Mechanical Solid Waste Sorting Stations (WSS) Project

Proposal Summary

The Far East Projects & Development Company (FEC)

General Manager, Eng. Mohammed Al-Khatib
Project Manager and Consultant, Eng. Khadr Al-Dakheel
Strategy Consultant, Dr. Reem N. Bsaiso
Business Development Consultant, Azeddine Al-Kharrat
Studies Development Consultant, Suleiman Al-Assaf
Financial Consultant, Emad Al-Samadi
Studies Coordinator, Eng. Malek Al-Jawabrah
Administrative assistant, Fatima A. Saleem

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1 Introduction

The sorting stage is the key pillar to achieve a circular economy and enhance the efficiency of recycling processes. However, manual sorting faces significant challenges, resulting in the loss of more than 90% of the recyclables in landfills, as a result of human constraints, reduced operational efficiency, and the health and environmental risks associated with direct contact with waste.

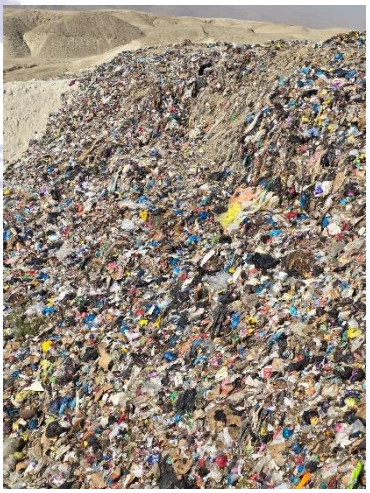
After a three-year study across the Kingdom, which included an analysis of field experiences and actual work carried out within the landfills under the company's management, and the implementation of pilot sorting operations on the ground, The Far East Projects & Development Co. concluded that relying on manual sorting was no longer a sustainable or effective solution to achieve the desired environmental and economic goals.

To address these challenges, the company proposes to implement the Solid Waste Sorting Stations (WSS) project, which is based on the construction of modern mechanical sorting stations equipped with advanced technologies capable of efficiently sorting waste, increasing the recovery rates of recyclables, and reducing waste rates.

This project contributes to improving the efficiency of the waste management system, reducing the environmental impact of landfills, reducing health risks to workers, in addition to supporting the construction of a sustainable recycling infrastructure, in line with the Kingdom's sustainability and circular economy goals.

Through this project, Far East Company aims to:

- Reduce the loss (waste) of recyclables in landfills by at least 90%.
- Provide at least 250 jobs per site with a capacity of 1000 tons per hour.
- Reducing the environmental impact of landfills of recyclable waste, such as sap from waste



A summary of our project, which came as a result of more than five years of continuous work in the field of waste sorting from landfills, during which the existing challenges were analyzed and realistic and effective solutions were developed that contribute to raising the efficiency of sorting, reducing waste and strengthening the recycling system.

2 Overview of the current situation in Jordan

Jordan has a population of about 11.6 million, with an annual population growth of about 1.9%, and non-Jordanians make up about 30% of the population, increasing the pressure on resources and infrastructure. Jordan produces about 1 kg of waste per capita per day, bringing the total solid waste to about 3 million tons per year, while the percentage of recycled does not exceed 10%. The Ministry of Environment aims to raise this percentage to 40-50% by 2030, reflecting the urgent need to develop effective waste management solutions.

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The following table shows the daily amount of waste for a group of landfills from different governorates according to the surveys of The Far East Company.

