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ECONOMIC RESEARCH DEPARTMENT
BLOMINVEST Bank Headquarters
Bab Idriss, Beirut, Lebanon
T (01) 991 784/2 F (+961) 1 991 732
research@blominvestbank.com
www.blom.com.lb

FOCUS IN BRIEF

Solid Waste Management in Lebanon Part 2: How to Solve Lebanon's Waste Crisis

Lebanon's natural beauty has been scarred by the sloppy management of waste. Trash has been piling up on the streets for more than 2 months now, after the forceful closing of the Naameh landfill. No solution has been put in place yet, turning the situation into an environmental crisis. Inadequate waste management has become a public health, economic, and environmental problem. Lebanon is in dire need of a sustainable and integrated solid waste management system that would restore the country's exquisiteness.

According to Sweep-Net, Lebanon generates around 2.55M tons of waste annually, where each person is expected to produce approximately 0.8 to 1.2 kg per day. Municipal Solid Waste (MSW) is projected to increase by an annual rate of 1.65%. The collection services rate stands at 98%-100% in urban areas, while this rate declines slightly to 90%- 95% in rural areas. (For more information on Municipal Solid Waste, read the report "Solid Waste Management in Lebanon")

MSW can be divided to 2 kinds, organic and inorganic waste. Inorganic waste consists of paper, plastic, glass, nylon, metal, and textiles. These can be sorted, recycled, and resold. As for the former, different methods can be used to treat it, yielding varying results. A few of these techniques, their advantages, and disadvantages are discussed below.

Landfilling is one of the most popular waste disposal methods, consisting of the burying of waste. However, this method is being used less these days, due to the lack of available space and the strong presence of methane and carbon dioxide, both of which cause numerous contamination problems that affect the quality of air, soil, and water resources.

Another waste management technique is composting, an easy and natural bio-degradation process that takes organic wastes and turns them into fertilizer and soil improver. Composting occurs by allowing organic materials to sit in one place for months until microbes decompose it. Biodegradable wastes must be separated prior to composting: only pure food waste, garden waste, wood chips and, to some extent paper, are suitable for producing good quality compost. Depending upon the composition of the waste material and the applied method of composting, the compost will be ready after 3-18 months. However, other products are also formed such as gas in the form of carbon dioxide, water vapor and ammonia. Odorous compounds other than ammonia may be generated especially when oxygen supply is inadequate.

Incineration or combustion is a type of disposal method in which municipal solid wastes are burned at high temperature to be converted into residue and gaseous products. The most important advantage of incineration is that it can reduce the volume of solid waste to 20-30% of its original volume, and it can sterilize the hazardous components. At the same time, it generates thermal energy that can be recovered as heat and/or electric power. Nevertheless toxic ash is emitted, and waste water is produced.

Pyrolysis and gasification represent thermal treatment methods as alternatives to incineration. The methods are characterized by the transformation of the waste into product gas as energy carrier for later combustion in a boiler or gas engine. The purposes of pyrolysis and gasification are to minimize emissions and organic waste, to maximize the gain and quality of recyclable products, as well as to sterilize the hazardous components. Nonetheless, nutrients and organic matter are not recovered.

Anaerobic digestion, also a waste-to-energy technique, is a biological treatment method that can be used to recover both nutrients and energy contained in biodegradable municipal waste. Almost 100% of nutrients are recovered from the organic matter. In addition, a hygienic fertilizer is produced that has no risk of spreading plant and animal diseases.

Features of Waste Management Technologies

Technology	Sustainable	Impact on the environment	Energy recovery	Fertilizer output	Water recovery	Heavy metal recovery
Landfill	Unsustainable waste of resources	Some CH4 to atmosphere, leachate problems	Partial if landfill gas extracted	No fertilizer output	Lost in leachate	Not possible
Composting	Energy required	Damage to ozone layer, also leachate problems	None	Incomplete pathogen kill	Lost to atmosphere	Not possible
Incineration	Fertilizer loss negates any energy gain	Toxic ash	Some but energy wasted	Some P&K output, but N destroyed	Burnt off	Secondary waste
Pyrolysis	Fertilizer loss negates any energy gain	Toxic ash, emissions regulated	Some but energy wasted	Some P&K output, but N destroyed	Burnt off	Secondary waste
Gasification	Fertilizer loss reduces energy gain	Pollutants locked in slag	Some but energy wasted	Some P&K output, but N destroyed	Burnt off	Controlled not recovered
Anaerobic Digestion	Carbon neutral	Total recovery of energy as CH4, CO2 & fertilizer	Maximum overall energy	Clean NPK fertilizer and trace elements	100%	Heavy metals can be recovered from digestate

Source: Organic Power

The table above shows that anaerobic digestion is the only system that deals with organic waste in a sustainable way. This is due to its ability to recover the maximum energy, retain fertilizer and water content, and recover heavy metals. In addition, this process occurs in a completely closed system with no emissions to air, land, or water.

