 2006-2016, it has not yet been implementing, due to the obstructions of the 2006 war in July with Israel, lack of financing as well as objection from some communities regarding site locations. The plan sets out to divide the country into four service areas - Beirut and Mount Lebanon; North Lebanon and Akkar; Bekaa and Baalbeck-Hermel; and South Lebanon and Nabatieh - and foresees the building of several waste management facilities throughout the country, including one sorting and composting facility for each Caza, and at least one sanitary landfill site in each service area⁷³.

As relatively little of this strategy had been achieved by 2010 however, the Council of Ministers issued Decision 55 in September 2010 to amend and complement the SWM strategy from 2006. In this the government's commitments to construct planned SWM facilities detailed in the 2006 strategy are renewed, whereas the Prime Minister is authorised to oversee implementation and secure finances. The decision further called for exploring the feasibility of waste-to-energy (WtE) plants in large cities, such as in Beirut, Tripoli, Saida and Sour, and to expand private sector participation in waste management⁷⁴. As Decision 55 strongly recommends the adoption of WtE technologies in Lebanon, it sometimes also goes under the name the *Waste-to-Energy Strategy*. In order to advance these technologies in Lebanon, a public-private partnership has been suggested, where the government will provide the land and a private operator will build and operate WtE facilities in large cities, and sell the electricity to the government at agreed prices⁷⁵. Currently, a private consultancy has been contracted to make a study of the feasibility of such plants, the results of which will provide a clearer picture of the extent to which WtE facilities will figure in Lebanon in the future.

In 2011, an ambitious Master Plan for the closure and rehabilitation of uncontrolled dumps throughout Lebanon has also been presented. The Master Plan surveys all existing MSW and CDW dumps in Lebanon, prioritises dumps in terms of necessity for rehabilitation and identifies the most suitable remedial measures for all dumps. The prioritisation of different dumpsites was based on number of attributes, including among others lithology, faults and lineaments density, and distance to drainage lines, springs and urban centres, total volume of dumpsite as well as the existence of available alternatives. Within the plan, 20 priority MSW dumps as well as 20 priority CDW dumps needing imminent closure and rehabilitation are identified. The most ambitious undertaking in this plan is the closure and rehabilitation of Saida dumpsite, whereas the plan foresees an excavation, treat and transfer operation of the approximately 1,2 million m³ of waste stored in the dumpsite⁷⁶.

With regards to wastewater management, policy initiatives have largely been undertaken in line with international commitments, including the Barcelona Convention, which commits

⁷¹ MoE 2011

⁷² COM Decision 1/4952 18/8/2005

⁷³ Sweep-Net 2010

⁷⁴ MoE 2011

⁷⁵ World Bank 2011

⁷⁶ MoE/UNDP 2011

Lebanon to preventing pollution of the Mediterranean Sea, as well as the EC Horizon 2020, whose aim is the de-pollution of the Mediterranean by tackling top pollution sources by the year 2020⁷⁷. In line with especially the Barcelona Convention, a Damage Assessment Report was prepared in Lebanon in 1995 to formulate a policy framework for the wastewater sector, which in turn resulted in the National Emergency Rehabilitation Programme (NERP). Under the programme, the authorities have set out to develop the wastewater sector through the execution of emergency rehabilitation works of existing wastewater networks and pumping stations. Two individual programmes have also been launched under NERP: the *Coastal Pollution Control Programme (CPCP)* and the *Water Resources Protection Programme (WRPP)*.

Within NERP, it has been proposed that several major wastewater plants be constructed along the coast. These include Abdeh, Tripoli, Chekka, Batroun, Jbeil, Kesrouan, Dora (North Beirut), Chouf (coastal area) and Sour, as well as an upgrading of pre-treatment plants in Ghadir and Saida to allow for secondary treatment. In addition to the coastal plants major inland treatment plants are proposed near major cities, such as Zahle and Nabatiyeh, and other areas of priority. The overall design capacity of all these plants will allow around 80% of generated wastewater to undergo secondary treatment by the year 2020. Of the proposed coastal and inland wastewater plants some have already been built, some are under construction, and some still waiting for funding⁷⁸.

In 2003 a Sludge Management Master Plan –study was also carried out, surveying a number of options for the disposal of sludge generated from wastewater treatment plants; an issue that will become all the more important as the new plants become operational. The study recommended very limited reuse of the treated sludge in agriculture and recommended incineration. Accordingly incinerators have been installed in the wastewater plants in Tripoli and Chekka (and planned for the Ghadir upgrade) in order to avoid disposing of the sludge in open dumps or near full capacity landfills⁷⁹.

Most recently, in 2011, the Ministry of Energy and Water (MoEW) has prepared a new strategy for the wastewater sector. The strategy, still awaiting official endorsement, sets out ambitious targets for the wastewater sector in Lebanon, including increasing collection and treatment of wastewater to 95%, pre-treatment of all industrial wastewater, and increase of reuse of treated effluent to 50%, all by the year 2020. In order to meet these targets, the strategy proposes an integrated and prioritized investment program for wastewater collection, treatment and reuse; a number of legal, regulatory, policy and institutional measures; cost-recovery mechanisms based on the polluter-pays-principle; as well as increased private sector participation.

Legislation

Currently, although a number of independent laws, decrees and ministerial decisions – some dating back to the 1920s and 30s – govern environmental management in Lebanon, there is no specific legislative framework that deals directly with waste management. For example, in 1988 a framework law for the protection of the environment was adopted and amended

⁷⁷ World Bank 2011

⁷⁸ Geara et.al. 2010

⁷⁹ World Bank 2011

in 2002 (Law 444/2002), which does define the basis and norms for environmental protection in Lebanon. However this does not provide any specific details for waste management activities in relation to environmental protection⁸⁰.

In 2005, the MoE presented a Draft Law on Integrated Solid Waste Management under the METAP programme. The Draft Law aims at reducing the quantity of wastes to be disposed of to the lowest extent possible; assisting in the management of solid waste and promotion of recycling and treatment facilities; and promoting waste minimization, source separation, recycling, energy recovery and effective waste treatment facilities. The Draft Law was presented to the Council of Ministers in 2005, but is still pertaining approval⁸¹.

The legal instruments for industrial and hazardous waste are also limited. There is no specific law with regards to industrial waste, but decisions on industrial waste management issued by MoE concerning the required environmental conditions are to be respected by the industries. Hazardous wastes are regulated under Law 64 from 1988, entitled The Law of Environmental Preservation against Harmful and Hazardous Waste Pollution. Health care waste is regulated by Decree 8006 from 2002, which was amended through Decree 13389 in 2004. This decree classifies different health care waste categories and addresses their relative disposal conditions in treatment facilities licensed by MoE⁸².

Existing legislation for the protection of water resources in Lebanon, indirectly involving wastewater treatment, date back to 1925. However, these laws have not been updated and seldom complemented with specific laws or application decrees. At present, the main regulations directly related to wastewater treatment cover pollution from solid waste and wastewater, standards for environmental quality, as well as environmental guidelines for the establishment and/or operation of small wastewater treatment plants⁸³.

Since the early 1970s, Lebanon has entered into several multilateral environmental agreements, treaties and conventions, which contain specific regulations that affect the waste management sector, especially with regards to the use and disposal of hazardous wastes and prohibition of dumping waste in the Mediterranean Sea (*see further Annex 4*)⁸⁴.