City	Mafraq	Aqaba	Ma'an	Russeifa	Zarqa	Madaba	Irbid	Karak	Salt	Deir Alla
Waste Management Site Name	Al-Husayniyat	Aqaba	Ma'an	Russeifa	Zarqa	Madaba	Al-Akaidr	Al-Lajjun	Al-Humra	New Deir Alla
Landfill / Transfer Station	Landfill	Landfill	Landfill	Transfer	Transfer	Landfill	Landfill	Landfill	Landfill	Landfill
2020	250	139	95	268	351	381	1300	236	393	190
2021	224	153	106	294	403	423	1547	278	451	232
2022	247	166	116	334	460	461	1702	330	496	273
2023	271	182	127	363	540	507	2008	387	545	300
2024	307	198	149	400	600	558	2273	443	620	343

Approximate Percentages for Solid Waste Compositions in Landfills	
55%	**Food Waste**
8%	**Paper & Cardboard**
13%	**Plastic**
3%	**Minerals**
3%	**Glass**
3%	**Clothing & Fabrics**
4%	**Wood & Garden Waste**
11%	**Other Waste**

3 Problem Statement

3.1 First: Manual sorting in landfills

Manual sorting is the main method of sorting in all landfills in Jordan, where the sorting process is done manually or using simple tools. As a result of this limited mechanism, the percentage of waste in recyclables in landfills is more than 90%.

Example of losses (Deir Ala Landfill) – 95% Lost:

Based on the studies and surveys conducted by The Far East Company, the work carried out on the ground, in addition to reviewing the records of the quantities of materials sorted by the workers, it is clear that the average number of sacks produced by one worker in the landfill is about five tabanats per day, and this varies according to the capacity of each worker. The weight of one sack ranges between 40 and 60 kg.

A picture showing the sacks sorted form the Deir Ala landfill

The number of workers in the Deir Ala landfill is 14, while the landfill receives about 350 tons of waste per day. Based on these data, and **based on the number and weights of the sorted sacks, and the composition of solid materials for the company's landfills, the following are concluded:**

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- **Amount of recyclables sorted per day:**

Number of workers	amount of waste received Daily	Avg waste sorted Daily (Sacks)		Avg waste sorted Daily (Kg)	
		Individual (per worker)	Total (14 workers)	Individual (per worker)	Total (14 workers)
14	350 metric tons	5 Sacks	70 Sacks	200-300 Kg	2800- 4200 Kg

- **Percentage of losses in recyclables per day:**

amount of waste received Daily	Percentage of solid recyclables	Daily amount of solid recyclables received	Daily amount of sorted solid waste	Daily losses in recyclables	percentage of loss in recyclables
350 metric tons	24%	84 metric ton	2.8-4.2 metric ton	79.8 – 81.2 metric tons	95% - 96.67%

- **Percentage of daily losses in RDF and/or compost:**

Amount of waste received Daily	Percentage in waste that can be converted into RDF and/or Compost	Amount of waste that can be converted into RDF and/or Compost	Daily sorted waste that can be converted into RDF and/or Compost	Daily percentage of loss
350 metric tons	62%	217	0 metric ton	100%

It can be concluded that the losses in recyclables at the Deir Ala landfill exceeds 95%.

Given the inability of the workforce to fully sort waste, there is a need for a modern system based on dedicated sorting equipment and machinery, which makes it easier for workers to work and provides additional employment opportunities in this field.

3.2 Second: Waste in Cell Systems

Cell System Overview

The cell system used at the Ghabawi landfill to produce electricity is a solid waste management technique, especially organic waste such as **food waste**. This system is based on **burying waste inside dedicated cells** that have been designed according to precise environmental and engineering standards. The waste inside these cells is distributed in an orderly manner, with layers of soil to ensure that surface pollution is prevented and odors are minimized. The organic part of the waste, such as food waste, is left to decompose naturally, resulting in the production **of gases** such as **methane gas.** Gas **is collected** and used in **the generation of electrical power**.

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Overview of the Al-Ghabawi project:

The Ghabawi landfill covers an area of about **2000 dunums**, and contains **5 cells**, each cell has an area of 170 to 190 dunums, and accommodates about 3-4 million cubic meters of mixed waste **per cell**. The project has a production capacity of up to **5 MW of electricity**.

