# Assessment of Sustainable Used Lead Acid Battery Collection and Recycling Scheme in Jordan

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## Abstract

In Jordan, as in other countries in the world, the main problems associated with Used Lead Acid Batteries (ULABs) stem from the widespread operation of unauthorized collectors and smelters due to the high value of recovered materials and from the lack of public awareness and education concerning the potential risks of improper ULAB management. The introduction of a new scheme is critical in order to ensure sound environmental management in the country, as well as safe and legal operations in this sector was critical for the kingdom.

In the framework of the study "Assessment of Sustainable Used Lead Acid Battery Collection and Recycling Scheme in Jordan" funded by European Bank of Reconstruction and Development (EBRD), EPTA S.A. Environmental Consultants and Engineers in collaboration with Mostaqbal Engineering Environmental Consultants assessed the viability of a ULAB collection and recycling scheme in the Jordanian context, based on international best practices.

As part of the viability assessment, the most suitable scheme selected for ULAB management in Jordan was the "PPP scenario", i.e. a special purpose entity (SPE) is established through public and private partnership for the overall ULAB management, while economic instruments, national registries and auditing mechanisms are also established.

In order to evaluate the efficiency, profitability, and sustainability of the scenarios, a financial analysis took place with the following main conclusions:

- The project is financially attractive in terms of IRR, NPV.
- The proposed ULAB management scheme is economically sustainable.
- The PPP proposed scheme yields Value for Money.

## Keywords

Used Lead Acid Battery, Public Private Partnership, Kingdom of Jordan, Producer Responsibility

## Introduction

Lead Acid Batteries are widely used on a mass-scale around the world, as power sources in a wide-range of equipment and appliances used by households, commerce and industry. Lead-acid batteries finds wide application in transport including cars, trucks, buses, boats, trains, rapid mass-transit systems, recreational vehicles etc. During power-cuts, lead-acid batteries provide emergency power for critical operations such as air-traffic control towers, hospitals, railroad crossings, military installations, submarines, etc.

Lead Acid Batteries (LABs) are made up of 65% plates, lead, and lead oxide and 35% sulfuric acid, water electrolyte solution and plastic. Used LABs are considered hazardous waste, listed in Annex III of the Basel Convention, because liquid acid is very corrosive and can cause serious injury. For these reasons, Used Lead Acid Batteries must be stored, collected, transported and treated in accordance with the legislation related to hazardous waste. Strict specifications are required throughout the life cycle of the LABs including the recycling facilities, collection and transportation operators.

Recycling potential of ULABs is very high, as lead components are recovered and used for the production of commercial quality lead, which is a valuable material. Plastic parts of the ULAB can also be recycled, while sulfuric acid is treated separately and is utilized appropriately.

In Jordan, as in other countries in the world, the main problems associated with ULABs stem from the widespread operation of unauthorized collectors and smelters due to the high value of recovered materials and from the lack of public awareness and education concerning the potential risks of improper ULAB management.

ULAB collectors are spread in almost all regions of the Kingdom and vary in scale from individuals who seek to collect few batteries per day from small scale sources, such as auto repair shops to organized groups of collectors who seek larger scale retailers, such as battery agencies. Unauthorized collectors eventually sell their batteries to either unauthorized backyard smelters or to recycling ULAB factories. Unauthorized ULAB smelters take a good advantage of the existing situation of ULAB management and control a high share in ULAB market. Due to the illegal nature of their activity, unauthorized smelters, which are not licensed, manage to escape the Ministry of Environment's inspections and do not follow the Health and Safety requirements, nor do they comply with the Environment protection measures. The plastic resulting from the crushing of batteries is disposed of through incineration, liquid acid leaks to the ground water and the produced lead will not be of the required commercial quality.

The following figure depicts the current situation of ULAB management in Jordan.