It should be noted that the enforcement of the above mentioned laws and international treaties is relatively weak in Lebanon and the responsibilities of different authorities are not sufficiently well-defined. Generally, regulations lack clarity and precision, while coordination between authorities is minimal, and enforcement is practically non-existent, often due to staffing constraints, lack of proper training, low level of fines, as well as political interferences. There is also a severe lack of awareness of regulations amongst personnel

⁸⁰ There are few main legal instruments that deal with solid waste management: Decree 8735 from 1974, which assigns SWM as a municipal responsibility, Law 118 from 1977 that assigns the responsibilities of waste collection, disposal and management operations at the sub-national level to municipalities, and Decree 9093 from 2002, which provides municipalities with an incentive to host waste management facilities. (GTZ-ERM-GKW 2004)

⁸¹ Sweep-net 2010

⁸² Ibid.

⁸³ Main legislation in wastewater management include: Decree 8735 from 1974 on pollution from solid waste and wastewater; Decision 52/1 from 1999, in which MoE set out the requirements for measures to protect against air, water and soil pollution; Decision 8/1 from 2001 of MoE on the national standards for environmental quality, covering air and liquid emissions of all sectors; and Decision 3/1 from 2005 about environmental guidelines for the establishment and/or operation of small wastewater treatment plants.

⁸⁴ MoE 2011

who are supposed to enforce them – i.e. health inspectors, police officers, etc. – as well as the general public that is supposed to abide by them⁸⁵. Therefore, if greening the waste management sector in Lebanon is to be achieved, there is not only a need to strengthen and clarify legislation, but also to invest in education and awareness raising to assure that laws are actually enforced and followed.

Institutional Framework

Numerous government institutions, ministries, autonomous agencies and municipalities are involved in policy-making, planning and the management of the waste sector in Lebanon. With regards to greening the waste sector, aside from the Council of Ministers, the most central government ministry is the Ministry of Environment (MoE), which duties are to formulate a general environmental policy and propose measures for its implementation in coordination with the various concerned government administrations; to protect the natural and man-made environments in the interests of public health and welfare; and to fight pollution by taking preventive and remedial action. Within MoE, waste management issues fall under the Service of Urban Environment (Department of Urban Environmental Pollution Control) with the tasks to: 1) review studies and tender documents related to solid waste and wastewater treatment plants; 2) participate in committees linked to solid waste treatment facilities and landfills; 3) prepare and formulate Master plans for the management of MSW; and 4) define environmental limit values for the disposal of non-hazardous solid and liquid waste in water bodies and on soil⁸⁶.

Line ministries, local authorities and other stakeholders are responsible for implementation, including the Ministry of Interior and Municipalities (MoIM), Ministry of Energy and Water Resources (MEWR), Ministry of Public Health (MPH) and the Council for Development and Reconstruction (CDR). Whereas MoIM represents the municipalities on a national level, the latter of which ultimately are responsible for collection and disposal activities in Lebanon, MEWR has responsibility for wastewater management, and MPH is responsible for health care waste and also monitors water quality and the incidence of waterborne diseases. CDR is a public institution established in 1977, which reports directly to the Council of Ministers and is the lead agency in charge of national planning and infrastructure project design and implementation in all sectors, including SWM and wastewater treatment. Almost 85% of foreign funds earmarked for reconstruction transit through CDR.

Other relevant stakeholders also include the Ministry of Industry (MoI), where licenses are issued for SWM facilities; Ministry of Finance (MoF), through which all the finances for building, operating, and maintaining the waste sector have to go; the Independent Municipal Fund, which allocates funding to municipalities; Office of Minister of State for Administrative Reform (OMSAR), where several EU funded projects to build SWM plants are managed; the General Directorate of Urban Planning (DGUP) that falls under the Ministry of Public Works and Transport (MoPWT), with the mandate to develop regulations and organize urban development; as well as non-governmental agencies, such as National Council for Scientific Research (NCSR), the Association of Lebanese Industrialists (ALIND), academia and several environmental NGOs⁸⁷.

⁸⁵ SWEEP-NET 2010

⁸⁶ MoE 2011

⁸⁷ Sweep-Net 2010

At regional and local levels, municipalities and municipal federations have many responsibilities within their jurisdiction, whereas by law they are responsible for building and maintaining certain infrastructure and providing basic services, including waste collection and disposal. Municipalities are also responsible for controlling the occurrence of violations due to improper waste disposal. What regards wastewater, four regional water establishments with head offices in Beirut, Tripoli, Zahle and Saida, were founded in 2000 and were given the specific responsibility of ensuring the provision of water and sanitation at the regional level⁸⁸. The intention is that the regional water establishments will take possession of and manage the wastewater treatment plants once they are operational; however, currently they neither have the financial nor the human resources to do so.

The myriad of actors and institutions involved in policy making in the waste management sector, the difficulties in coordination between these, and the lack of clarity in institutional responsibilities has been a major obstacle in developing the sector and often acted as a barrier in endeavours to green waste management in Lebanon. Acknowledging this, the 2005 Draft Law on Integrated Solid Waste Management proposes the establishment of an independent SWM Board so as to improve coordination and clarify responsibilities in the sector. According to the proposal, the SWM Board, headed by MoE, would be responsible for planning and decision-making, as well as waste treatment, at the national level, while local authorities would be responsible for collection activities⁸⁹. If approved, the Draft Law could considerably simplify the institutional framework in solid waste management, thus strengthening opportunities for greening the sector, and also act as an impetus to streamline and reinforce the institutional structures in hazardous waste and wastewater treatment.

Financing

Waste management does not necessarily come cheap. The total estimated costs for implementing the 2006 Municipal SWM strategy are at the tune of USD 400 million. These costs are further expected to increase to at least USD 885 million if waste-to-energy facilities would be introduced as recommended in Decision 55. Additionally, the investments in secondary wastewater plants and supportive networks, according to the most recent strategies, are estimated at USD 2.2 billion. Overall, total capital investments and operations and maintenance spending on water, wastewater, and solid waste management are estimated to have reached an average USD 413 million per year over the 1999 – 2008 period. Operations and maintenance costs are likely to further increase as new facilities are built and become operational⁹⁰.

Financing of solid waste management in Lebanon is currently achieved through a number of different mechanisms including several different institutions and stakeholders. Generally the CDR and the MoF allocates direct budget funding through the treasury or the Independent Municipal fund for waste collection and construction and operation of SWM facilities. In some cases sanitary landfills, such as in Zahle, are funded through local taxes and supported through the Independent Municipal Fund, while in other instances SWM facilities are constructed and operated through international loans and grants, as for example through

⁸⁸ DG Environment 2005

⁸⁹ MoE 2011

⁹⁰ World Bank 2011

the EU-funded SWM project implemented by OMSAR. In the wastewater sector, financing is channelled through CDR and international loans and grants in the construction of treatment plants, as well as through MEWR, MOIM and municipalities for sewerage and maintenance. Any explicit fees and long-term cost recovery systems for either solid waste management or wastewater treatment do not currently exist in Lebanon and consequently the entire sector is experiencing severe budget deficits⁹¹.

The medical waste treatment is largely an exception, as the sub-sector mainly works on the polluter-pays-principle. Although certain reluctance in Lebanon still exists in paying for medical waste treatment, the sub-sector is nonetheless growing, and currently an increasing number of hospitals and health care centres are buying treatment services from local providers, such as Arc En Ciel, or operating their own treatment units. Increased governmental incentives and enforcement for hospitals and health care centres to treat infectious medical waste is further expected to strengthen this development⁹².