Problems facing Al-Ghabawi project:

1. **Fermentation Duration:** Due to manual **sorting in Ghabawi landfill**, the waste is buried **mixed** in the cells**,** which increases the time required for the fermentation process. At present, due to this manual sorting, each cell needs 3-4 years for the fermentation process to take place and reach maturity to produce the gas in the required quantities, resulting in the production of methane gas at low efficiency. Sorting mixed waste and burying organic matter only, the time required for fermentation will be drastically reduced, reaching **only 4-6 months instead of 3-4 years.** This large difference in time duration shows the importance of waste sorting to improve the efficiency of the cell system.

2. **Loss of recyclables:** About 5 megawatts of electricity is produced in the project, while data indicates that about **20**% of the mixed waste is recyclable waste (**about half a million tons per cell**). This represents a significant loss of economic opportunities, as the profits of energy produced compared to losses from burying recyclables indicate the need to improve sorting processes to ensure that these recyclables are utilized and value is added Larger.

3. **Gas Impurities:** Impurities and contaminants resulting from the mixing of food waste with organic matter in the fermentation process lead to increased failures in gas turbines. These impurities cause an increase in the need for costly periodic maintenance, and lead to increased system failures. Increasing gas processing costs, this contributes to reducing process efficiency and increasing operational costs, which negatively affects the lifespan of the equipment.

Cell systems are one of the solutions used to treat waste and convert it into energy, but the mechanism currently adopted in Jordan, such as in the case of the Ghabawi landfill, lacks waste sorting before landfill. This results in a significant waste of recyclables, estimated at about half a million tonnes per cell. The Ghabawi landfill currently includes five cells, with the Municipality of Amman aiming to expand and reach nine cells in the future.

4 Proposed solution

The solution lies in the development of a comprehensive, effective and applicable system at the national level, which aims to improve solid waste management, recovery and maximization of resources, through the establishment of dedicated solid waste sorting stations within landfills, based on modern technologies for sorting recyclables with high efficiency, thus contributing to reducing the amounts of landfilled waste and preserving the environment.

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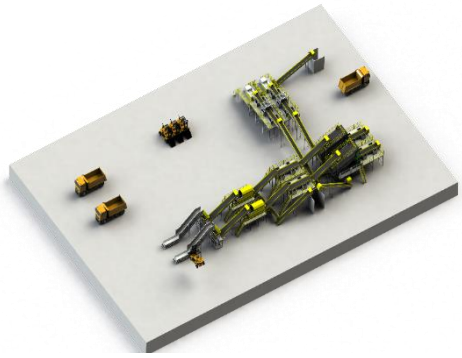
Sorting stations will work to ensure that all recyclables in landfills are recovered and recycled and prevented from being buried, supporting environmental sustainability and enhancing resource management efficiency at the national level.

5 Solid waste sorting stations: An effective strategy to solve the problem .of manual sorting and support cell systems

The adoption of mechanical sorting stations is an effective solution to address the challenges of manual sorting in landfills, as it reduces the waste of recyclables in landfills to less than 10% and can sort more than 100 tons per hour, significantly increasing recycling rates. It also contributes to enhancing occupational safety and health by reducing direct waste handling and reducing health and environmental risks.



5.1 Facility Type

Materials Recovery Facility (MRF)

5.2 Sorting Station Objective

Separating recyclables from the rest of the waste in the landfill to enable the recycling process.

5.3 Sorting Station Components

The waste sorting station mainly consists of the following units:

- **Waste Receipt System:** Introduction of Landfill Waste into Sorting Lines
- **Bag opening unit:** To open bags and facilitate access to waste contents.
- **Disk Screen:** Separates materials by size or type using rotating discs.
- **Magnetic separator:** For separating magnetically attracted ferrous metals.
- **Eddy current separator:** For separating non-ferrous metals.
- **3D separation unit:** to separate materials according to their sizes.
- **Conveyor belts:** to transport waste between different units and complete the sorting process.

5.4 Outputs

- **Recyclable separated materials:** including paper and cardboard, plastic, ferrous and non-ferrous metals, reusable wood, some fabrics and clothing, and other materials such as tires and rubber.
- **Non-recyclable separated materials:** Includes food waste, construction waste, contaminated wood, damaged fabrics, and some non-recyclable plastics.
- **Future Plan:** Converting a portion of non-recyclable materials into RDF and/or organic compost, to be implemented later after the sorting stations are established and the waste is properly segregated.