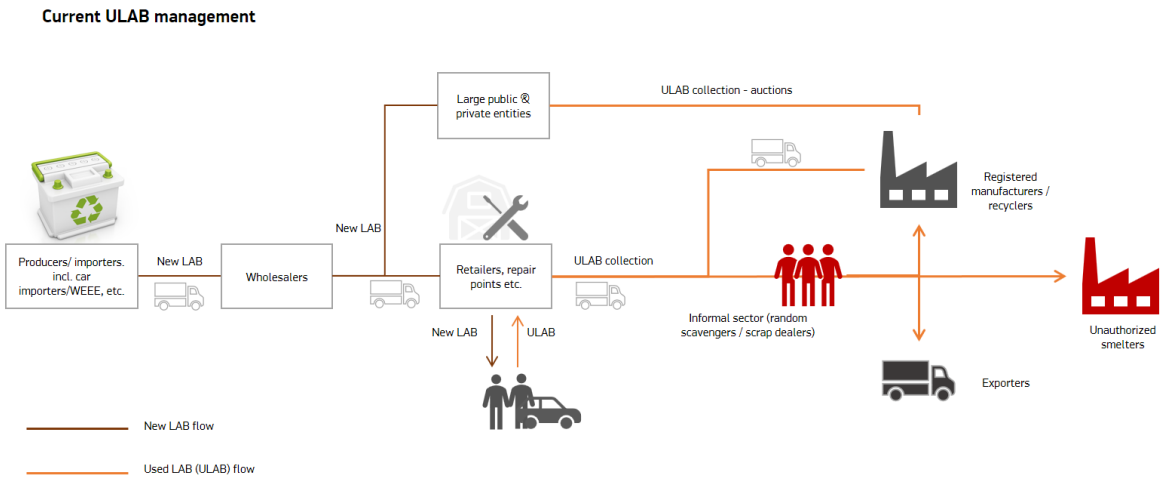


Figure 1: Current ULAB management in Jordan

Taking into account the current situation, the introduction of a new scheme is critical in order to ensure sound environmental management in the country, as well as safe and legal operations in this sector.

## Methods

For the assessment of the current management of ULAB in Jordan, robust collection and collation of data took place, concerning the number and types of batteries, mechanism of collection, storage, transportation and recycling.
The estimation of the quantities generated in the market was based on the end use (automotive, portable, industrial), while there were no records available to record the exact number of consumed LABs except for those obtained from the Customs Department showing the amounts entering the market annually. The quantities collected and calculated by the project team are summarized below.
***Automotive***: One of the common methods to calculate the annual generation of ULABs is based on the total amount of annually licensed vehicles divided by the estimated life of the automotive battery.
***Industrial ULABs***: These have been considered to be 10% of the estimated automotive ULAB quantity. In the telecommunications industry, LABs are the most common source of backup energy supply, which in case of failure of the existing network power supply should be able to provide energy for a few hours.
***Portable***: The quantity of Portable ULABs has been estimated at 1%-2% of the total quantity of ULABs.
The estimated quantities of ULABs in the next 10 years are presented in the following table.

Table 1: Future projection of automotive, portable, and industrial ULAB quantities in Jordan

| Years | Estimated Automotive ULAB Quantities (tn) | Estimated Portable ULAB Quantities (tn) | Estimated Industrial ULAB Quantities (tn) | Total Estimated ULAB Quantities (tn) |
|---|---|---|---|---|
| 2016 | 17,551 | 300 | 1,755 | 19,606 |
| 2017 | 18,604 | 308 | 1,860 | 20,771 |
| 2018 | 19,720 | 315 | 1,972 | 22,007 |
| 2019 | 20,903 | 323 | 2,090 | 23,316 |
| 2020 | 22,157 | 331 | 2,216 | 24,704 |
| 2021 | 23,487 | 339 | 2,349 | 26,175 |
| 2022 | 24,896 | 348 | 2,490 | 27,733 |
| 2023 | 26,390 | 357 | 2,639 | 29,385 |
| 2024 | 27,973 | 366 | 2,797 | 31,136 |
| 2025 | 29,651 | 375 | 2,965 | 32,991 |
| 2026 | 31,430 | 384 | 3,143 | 34,957 |

## 1. PROPOSAL OF THE MOST SUITABLE ULAB SCHEME FOR JORDAN

Several models for ULAB management systems have been developed around the world in order to meet specific country needs. The main economic instruments and measures that are usually applied include the following:

- Producer responsibility schemes

- Deposit refund systems
- Mandatory take back system or exchange system
- Take back programmes
- Taxes (product, recycling or transport)
- Strict licensing and control system

However, most of them, especially in Europe, seem to follow a general trend to develop legislation based on the principle of Extended Producer Responsibility (EPR) and share the following features:

1. There is a common, fully private body (not for profit organization), which is run, owned and supported by the obligated producers. The body's responsibility includes the marketing of collected and sorted materials.
2. Producers are required to fully fund the collection and recycling scheme which is implemented; and
3. High targets are set (or a requiring a high level of service, such as generalized take-back obligations, which may have the same impact as high targets).

Taking into account the current situation of ULAB management in the Kingdom of Jordan, the introduction of a new scheme was critical and had to meet the following main objectives:

- Ensure high environmental protection and health safety, by minimizing the negative impact of the informal ULAB facilities and operations.
- Promote extended producer responsibility (EPR), which means that producers take over a financial or organizational responsibility for ULAB collection and recycling.
- Ensure government surveillance through new institutional structures and central monitoring system.
- Ensure end-users' accessibility and awareness.
- Incorporate key players in the sector (existing factories, exporters, illegal smelters, etc).
- Incorporate non-lead batteries in the same scheme.