A number of cost recovery systems have been proposed for both solid waste management and wastewater treatment to cover further operations and maintenance expenses. The 2005 draft law on ISWM and its legal framework provide several venues for cost recovery in solid waste management. These include direct at-source waste management fees, such as tipping fees at various waste transfer, treatment and disposal facilities collected by local authorities; product charges on packaging waste; as well as fines for non-compliance of laws and regulations on waste disposal. The draft law further calls for the development of fiscal incentives to promote safe and effective waste management, such as tax exceptions on the purchase of recycled or recovered material as well as tax reductions on the profits made by private entities that are recognized to perform beneficial waste management activities⁹³. In wastewater treatment, similar cost recovery systems based on taxes, fees and incentives have been proposed⁹⁴.

Greening the waste sector also offers other sources of funding, especially as a shift towards more environmentally sustainable waste management practices can result in considerable reductions in GHG emissions and can thus earn carbon credits. The Clean Development Mechanism (CDM) introduced under the Kyoto Protocol awards Certified Emission Reduction (CER) credits to avoided emissions from waste and hence can be applicable to various composting and recycling projects, waste-to-energy facilities and landfill gas recovery for power generation. According to the World Bank, the potential annual carbon finance revenues that can be accrued in greening waste management per million residents are USD 2,580,000 for landfilling gas recovery, USD 1,327,000 for composting, and up to USD 3,500,000 for recycling⁹⁵.

⁹¹ Sweep-Net 2010; World Bank 2011

⁹² Information provided by Arc En Ciel

⁹³ Sweep-Net 2010

⁹⁴ World Bank 2011

⁹⁵ Managing municipal solid waste in Latin America and the Caribbean Integrating the private sector, harnessing incentives. World Bank. Washington. Hoorweg and Giannelli 2007

5. Green Jobs in the Waste Management

This section seeks to assess the current and future number of green jobs in waste management in Lebanon and discuss challenges regarding skills and training as well as labour conditions in the sector. According to the definition used by ILO, UNEP, ITUC and IOE, green jobs are decent work that reduces the environmental impact of enterprises and economic sectors ultimately to levels that are sustainable or involve jobs that conserve or rehabilitate the environment⁹⁶. In waste management, green jobs are here understood as jobs providing decent work and that seek to prevent and decrease waste loads and the use of virgin resources through sustainable activities such as reuse, composting, recycling and recovery, and reduce the environmental impact of the waste sector by containing or treating substances that are harmful to the natural environment and public health.

Below, the current number of green jobs in waste management in Lebanon will firstly be assessed. This will be done by identifying currently practiced green activities within the sector and estimating the number of jobs that are involved in these activities. The aim is also to make a projection regarding the potential increase in green jobs in waste management towards the year 2020, through examining growth estimates of annual MSW generation and current and planned constructions of SWM facilities and wastewater treatment plants. Furthermore, main policy strategies will also be focused upon, and the potential employment generated from the implementation of these will be further analysed⁹⁷. Finally, challenges with regards to skills needs and training as well as labour conditions and decent work in waste management will also be discussed.

Current Green Jobs in Waste Management in Lebanon

The waste management sector in Lebanon currently provides direct employment for roughly 6,000 to 8,000 people in collection, treatment and disposal of municipal solid waste, wastewater and, to a lesser extent, hazardous waste. This makes for a broad diversity of jobs, in terms of required skills, health and occupational conditions, as well as wage levels. The waste sector includes such diverse activities as operating dumpsites, street cleaning and waste collection, maintaining sewage systems and operating wastewater treatment plants, as well as scavenging and other related informal work. Other than those directly employed in waste management, a variety of supporting services such as consultants, contractors and plant, equipment and materials suppliers are also involved in the sector.

It must be noted however that several waste management activities practiced in Lebanon today, such as the indiscriminate waste disposal in the country's MSW and CDW dumpsites or the open burning of waste are not particularly "green" or sustainable, but rather infer directly negative impacts on the environment and public health. Similarly the mere pre-treatment of wastewater, as is done in Ghadir and Saida, and several smaller wastewater treatment plants, as well as sewerage not connected to any treatment plants, cannot be

⁹⁶ Green Jobs: Towards decent work in a sustainable, low-carbon economy: ILO, UNEP, ITUC and IOE 2008

⁹⁷ The green jobs projections and estimation focus mainly on permanent jobs in operation and maintenance, with the exception of temporary jobs generated in closure and rehabilitation operations. Due to data limitation, the estimations do not include employment in awareness-raising or temporary employment in construction of solid waste management facilities and wastewater treatment plants.

considered green, as these activities allow insufficiently or even untreated raw sewage to contaminate soils, rivers and coastal waters. Other activities, such as scavenging and related informal work in urban centres and around dumpsites, also often involve dirty and dangerous jobs that do not match the basic requirements of decent work, be it occupational safety and health, social protection or workers' rights. Therefore, it is clear that not all jobs in waste management in Lebanon match the definition of *green jobs*.

In order to assess the current green jobs in the sector, the table below lists a range of waste management activities, adhering to the main principles of green or sustainable waste management, with focus on the facilities and operators that currently carry them out in Lebanon as well as the estimated employment number involved in them.

Activity	Facility/Operator	Employment
Solid Waste Management		
Waste Collection	Sukleen, NTCC, Lavanet, Municipalities and local contractors	2,153
Recycling	Lebanese Recycling Works, Liban Fonderies, SOLICAR, SIPCO, Ohanis Kasarjian, SICOMO, NINEX, Unipack, Mimosa, Mazar Plast and Rocky Plast	998
Sorting	Quarantina and Amroussieh, Zahle and Arab Selim	112
Composting (including sorting)	Coral (Qarantina), Sour, Kherbet Silim, Aitaroun, Chacra, Bint Jbeil, Khiam, Taybeh, Qlaiaa, Qabrikha, Ansar and Kfar Sir	100
Waste-to-energy/Biogas	Currently no operating facilities	0
Sanitary landfilling	Naameh, Zahle and Bsalim	31
Hazardous Waste Treatment		
Hazardous waste treatment	Currently no operating facilities	0
Medical waste treatment	Arc De Ciel, Clemenceu Medical Centre, Haykal Hospital, Abbassieh medical treatment centre	37
Wastewater Collection and Disposal		
Sewerage (connected to Secondary WWTP)	Municipalities and local contractors	13
Secondary Wastewater treatment plants	Baalbeck, Aitanit and Fourzol	17
Wastewater Reclamation	Jabboule	2
Total		3,463

As can be seen from the table, the bulk of green jobs in waste management in Lebanon are mainly found in waste collection and recycling, which currently employ 2,153 and 998 people respectively⁹⁸. Some green jobs are also found sorting, composting and sanitary landfilling, which together provide employment for 243 people⁹⁹. Considerably fewer jobs are currently found in secondary wastewater management, sewerage and wastewater reclamation as well as medical waste treatment, the former employing 32¹⁰⁰ while the latter 37 people¹⁰¹. Currently no jobs exist in waste-to-energy/biogas facilities or in non-medical hazardous waste treatment in Lebanon. Taken together, the above reviewed green waste management activities currently provide green jobs for an estimated 3,463 people in Lebanon (see further Annex 1 for specific employment numbers in different facilities).