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6 Comparison of Current Manual Sorting – Sorting Stations – Cell System

Category	Manual Sorting at Landfills	Waste Sorting Stations (WSS)	Cell System Without Sorting Station	Sorting Stations + Cell System
Recovery rate of recyclable materials from waste	3-5%	+90%	3-5%	+90%
Food waste treatment	0%	0%	+95%	+95%
Energy production	No energy produced	No energy produced	Energy is produced	Energy is produced
Cell gas maturation period	-	-	3–4 years	4–6 months
Direct employment opportunities	20–30 direct jobs	+200	N/A	+200
Indirect employment opportunities	N/A	+300	N/A	+300
Utilization rate of total waste	3–5%	20–26%	50–60%	70–86%

6.1 Components of the Sorting Station (sample)

No.	Unit	Function	Quantity	Individual KWh	Total KWh
1	Conveyor Belt Machine with Chain	Waste receiving and sending it to the bag breaker	2	7.5	15
2	Conveyor 1#	Waste transport to/from units, and sorting	2	4	8
3	Conveyor 2#		2	3	6
4	Conveyor 3#		2	3	6
5	Conveyor 4#		2	3	6
6	Conveyor 5#		2	3	6
7	Conveyor 6#		1	1.5	1.5
8	Conveyor 7#		1	4	4
9	Conveyor 8#		1	2.2	2.2
10	Conveyor 9#		1	5.5	5.5
11	Conveyor 10#		2	4	8
12	Conveyor 11#		1	3	3
13	Conveyor 12#		1	4	4
14	Conveyor 13#		2	2.2	4.4
15	Conveyor 14#		1	3	3
16	Conveyor 15#		1	4	4
17	Conveyor 16#		1	3	3
18	Conveyor 17#		1	4	4
19	Bag Breaker	Opening bags and facilitating access to waste	2	180	360
20	Disc Screen	Sorting materials by size (for food waste)	2	16	32

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21	3D Sorting Device	Sorting materials based on Shape (2D materials like paper and cardboard, 3D materials like beverage cans)	2	18.5	37
22	Magnetic Separator	Sorting ferrous metals	2	3	6
23	Eddy Current Separator	Sorting non-ferrous metals	2	6.3	12.6

7 Target Sites to be Invested in for the Establishment of Sorting Station

The station in addition to its accessories requires 35 dunums, and the sorting station will be established **on the following locations:**

7.1 Deir Ala and Salt:

- **Waste Quantity:**
  - The daily waste capacity and quantity of the Salt landfill is 600 tons, and the Deir Ala landfill is 300 tons per day.
- **Working mechanism:**
  - Converting the waste of the Al-Hamra landfill (Salt) to the Deir Ala landfill and establishing a sorting station with a capacity of 1000 tons on the Deir Ala landfill.
- **Key site advantages:**
  - The distance between the Salt landfill and the Deir Ala landfill does not exceed 10 minutes downhill.
  - The Deir Ala landfill has vast areas belonging to the Ministry of Local Administration, which allows the landfill to receive the waste from the Salt landfill.
  - The Salt landfill is under great pressure due to its reception of waste from the Al-Akaidr landfill, and the transfer of waste to the Deir Ala landfill will ease the pressure on the Salt landfill.