In the framework of the study, a range of internationally used technical approaches were examined and analysed in terms of their application in Jordan and three (3) alternative options for ULAB management were finally proposed:

- *Option 1: Basic scenario* - national authorities have the overall supervision of the scheme, while economic instruments are applied. In addition, national registries and auditing mechanisms are established.
- *Option 2: Typical EPR scenario* – a Producer Responsibility Organisation (PRO) is established by LAB producers/importers having the overall financial and operational responsibility. In addition, economic instruments, national registries and auditing mechanisms are established.
- *Option 3: PPP scenario* – a special purpose vehicle (SPV) is established through public and private partnership for the overall ULAB management. In addition, economic instruments, national registries and auditing mechanisms are established.

All the aforementioned schemes could provide a solution for ULAB management depending on the country specific factors at the time that the decision is made.

Option 1 lets key responsibilities to national authorities creating a high grade of uncertainty and risk. It is not preferred to countries like Jordan with moderate public authorities experience and performance in specific environmental subjects. It could be a mid-term future option after some years of operation with another option (i.e. Option 3).
Option 2 transfers full responsibility to a PRO, relying on its capacity to reorganize ULAB market. It is not preferred to countries like Jordan with small medium sized LAB producer's / importers, because they lack human resources to be involved in the PRO operation and their commercial interest conflicts usually to the environmental / social responsibility interest.
Option 3 had a sound advantage over the other two options, considering that responsibilities are allocated between public and private entities, high performance is ensured through binding contract indicators and payments, as well as all investments are guaranteed by the contract itself. It is suggested to countries like Jordan that need to make a significant improvement, by involving the less possible public resources (financial, human) and at the same time have the best possible contractual obligations and results from a SPV company through open and transparent procedures. This system, after the end period of the proposed SPV, could be evaluated and be easily transformed to option 1 or 2 if the circumstances were then positive.

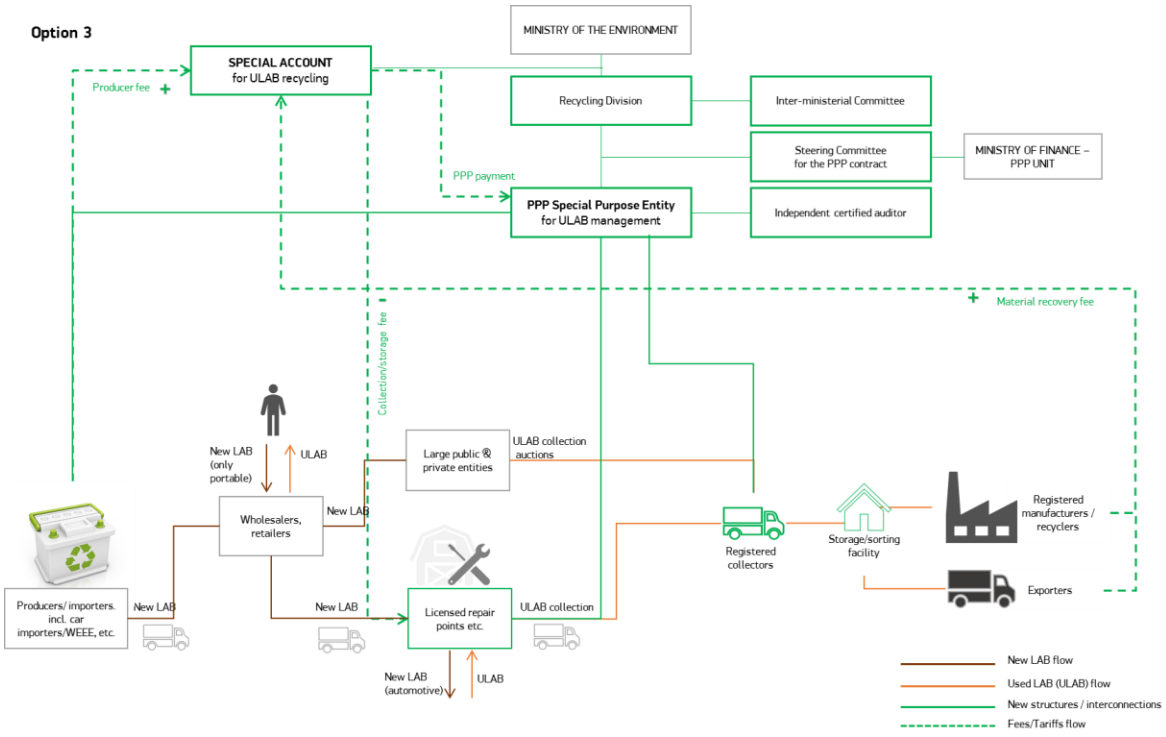


Figure 2: Proposed ULAB scheme for Jordan – PPP scenario

## 2. TECHNICAL DESCRIPTION OF THE PROPOSED SCHEME

The proposed ULAB management scheme foresees that the overall financial and operational responsibility of ULAB management is transferred to a new PPP organization. Thus, a special purpose vehicle (SPV) is established with sharing responsibilities between the public and the private sector through a binding multi-year contract. Private bodies (producers, importers or other economic actors) and the government can be shareholders.