⁹⁸ Employment estimates for waste collection and recycling has been acquire through information provided by Mohamad Baraki

⁹⁹ Employment estimates for sorting, composting and sanitary landfilling have been acquired through interviews with Farouq Mehrebi (OMSAR) and Bassam Sabbagh (MoE)

¹⁰⁰ Employment estimates for secondary wastewater treatment, sewerage and reclamation has been acquired through interview with Younes Hassib (GIZ)

¹⁰¹ Information provided by Farouq Mehrebi (OMSAR) and Arc En Ciel

Prospects for Green Jobs in Waste Management in Lebanon by 2020

Based on current growth estimates and ongoing constructions or initiated plans for SWM facilities and wastewater plants, a number of green jobs will be generated in the waste management sector in the near future. These jobs will especially be found in waste collection, recycling, sorting and composting as well as wastewater treatment and sewerage, and to a lesser extent in waste-to-energy/biogas facilities, sanitary landfilling and medical waste treatment. Currently it is not envisaged that several further jobs will be created in either hazardous waste treatment or wastewater reclamation.

Table 5. Future Green Jobs in the waste management sector in Lebanon			
Activity	Managed by	Description / Facilities	Employment
Solid Waste Management			
Waste Collection	Sukleen, NTCC, Lavanet, municipalities and local contractors	Potential additional jobs in waste collection to cover the increased generation of MSW by the year 2020 (assuming 99-100% coverage)	385
Recycling	Private companies	Potential additional jobs in recycling accrued by the increased generation of MSW by the year 2020 (assuming 8% or up to 12% of MSW is recycled)	178 – 766
Sorting	OMSAR	Sorting facilities currently completed, under construction or planned: Swayani, Hbaline and Al Fayhaa	53
Composting (including sorting)	OMSAR-EU, Pontifical Mission, IBC and Cedar Environmental	Minieh, Michmich, Naqqoura, Bedias, Saida, Bazourieh, Qana, Kfour and Baalbeck	173
Waste-to-energy/Biogas	IBC, COSV	Anaerobic digester in Saida and biogas facility in Baalbeck	8 - 12
Sanitary Landfilling	Italian Cooperation	Sanitary Landfills currently under construction in Baalbeck	7
Hazardous Waste Treatment			
Hazardous waste treatment	N/A	Currently no plans to introduce hazardous waste treatment facilities in Lebanon	N/A
Medical waste treatment	Arc En Ciel	Potential additional jobs in medical waste treatment if current treatment levels are increased from 60% to 100%	25 – 30
Wastewater Collection and Disposal			
Sewerage (connected to secondary WWTP)	CDR, private operators and municipalities	Sewage network supporting secondary WWTPs in 2020	781
Secondary wastewater treatment	CDR and private operators	Secondary WWTPs constructed or under construction in Ghadir (upgrade), Saida (upgrade), Batroun, Tripoli, Jbeil, Nabatiyeh, Jiyeh, Chekka, Sour, Zahle, Ablah, Chimstar, Bouj Hamoud and Kesrouan	292
Wastewater Reclamation	N/A	Currently the potential for wastewater reclamation in Lebanon is considered low	N/A
Total			1,902 – 2,499

By the year 2020, about 560 to 1150 new permanent jobs could be created in waste collection and recycling¹⁰². These projections have been made based solely on the estimated increase in annually generated MSW, from approximately 1.60 million tons/year in 2010 to 1.91 million tons/year in 2020. Waste collection currently employs 2,153 people. If the high coverage in Lebanon of 99-100% is to be upheld, assuming there are no changes in waste collection efficiency, a further 385 people could be employed in waste collection by the year 2020. Similarly, recycling currently employs an estimated 998 people that recycle about 129,600 tons of MSW per year; equivalent of 8% of the annual MSW generated in Lebanon. If the recycling sector is to uphold this share, about 152,800 tons of MSW should be recycled annually in 2020, which translates into 178 further job opportunities in recycling. Considering that recycling internationally is one of the fastest growing green waste management industries, an alternative projection can also be made were the share of MSW that is

¹⁰² It should be noted that the projections for waste collection and recycling assume that there is no change in the efficiency in either sub-sector by the year 2020. This assumption can reasonably be questioned, especially considering the introduction of new technologies. Therefore the additional employment in these sub-sectors should at best be understood as *potential* future green jobs rather than definite ones.

recycled increases to 12% by 2020. This would imply that up to 229,200 tons of MSW would be recycled, which substantially increases the job opportunities in recycling to 766.

Sorting, composting, sanitary landfilling and biogas extraction will also employ several more people in 2020. Under the OMSAR-EU project, three sorting facilities have already been constructed, which once operational will employ 53 people. Within the same project two combined sorting and composting facilities have also been recently constructed, while preparations for construction of two additional facilities have begun. The private waste management operator Cedar Environmental is further preparing the construction of four sorting and composting facilities in the Caza of Sour, while composting will also occur in the anaerobic digester constructed in Saida. Once all these composting facilities are operational, they are expected to employ about 173 people. Furthermore, the Italian Cooperation has begun constructions of a new sanitary landfill in Baalbeck that, once operational, is expected to provide for 7 permanent jobs. The application of biogas production from organic waste is also expected to be introduced in Lebanon by 2020. Currently, this is planned in the landfill in Baalbeck as well as in the anaerobic digester in Saida, whereas the former is expected to employ about 3 – 5 people and the latter 5 – 7 people in biogas related functions¹⁰³.

Currently, from the government's side, there are no concrete plans for setting up proper collections systems or constructing facilities for treating hazardous waste. Therefore, at present, it is not possible to foresee the exact increase in employment in this sector. Within medical waste treatment, however, the NGO Arc En Ciel have outlined clear plans for treatment units to increase the amount of treated medical waste from 60% up to 100% in the coming years. Considering that the amount of treated medical waste has increased from zero to 60 % in only five years, the objective of reaching 100% should not be considered unrealistic¹⁰⁴. Accounting for a likely increase in the annually generated medical waste, reaching this will require at least an estimated 25 – 30 new employees in the sub-sector.

Within wastewater treatment, several new secondary wastewater treatment plants are expected to be operational by 2020. A number of these are already constructed, such as in Batroun, Tripoli, Jbeil, Nabatiyeh, Jiyeh and Chekka, while constructions have started in Sour, Zahle, Ablah and Chimstar. Further treatment plants are also planned Bourj Hamoud and Kesrouan, while plans exist to upgrade Ghadir and Saida pre-treatment plants to secondary facilities. Once all these plants are operational, up to 781 green jobs are expected to be created in sewerage and a further 292 in operation and maintenance of the new wastewater treatment plants¹⁰⁵.

Taken together, the above reviewed waste management activities are expected to provide new green jobs for an estimated 1,902 – 2,499 people in Lebanon in the year 2020, which corresponds to an increase of approximately 55 – 70% from current levels. According to these projections, the total amount of green jobs in the waste management sector in 2020, including both current and future jobs, is expected to be 5,365 – 5,962 (*see Annex 2 for specific employment numbers in different facilities*).

¹⁰³ Information provided by Jacopo Monzini (Italian Cooperation). Employment figures for the anaerobic digester in Saida have been acquired through extrapolation of comparable figures in other facilities.

¹⁰⁴ Information provided by Arc En Ciel

¹⁰⁵ Interview with Younes Hassib (GIZ)

Green Jobs Prospects and Policy Strategies

A number of policy strategies in both solid waste management and wastewater treatment have been formulated in recent years. Several of these are still being prepared and in some cases pending final approval, whereas the construction of needed facilities has not yet been initiated. It is nonetheless purposeful to estimate the potential employment impact of these strategies, as if and when they are implemented, they could further contribute to the generation of green jobs in the sector.