7.2 Zarqa and Rusaifah:

- **Amount of waste**
  - The capacity and quantity of waste in Zarqa is 700 tons per day, and Rusaifah is 400 tons per day.
  - Note that these are transfer stations whose waste is diverted to the Al-Ghabawi landfill (Amman), which leads to high costs for the municipalities of Zarqa and Rusaifah.
- **Working mechanism:**
  - Converting the waste of the Rusaifah Transfer Station to Zarqa and establishing a sorting station with a capacity of 1000 tons on the land of the Zarqa Transfer Station. The company will take care of the process of transporting the waste to the Ghabawi landfill instead of the municipality of Zarqa.
- **Key site advantages:**
  - Reducing costs for the municipalities of Zarqa and Rusaifa by transporting their waste to the Ghabawi landfill.
  - Proximity to industrial sites.
  - Zarqa is the highest area in terms of population density, which makes it easier to find qualified staff, and reflects a positive impact on the population

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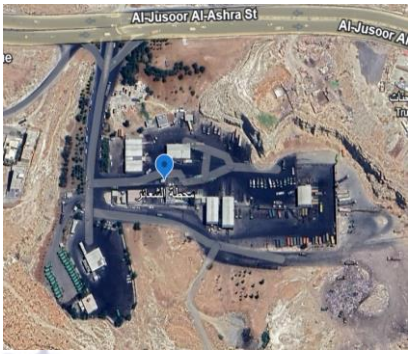
7.3 Madaba:

- **Amount of waste**
  - The capacity and quantity of waste in the Madaba landfill is 400 tons that can be increased through the southern regions to reach 800 tons per day.
- **Working mechanism:**
  - Transporting the waste of the southern regions to the Madaba landfill and establishing a sorting station on the land of the Madaba landfill with a capacity of 800 tons.
- **Key site advantages:**
  - Reduce waste disposal costs, by sorting waste and reducing the amount of waste landfilled.
  - Reduce the pressure on the sludge of the southern regions.

7.4 Amman (Al-Shaer Transfer Station):

- **Amount of waste**
  - The capacity and quantity of waste at the Al-Shaer Transfer Station exceeds 2500 tons per day. It is a station whose waste is diverted to the Al-Ghabawi landfill.
- **Working mechanism:**
  - Establishment of a sorting station with a capacity of 1000 tons on the land of the ritual station**.** The capacity of the site is feasible for the establishment of the project and future expansion without challenges or risks.



- **Key site advantages:**
  - Reducing the costs of transporting waste to the Al-Ghabawi landfill on the Municipality of Amman. By sorting waste and reducing the amounts of waste buried.
  - Easy access to recycling factories
  - Easy access to qualified staff
  - Supporting the Al-Ghabawi Cells Project

8 Key Phases of the Project

The waste management process for the project includes multiple stages:

- **First stage**: Collecting waste from cities and villages. to the target landfill.
- **Second Stage**: Sorting Waste within Sorting Stations.
- **Third Stage**: Transfer of Sorted Materials to Recycling Plants.
- **The final stage**: Turning waste into products.

9 Project Key Benefits

- **Reducing dependence on raw materials** by recovering recyclables**, especially plastics**, from waste, as manufacturing 1 ton of plastic requires approximately 1.9 tons of crude oil. Recycling will reduce the need for crude oil.
- **Job creation**, as the sorting station will lead to the creation of more than 250 direct and indirect job opportunities.

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- **Supporting the recycling sector and feeding factories by** pumping large quantities of recyclable waste into recycling factories, where at least 150 tons per day of recyclables are expected to be provided through the plant.
- **Reduce negative environmental impacts** through sorting and recycling and reduce the amount of waste that is landfilled.
- **Supporting Jordan's global position** in terms of environmental sustainability and combating climate change, by investing in projects that support the recycling sector and the circular economy in cooperation with international organizations supporting the fight against climate change.

10 Project Cost

A sorting station with all its accessories and infrastructure costs $18,000,000 per 1000-ton station.

Total targeted facilities: approximately $144,000,000 million.

11 Conclusion

This project offers an integrated national solution to address the high waste in landfills through the construction of modern sorting stations for sorting and recycling. The proposed system contributes to reducing waste by more than 90% transforming waste from an environmental burden into an economic resource, while supporting recycling, creating jobs, and reducing dependence on landfill and imported raw materials. The project is a strategic step towards promoting environmental sustainability and building an effective circular economy in Jordan.

Thank You for Your Interest in Environmental Sustainability.

Sincere regards,
General Manager, Eng. Mohammed Al-Khatib

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