In fact, this process is being adopted in Lebanon, more specifically in Saida. IBC, a privately funded company, is the owner of the solid waste treatment plant in Saida, serving the 16 municipalities of the Saida-Zahrani area. The IBC plant is a waste-to-energy plant, in which 100% of the municipal waste received is recycled, re-used and converted, approaching 0% landfill.

Upon arrival at IBC, the waste is processed in a sorting and separation area, designed to handle up to 450-500 tons of waste daily. During that stage inorganic components are separated to enable the process of recycling plastic, papers, tires, metals and others. The recyclables are then sold to appropriate manufacturers, who gain from buying these materials at a cost lower than the market.

As for the organic waste, it is treated by anaerobic digesters, where microorganisms degrade the waste in an environment starved of oxygen. 50-60% of the organic waste is transformed to biogas, constituting of methane and carbon dioxide, which is converted into energy. The remainder is used as fertilizer. An electric power plant utilizes the biogas to produce electricity and heat, which are more than enough to run the facility. The surplus electric power is granted to the municipalities, served by IBC, to ignite their street lights. Meanwhile, the organic fertilizer is used by farmers to cultivate their farms, halting their dependency on chemical fertilizer. Worldwide, a ton of compost is sold at an average price of $100.

Finally, inert matter is not biodegradable or chemically reactive, thus it can be landfilled without eliciting any harm or secreting odors. Moreover, inert matter can be sorted where asphalt and concrete can be re-used in construction. In addition inert matter can be converted to Refuse Derived Fuel and sold to industrialists.

According to Mr. Karim Hammoud, deputy general manager at IBC, the company started its operation in November 2012, during which it agreed with the 16 municipalities of the Saida-Zahrani area to receive 350 tons of waste per day. The contract stated that the fee for 1 ton of waste received by IBC would be $85 for the first 2 years and $95 for the following 3

years, where the municipalities collect the waste and deliver them to the company's site. However, IBC received only 150-200 tons of waste per day, thus operating at half of its capacity.

IBC states that it is 100% environmentally correct: gases are filtered before reaching the air, no odors are emitted, water is reused, and all of its employees are vaccinated.

On the 8th of September 2015, the government gave municipalities the responsibility of managing their own waste under the supervision of the related ministries, in a period not exceeding 18 months. One of the main purposes is that on the technical front, Lebanon should adopt the international solid waste management hierarchy, whereby waste is reduced, re-used, sorted at source, recycled, converted to energy, treated, and finally disposed. Moreover, the government called for the conversion of the gases emitted from the Naameh landfill to energy.

On the other hand, the government also presented a few intermediary proposals to treat the municipal wastes that have been piling up on the streets since mid-July, until the final solutions are reached and implemented. In details, the government suggested that the municipalities should send 250 tons of waste daily to IBC and transform the uncontrolled dumpsites in Aakar, Bourj Hammoud, and the Lebanese-Syrian Border area to a sanitary landfill. For example, the dumpsite in Aakar should become a sanitary landfill with a capacity to receive 1,500 tons of waste/day for a period of 6 months and 1,000 tons/day during the following year. In addition, the government decided to open the Naameh landfill for 7 days, in order to transport the trash that piled up from the 17th of July till the approval on these proposals.

The method followed by IBC can be adopted all over Lebanon, to solve the waste crisis threatening the country. According to Mr. Hammoud, Lebanon needs almost 4-5 more companies similar to IBC, each with a capacity to receive 1,000-1,500 tons of waste each day, located in the North, Bekaa, Mount Lebanon, and Beirut. Mr. Hammoud estimated the initial capital required to build one company, with a capacity of 500 tons, to be $40M, where the return on the investment would reach 20%.

The revenues of the companies would come from collection and treatment services, selling recyclables and fertilizer. Moreover, in the long run, Electricity du Liban can also buy electricity from these companies, in order to decrease its oil and fuel bill.

As for the costs, they consist of maintenance costs and the salaries of the employees. The companies would incur no operational costs as the machines would be run by the electric energy produced by the treated waste. These companies would enjoy economies of scale, since if they increase the capacity their average costs would decrease. A company would need almost 2 years to become fully operational, but it can start receiving waste, separating and recycling, in addition to composting after 1 year.

Research Department:

Wael Khoury	wael.khoury@blominvestbank.com
Lana Saadeh	lana.saadeh@blominvestbank.com
Riwa Daou	riwa.daou@blominvestbank.com
Mirna Chami	mirna.chami@blominvestbank.com
Marwan Mikhael	marwan.mikhael@blominvestbank.com

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