Main strategies that will affect the waste management sector include the Municipal SWM Strategy from 2006, seeking to extend SWM coverage throughout the country; Decision 55 or the Waste-to-Energy Strategy from 2010, which proposes the introduction of waste-to-energy facilities in main cities; the Master Plan for Closure and Rehabilitation of Open Dumpsites from 2011, which seeks to close down and rehabilitate the 504 MSW and 166 CDW dumpsites in Lebanon; as well as the Water Sector Strategy from 2011, which seeks to increase water reclamation to 50% by 2020. In the table below, the employment generation in operations and maintenance as well as closure and rehabilitation operations resulting from the implementation or completion of these strategies have been estimated.

Strategy	Description	Employment
Municipal SWM Strategy 2006 (MoE/CDR)	Seeks to extend SWM coverage throughout the country. Current plans envisage the further construction of at least 6 landfill sites, as well as 14 combined sorting and composting plants.	442
Waste-to-Energy Strategy/ Decision 55 2010 (MoE/CDR)	Seeks to introduce waste-to-energy facilities in major cities in Lebanon. One possibility is the construction of two medium-sized facilities in Tripoli and Saida, and one larger in Beirut.	200
Master Plan for the Closure and Rehabilitation of Open Dumpsites 2011(MoE/CDR)	Proposes the closure and rehabilitation of open dumpsites in Lebanon. Especially 20 prioritized MSW and 20 CDW sites needing imminent action have been identified.	418 Temporary
Water Sector Strategy 2011 (MWER)	Sets objective to increase water reclamation to 50% by 2020.	N/A
Total		Permanent 642; Temporary 418

Regarding the Municipal SWM Strategy, excluding facilities that already exist or are currently being constructed, the current plan to complete the strategy is to construct at least 6 further landfill sites, as well as 14 combined sorting and composting plants. Assuming that a landfill site with a design capacity of treating about 150 tons of MSW per day employs about 7 people in landfilling and 20 in sorting, the completion of the remaining 6 landfill sites would create 162 new permanent employment opportunities. Similarly, assuming that a medium-sized combined sorting and composting plant employs on average 20 people, the completion of the remaining 14 plants would create 280 jobs. In total, the completion of planned facilities outlined in the Municipal SWM strategy would therefore create 442 new green jobs¹⁰⁶ (see further Annex 3).

Under Decision 55, or the Waste-to-Energy Strategy, the government has also begun exploring the feasibility of adopting waste to energy facilities in major urban centres as part of the overall solid waste management system. As the feasibility studies for this have only recently begun, it is too early to provide a definite estimate of the number of facilities or potential job opportunities this could generate. One scenario nonetheless suggests that up

¹⁰⁶ Interview with Bassam Sabbagh (MoE)

to three waste-to-energy facilities would be installed in the major coastal cities: two 300,000-tons/year plants to serve Tripoli and Saida and one 600,000-tons/year facility in the Greater Beirut Area to serve Beirut and Mount Lebanon. These three facilities could potentially generate up to 200 new job opportunities in operations and maintenance¹⁰⁷.

Within the Master Plan for the Closure and Rehabilitation a priority list has been put forward for the closure of 20 MSW and 20 CDW that would require immediate action. If the closure and rehabilitation for these 40 MSW and CDW dumpsites would be implemented an estimated 418 temporary job opportunities could be created in range of different rehabilitation activities. These include excavation, treatment and transfer as well as grading, capping and managing gases and leachate for MSW dumpsites, and achieving intended use and sorting as well as crushing and recycling for CDW dumpsites¹⁰⁸ (see further Annex 3).

The Water Sector Strategy from 2011 sets out a number of ambitious goals. Among other things, the strategy envisages a substantial increase in water reclamation for agricultural purposes, from the current level at nearly zero to 50%. Achieving this target could significantly contribute to achieving a more efficient use of irrigation water in agriculture. At present, however, it is very difficult to estimate the potential employment that could be generated in this sector¹⁰⁹.

In summary, the implementation or completion of main strategies such as the Municipal SWM strategy from 2006, Decision 55 or the Waste-to-Energy strategy, as well as the Master Plan for the closure and rehabilitation of open dumpsites, would potentially generate up to 642 permanent green jobs in operations and maintenance as well as 418 temporary jobs in closure and rehabilitation operations, while water reclamation would probably generate considerably fewer jobs, despite the high targets set in the 2011 Water Sector Strategy.

Skills Needs and Decent Work

Greening the waste management sector and promoting green jobs requires an increased emphasis on enhancing skills and training as well as on improving labour conditions. This is especially important if the transition towards more environmentally sustainable practices involves a high number of occupations with a broad range of skills requirements. The unavailability of relevant skills and decent work deficits can act as major barriers in greening the sector, both in inhibiting the introduction of new environmentally sustainable technologies and practices as well as in rendering the sector unattractive for skilled workers.

Skills shortages in greening waste management can occur as emphasis is shifted from certain undesirable practices towards greener practices. Such shifts result in decreased demand for

¹⁰⁷ Information provided by Mohamad Baraki

¹⁰⁸ Interview with Farouq Mehrebi (OMSAR)

¹⁰⁹ Studies point to a number of unfavourable conditions that might hinder the achievement of the target, not least the geographical and topographical features of Lebanon. Domestic wastewater is mainly generated in the coastal zones, where about 80% of the population lives, while the major agricultural areas are located on the other side of Mount Lebanon in the Bekaa valley, which consumes about 52% of all irrigation water in Lebanon. Furthermore, in order to use gravity for sewage flow, most wastewater treatment plants are located at lower altitudes, while most agricultural areas are located at higher altitudes. Considering that the long distances and the substantial energy costs for pumping water to higher altitudes would create considerable costs for reclaimed water, it is very unlikely that farmers would be ready to pay this, especially as the costs of other water sources remain relatively low in Lebanon. Euromed 2009; Interview with Younes Hassib (GIZ)

some occupations and skill profiles while increasing demand for others. Skills shortages can also appear as new waste management technologies and practices are introduced, resulting in entirely new occupations and skills requirements. The availability of applicable training thus becomes critical in the transition towards greener practices, in order to enable workers and enterprises to move from declining to growing activities and to take advantage of new emerging opportunities and occupations¹¹⁰.

International experience has shown that greening waste management tends to generate a high variety of different occupations and jobs. These include conventional waste management occupations such as waste collection, sorting, sanitary landfilling and sewerage, activities that often require three skills categories: blue collar, technical and managerial. However, new occupations also tend to appear in more specialized fields. For example, in recycling alone, depending on the recyclable items, a variety of jobs at technician and engineering level are emerging in electrical appliances and electronics, metal works, paper and pulp processing as well as plastics. Also in management and treatment of hazardous and medical waste, as well as in secondary wastewater treatment, new occupations in highly specialized tasks are opening up. As the waste sector becomes more sophisticated, entirely new avenues for employment can also be created, for example in information technology (e.g. using Geographic Information Systems (GIS) for waste tracking and mapping), mass communications for awareness, and training for skills and development¹¹¹.

A large network of training and education providers exists in Lebanon that could facilitate the skills requirements resulting from greening the waste management sector. This includes especially the country's 103 public vocational and education training centres and up to 400 private training institutes, which provide a broad range of occupational and technical skills and training needed in green waste management activities. Contractors involved in the construction of SMW facilities and wastewater treatment plants also provide training for the personnel as part of the contract, while international organisations and MoE have conducted several training workshops to strengthen capacities of personnel both at the national and municipal levels¹¹².

Several universities have also included degree courses that provide specialized expertise relevant for greening the sector. These include in particular degree programmes in environmental sciences, technology and health, as well as in engineering offered by universities such as the American University of Beirut (AUB), Université Saïth Joseph (USJ), and Balamand, among others. Furthermore, a number of research centres and institutes in Lebanon also carry out targeted research with relevance to the sector. These include the Environmental Engineering Research Center (AUB) that investigates chemical, physical and biological contaminants associated with water, air and solid wastes; the Environment Core Laboratory (AUB) that provides testing services for wastewater and sludge, hazardous waste and compost; as well as the Regional Centre for Water and Environment (USJ) that researches hydrology, drainage and treatment, and water quality¹¹³.

¹¹⁰ Skills for Green Jobs: A Global View. Synthesis Report Based on 21 Country Studies. ILO and Cedefop 2011 (forthcoming)

¹¹¹ UNEP 2011a

¹¹² Sweep-Net 2010

¹¹³ MoE 2011

Regardless of the availability of education and training providers, it has nonetheless been observed that in the waste management sector in particular skills shortages on both national and municipal level already exists in Lebanon today. These skills shortages include especially issues such as management, technology application, financing, enforcement, monitoring and follow-up. In the public sector in particular, capacities would further need to be improved in the procurement and contracting of private sector services, community awareness and participation as well as in information technology and knowledge management. Further shortages have also been noted in technical skills, for example in composting and wastewater treatment, as well as a general lack of knowledge and awareness in occupational safety and health issues. In order to improve these areas, there would be a need to further emphasise skills enhancement and training in the sector¹¹⁴.

Training and skills enhancements also tend to have positive effects on labour conditions and decent work, for example through training and education in occupational safety and health. Conversely, poor labour conditions can also affect the availability of skills, as inadequate wages, hazardous health and safety conditions, and other features of poor-job quality can render jobs unattractive to people with the appropriate skills. Especially the waste management sector suffers from a poor image which deters students and apprentices from acquiring technical, engineering and management qualifications in this field¹¹⁵.

The promotion of green jobs is part of the ILO's Decent Work Agenda. As such, minimum requirements for green jobs should be that they provide adequate wages, ensure safe working conditions and basic social protection, respect workers' rights, and are part of a process of social dialogue. Several jobs in waste management do not fulfil these requirements. In the formal sector, jobs in especially waste collection, sorting, recycling, and sewerage generally have low wages, questionable safety and health practices and often offer limited career prospects. In the informal sector, wages are often far below national minimum threshold and labour conditions are seldom respected. According to estimates, there are about 2,000 to 4,000 people working in the informal waste management sector in Lebanon, as scavengers and related activities. The day-to-day reality for these is characterized by extremely poor practices and wages, exposing workers to hazardous substances that endanger their health and lives, and often involving child labour¹¹⁶.

Labour conditions and decent work are therefore perhaps the greatest challenge in greening the waste management sector, and considerable measures need still to be made in order to improve occupational safety and health, social protection, and freedom of association (trade unions, local associations and cooperatives) in the waste sector, both with regards to the formal and informal sector. Furthermore, because informal jobs in scavenging and recycling often represent a source of income for workers that lack other readily available alternatives, improving the conditions of these jobs is also an important element in poverty alleviation¹¹⁷.

¹¹⁴ Sweep-Net 2010; Interview with Younis Hassib (GIZ)

¹¹⁵ ILO and Cedefop 2011

¹¹⁶ The world's scavengers, salvaging for sustainable consumption and production Medina 2007; The informal recycling sector in Developing countries – Organizing waste pickers to enhance their impact Medina 2008

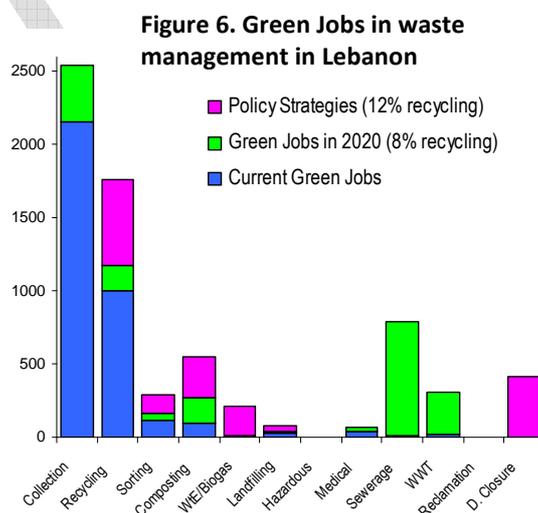
¹¹⁷ Promotion of Decent Work in a Green Economy ILO 2011

6. Conclusions and Recommendations

This report has sought to provide a preliminary assessment of current and potential future green jobs in waste management. Greening waste management is advanced by both changes in policies and regulations as well as markets and economic opportunities. In Lebanon, both these forces seem to be at play. Whereas governmental policy strategies and constructions of waste management facilities are providing the necessary infrastructure for green waste management activities such as in sorting, composting, sanitary landfilling and wastewater treatment, increasing opportunities are also opening up for private sector enterprises in recycling, waste-to-energy and medical waste treatment. As these developments incrementally contribute towards the greening of the waste management sector in Lebanon, considerable economic, environmental and social benefits can be achieved.

The findings of this preliminary assessment indicate that a substantial job creation potential exists in greening waste management in Lebanon. New green jobs are expected to appear in a number of different activities, including waste collection, recycling, sorting, composting, sanitary landfilling and biogas extraction, medical waste treatment as well as sewerage and wastewater treatment. Currently there are an approximate 3,400 green jobs in waste management in Lebanon. By the year 2020, this number could potentially increase by up to 1,900 to 2,500 new green jobs. Additionally, if main policy strategies are implemented, a further 640 permanent green jobs as well as about 400 temporary jobs can be created. Overall this would result in some 5,900 to 6,400 green jobs in 2020. Although not studied in this assessment, the greening of the waste management sector is further expected to create several thousand additional short-term job opportunities in construction of facilities, as well as indirect jobs in the supply of equipment and materials.

The three main solid waste treatment methods are traditionally landfilling, recycling and composting. From the findings of this assessment it can be concluded that of these, both recycling and composting present the greatest long-term job potential in Lebanon. Not only are recycling and composting more preferable than landfilling in terms of environmental and economic benefits, they are also clearly more employment-intensive. In fact, if the same amount of MSW is treated (not accounting for sorting), composting in Lebanon tends to generate 10 times more jobs, and recycling up to 140 times more jobs, than landfilling¹¹⁸. Composting and recycling further have potential to generate green jobs in other waste management activities, such as sorting and more coordinated waste collection. Biogas extraction and waste-to-energy also present job creation potentials; however, as these activities are only now being introduced in



¹¹⁸ The comparison is based on the total treatment capacity and employment figures reviewed in this assessment for recycling and SWM facilities currently existing, under construction or planned in policy strategies.

Lebanon, it is too early to predict the long-term impact of these activities. International experiences however indicate that the job creation potential in these fields is substantial.

Other green waste management activities, such as solid waste collection, sewerage and wastewater treatment, also present significant current and future numbers of green jobs. However, the increase in job opportunities in these activities is unlikely to continue forever, especially if the increase in MSW generation is restrained or curbed, or when full wastewater treatment coverage has been reached. In fact, the total numbers of jobs in waste collection, sewerage and wastewater treatment, once a certain maximum has been reached, will most likely start to recede as efficiencies are increased through the adoption of new technologies and practices.

In order to green the waste management sector in Lebanon, and to reap the benefits of this, considerable efforts still have to be made and several obstacles have to be overcome. Whereas policy strategies are strongly focusing on improving solid waste management and wastewater treatment, thus considerably reducing the environmental impact of these, hazardous waste management is still largely neglected. Apart from medical waste treatment, there are no strategies or systems in place for the collection or disposal of hazardous waste in Lebanon, either from industries, agriculture or households, while country-specific data and research on this topic is also severely lacking. As long as no efforts are made to change this, the waste sector in Lebanon will continue to incur a considerable threat to the environment public health.

To create an enabling environment to green the waste management sector, several further improvements in the legislative, institutional and financial frameworks across the waste sector would also be needed. These include taking steps to strengthen and clarify environmental and waste management related legislation and invest in education and awareness-raising to assure that laws are actually enforced and followed; streamlining institutional frameworks and clarifying responsibilities to increase policy coherence; and further take advantage of more efficient financing mechanisms. Several of these improvements are already foreseen in the draft law on ISWM. A development towards greening the waste management sector in Lebanon would therefore considerably be advanced by the adoption of this legal framework in solid waste management, and of an extension of similar legislation throughout the waste management sector.

Based on the findings of the report, as well as on available and efficient tools to promote green jobs, the following recommendations in particular can also be made:

- **Integrate Measures for Job Creation and Skills Development in Policy Strategies**

The greening of the waste management sector and the promotion of green jobs is to a large extent advanced by policies and regulations in the sector. The challenge for policy-makers is to choose policy options that maximize opportunities for productive and decent work, and to integrate skills development strategies in the policy framework to assure that the right technical and managerial skills and training opportunities exist to support this. In order to achieve this, policy-makers need to work together with employers' and workers' organisations, the private sector, training and education providers as well as community associations in orienting infrastructure investments towards the creation of higher levels of productive employment. The combined use of local participation in planning with the utilization of locally available skills, technology, materials, and appropriate work methods

has proven to be an effective and economically viable approach in doing this. Furthermore, there is a need to link skills strategies in waste management policies so as to better match specific training to the skills demand of the sector, help workers and enterprises to adjust to technological and market changes, as well as building and sustaining competencies for future labour market needs in the sector. The work of the International Labour Organization (ILO) in programmes such as the Global Green Jobs Programme, Employment Intensive Investment Programme and Skills and Employability Programme, offer policy-makers with support in achieving this.

- **Support Small and Medium-sized Enterprises (SMEs) in Sustainable Waste Management Activities with Growth Potential**

The greening of the waste management sector and the creation of green jobs are also advanced by the private sector, and by especially small and medium-sized enterprises (SMEs). There is great potential for SMEs and employment creation in a number of growth areas in waste management, including recycling, composting, as well as biogas extraction. Emerging niche-markets with growth potentials for start-ups and SMEs also include e.g waste derived compost and fertilizers for organic farming and electronic waste recycling. Smaller enterprises however usually have lower capacities and resources to adjust to government environmental policies, regulations and incentives compared to larger corporations with more developed managerial and organizational structures. In order to support SME-led activities in greening the waste management sector, a number of support measures can be applied. These include micro-financing, business group formation, cooperatives, marketing strategy and networking support as well as improved economic literacy¹¹⁹.

- **Promote Decent Work in Greening the Waste Management Sector**

Greening the waste management sector is also relevant in terms of labour condition enhancement, whereas a major challenge is to transform the environmentally constructive jobs in the waste management sector into truly decent work. Further work is needed throughout the sector, especially in improving occupational safety and health, social protection, and freedom of association, and especially to address the need for the progressive formalisation of the entire waste sector¹²⁰. Avenues to achieve this include promoting the formation of cooperatives and the introduction of targeted occupational safety and health programmes in the waste management sector to extend basic labour protection to the entire sector, strengthened legislation and enforcement in labour standards, as well as utilize more efficient use of labour inspections. Social dialogue, and cooperation between the government, trade unions and employers' organisations, has a strategic relevance in achieving these aims.

¹¹⁹ Useful ILO tools in providing such support include the Participatory Value Chain Analysis (PVCA), Know About Business (KAB), Start and Improve Your Business (SIYB), and other tailor-made entrepreneurship training packages.

¹²⁰ Lessons learned here can be drawn from ILO's work with regards to the informal sector in waste management in other countries, including India, Indonesia, Egypt and South Africa.

Annex 1. Current Green Jobs in Solid Waste Management, Medical Waste Management and Wastewater Treatment

Operational facilities for Sorting, Composting and Sanitary Landfilling and Employment						
Mohafaza	Caza	Waste Treatment Facilities				Employment
		Location	Type	Capacity (t/day)	Managed / Funded by	
Beirut	Beirut	Aamrousieh	S	758	Averda	40
		Qarantina	S	1,476	Averda	40
		Coral (Qarantina)	C	300	Averda	30
Mount Lebanon	Metn	Bsalim	BL	120	CDR-MoE	7
	Chouf	Naameh	SL	2,300	CDR-MoE	20
North Lebanon	Currently no operating facilities					0
South Lebanon	Sour	Sour	S – C	150	OMSAR-EU	21
Nabatiyeh	Bint Jbayl	Kherbet Silim	S – C	8	Pontifical mission	4
		Aitaroun	S – C	8	EU-ESFD Program	4
		Chacra	S – C	5	Pontifical mission	4
		Bint Jbeil	S – C	10	Pontifical mission	4
	Marjeyoun	Khiam	S – C	15	OMSAR-EU	8
		Taybeh	S – C	10	YMCA	4
		Qlaiaa	S – C	5	Pontifical mission	3
		Qabrikha	C	75	OMSAR	8
	Nabatiyeh	Ansar	S – C	10	OMSAR	8
		Arab Selim	S	5	UNDP – Italian Coop.	2
Kfar Sir		S – C	7.5	Pontifical mission	2	
Bekaa	Zahle	Haouch El Oumara	S	300	CDR-MoE	30
			SL	180		4
Total						243

S = Sorting; C = Composting; SL = Sanitary Landfilling; BL = Bulk landfilling

Medical Waste Treatment Units and Employment				
Location	Operator	Treatment type	Treatment (kg/d)	Employment
Clemenceu Medical Centre in Beirut	CMC & UMC	Microwave	315	3
Hotel Dieu de France in Beirut	AEC	Autoclave	385	3
Haykal Hospital in Koura	Haykal hospital	Microwave and Autoclave	82	2
Saydet Zgharta Hospital	AEC	Autoclave	783	5
Jisr el-Wati (within AEC centre)	AEC	Autoclave	3,235	11
Zahle (near Zahle landfill area)	AEC	Autoclave	332	6
Saida (adjacent to wastewater plant)	AEC	Autoclave	1,800	4
Abbassieh treatment centre	OMSAR/Mirage (private)	Autoclave	450	3
Total			7,382	37

Operational Wastewater Treatment Plants and Employment						
Location	Operator	Treatment type	Capacity (m ³ /day)	Population served	Employment	
					Sewerage	WWTP
Baalbeck	Nazih BRAIDI Est.	Activated Sludge	18,000	40,000	6	7
Aitanit	Municipality	Trickling Filter	5,000	29,000	6	5
Fourzol	Municipality	Trickling Filter	1,000	6,700	1	5
Total			129,000	715,700	13	17

Annex 2. Future Green Jobs in Waste Management

Operational Sorting, Composting and Sanitary Landfilling and Biogas Facilities in 2020 and Employment							
Mohafaza	Caza	Waste Treatment Facilities					Employment
		Location	Type	Capacity (t/day)	Managed / Funded by	Status	
Beirut		Currently no plans for further facilities					0
Mount Lebanon	Jbeil	Hbaline	S	77	OMSAR – EU	Completed, operational 2011	21
	Chouf	Swayani	S	26	OMSAR – EU	Completed, pending agreement	11
North Lebanon	Tripoli	Al Fayhaa	S	150	OMSAR – EU	Completed, operational 2012	21
	Minieh-Dinnieh	Minieh	S – C	61	OMSAR – EU	Completed, operational 2011	21
	Akkar	Michmich	S – C	10	OMSAR – EU	Completed, operational 2011	8
South Lebanon	Saida	Saida	AD	300	IBC	Completed, pending agreement	5 - 7
			S - C				30
	Sour	Naqqoura	S – C	25	Cedar Environmental	Planned	12
		Bedias	S – C	50	Cedar Environmental	Planned	20
		Bazourieh	S – C	50	Cedar Environmental	Planned	20
Qana	S – C	50	Cedar Environmental	Planned	20		
Nabatiyeh	Nabatiyeh	Kfour	S – C	120	OMSAR – EU	Pending	21
Bekaa	Baalbak	Baalbeck	SL	150	Italian coop	Under construction (2012)	7
			BG		COSV		3 – 5
			S – C		OMSAR – EU		21
Total							241 - 245

S = Sorting; C = Composting; SL = Sanitary Landfilling; BL = Bulk landfilling; AD = Anaerobic Digestion; BG = Biogas

Operational Wastewater Treatment Plants in 2020 and Employment								
Location	Operator	Treatment type	Capacity (m ³ /day)	Population served	Status		Employment	
					Treatment plant	Network completed	Sewerage	WWTP
Ghadir (upgrade)	Nazih BRAIDI Est.	Activated Sludge	50,000	250,000	Planned	Completed	42	17
Saida (upgrade)	Osman A. Osman	Activated Sludge	55,000	390,000	Planned	Completed	17	9
Batroun	OTV	Extended Aeration	4,000	30,000	Completed	2015	5	6
Tripoli	Dégrémont	Activated Sludge	135,000	821,000	Completed	2011	137	45
Jbeil	Dégrémont	Biofiltration	9,052	49,500	Completed	2011	8	7
Nabatiyeh	OTV	Extended Aeration	10,570	100,000	Completed	2015	17	9
Jiyeh	OTV	Biofiltration	5,970	88,000	Completed	2015	15	10
Chekka	Dégrémont	Extended Aeration	2,174	24,000	Completed	2015	5	4
Sour	OTV	Activated Sludge	18,000	40,000	Under construction	N/A	37	15
Zahle	Dégrémont	Extended Aeration	37,500	205,000	Under construction	2015	34	14
Ablah	Municipality	Trickling Filter	2,000	11,800	Under construction	N/A	2	5
Chimstar	Municipality	Trickling Filter	1,800	10,800	Under construction	N/A	2	5
Bourj Hamoud	N/A	Activated Sludge	330,000	2,200,000	Planned	N/A	367	114
Kesrouan	N/A	Activated Sludge	112,000	560,000	Planned	N/A	93	32
Total			773,066	4,780,100			781	292

Annex 3. Policy Strategies and Potential Green Jobs in Waste Management

2006 Municipal SWM Strategy – completed, under construction and remaining facilities						
Service Area	Sanitary Landfills including sorting facility		Employment estimate for remaining facilities	Sorting and Composting facilities in Cazas		Employment estimate for remaining facilities
	Existing or under construction	Still planned		Existing or under construction	Still planned	
Beirut and Mount Lebanon	Naameh and Bsalim	No further landfills planned	0	Beirut, Jbeil, Chouf	Kesrouane, Metn, Baabda, Alley	80
North Lebanon & Akkar	None currently existing	2 landfills planned (exact location to be decided)	54	Tripoli, Minieh-Dinnieh, Akkar	Koura, Hermel, Zgharta, Bcharre, Batroun	100
Bekaa and Baalbeck-Hermel	Zahle, Baalbeck	1 further landfill planned (Bar Elias)	27	Baalbeck, Zahle	West Bekaa, Rachaiya	40
South Lebanon and Nabatieh	None currently existing	3 landfills planned (Sour, Saida and Nabatieh)	81	Sour, Nabatieh, Bint Jbayl, Marjeyoun	Saida, Jezzine, Hasbaya	60
Total	4	6	162	12	14	280

Priority MSW and CDW dumpsites destined for closure and rehabilitation and Employment estimation				
Type	Location	Volume (m ³)	Planned rehabilitation	Temporary Employment
MSW Dumpsite	Saida	1,200,000	Excavate, treat and transfer	85
	Baalbeck	225,000	Excavate, treat and transfer to sanitary landfill	23
	Deir Qanoun, Hbaline, Srar, Adweh, Kfar Tibnit, Hamat, Barr Elias, Baalbeck, Qabb Elias, Ghaziye, Mqaiteaa, Fnaydek, Zouk Al Khrab, Haouch el Refqa and Birkayel	2,008,750	Grade, cap, manage gases and leachate	199
	Rouayset El Ballout, Timnine and Beslouqit	14,000	Group with other dumps and transfer	12
CDW Dumpsite	Chemstar, Ammiq Ech Chouf, Kounine, Mtayleb, Mar Moussa, Ed Douar, Aain Er Rihane, Maaser Ech Chouf, Zouk Mousbeh, Aatrine, Kfar Yasine and Aaytat	648,080	Achieve intended use	43
	Dmit, Beit Meri, Qlaiaat, Zouk Al Khrab, Dik Al Mahdi, Chebaa, Zouk Al Khrab, Zouk Al Khrab and Chbaniye	496,000	Sorting, crushing and recycling	56
Total		4,591,830		418

Annex 4. Multilateral Agreements relevant to Waste Management in Lebanon

Multilateral Environmental Agreements		
Treaty or Convention	Description	Law/Decree
Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade	Stipulates shared information and responsibility in the international trade of certain hazardous chemicals, including 24 pesticides, 11 industrial chemicals and 4 severely hazardous pesticide formulations	Law No. 738 15.5.2006
Stockholm Convention on Persistent Organic Pollutants	Prohibits the production and use of nine main chemicals and contaminants, limits the use of DDT to malaria control, and curtails inadvertent production of dioxins and furans	Law No. 432 8.8.2002
Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal	Regulates the movement of hazardous waste and obliges its members to ensure that such wastes are managed and disposed off in an environmentally sound manner	Law No. 387 21.12.1994
Barcelona Convention for the Protection of the Mediterranean Sea against Pollution (incl. Protocols) Amendment to the Barcelona Convention	Requires sound management of protected areas of the Mediterranean by banning the dumping of wastes into the sea, and the prevention, abatement, combating and control of pollution of the sea area by discharges emanating from any land-based sources within their territories	Law No. 126 30.6.1977 Law No. 34 16.10.2008
London Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter	Prohibits dumping of wastes in the Mediterranean Sea	Law No. 13 28.5.1983