In addition, a Special Account is established within the Ministry of the Environment, collecting two different fees, i.e. "producer fee" paid by LAB producers/importers and the "material recovery fee" paid by licensed recyclers /smelters. The SPV, being paid by the MoEnv through the Special Account, organizes the collection of ULABs and other types of batteries from the retailers, workshops and large public or private bodies till their safe transportation to the licensed recycling facilities or exporters.

The licensed workshops are reimbursed with a collection fee per kg of ULAB collected, while SPV provides them with suitable collection means (bins) for ULAB collection. At the same time, it contracts with licensed collectors via transparent tendering procedures, organized per area. In case that current collectors do not exist in a territory, the SPV has to ensure this activity.

Finally, the SPV organizes the development and operation of an Electronic Registry and the implementation of a wide public awareness campaign and training to several stakeholders.

An accredited independent auditor (independent certifier) assigned by the SPV, monitors compliance with legislation of all involved stakeholders (collector, recyclers, etc.), monitors fees from the participating producers and all other operators and implements audits.

The key elements of the **scheme**, analysed for the three main stakeholders, i.e. the Government, the new PPP structure and the private sector, are summarized below.

### a. Government

***New institutional structures***

The proposed scheme suggests the establishment of new structures within the government which will undertake certain responsibilities for ULAB management. Most of these structures can also be applied to any other recycling scheme based on EPR (e.g. WEEE, tyres, vehicles, etc.) which may be developed in the country in the future.

- Recycling Division (ReD) within the MoEnv
- Inter-ministerial Committee for ULAB management, providing support and guidance to the MoEnv
- Steering Committee for the PPP contract
- Special Account, for collecting fees and covering expenses for ULAB management
- New fees, including the producer fee, the material recovery fee and the collection fee for automotive ULABs at repair shops

- Licensing mechanism (reforming existing licensing procedures, especially for ca repair shops).

***New legal framework for ULAB management***
A new legal framework for ULAB management is proposed in order to cover in a coherent and efficient way, all activities related to ULABs and other portable batteries. It should, also, promote a high rate of collection and recycling and improvements in the institutional structures.

## b. Public Private Partnership (PPP)

***Special Purpose Vehicle***
A special purpose vehicle (SPV) is established with sharing responsibilities between the public and the private sector being responsible for the environmental sound management of ULABs in Jordan. The duration of the SPV will be for 16 years in total.
***Collection & Transportation***
The SPV will be responsible for organizing the collection of ULABs, starting from different collection points (workshops, retailers, industries, etc.) till transferring ULABs to recycling facilities or exporters. All necessary investments on new bins, vehicles, transfer stations, and sorting facilities will be made by the SPV.
***Electronic registration system (ERS)***
For monitoring the data on LABs placed on the market and the ULABs collected, sorted, recycled and exported, as well as for registering all authorized and licensed operators, the SPV will develop and operate an electronic registration system.
***Independent Certifier for the implementation of auditing mechanism***
An accredited external independent certifier (IC) will be contracted mutually by the SPV and the MoEnv, in order to monitor all the procedures of the new ULAB management scheme and oversee the efficiency and competence of the PPP project implementation.
***Public awareness & Training***
SPV will be responsible for organizing and implementing public awareness and training campaigns all over the country.

## c. Other private actors

In the framework of the proposed scheme, the maintenance and upgrading of the existing recycling facilities and infrastructures is suggested, in order to ensure high environmental and health protection. The investments shall be made by the facilities themselves, taking into account the high profitability of this sector.
Regarding LAB importers and manufacturers, they undertake partial financial responsibility and are charged with a fee per LAB put on the market.

For the successful implementation of the proposed scheme, a Roadmap has been prepared, setting out the framework for the design and implementation of future actions. It also outlines the institution/authority responsible for each action, the timescale and the estimated cost and funding.

Table 2: Policy Roadmap for ULAB in Jordan

| No. | Proposed actions | Type of action | Responsible institution/ authority | Indicative time scale | Estimated cost | Possible funding |
|---|---|---|---|---|---|---|
| **1** | Establishment of a Recycling Division (ReD) within the MoEnv | Institutional/ Administrative | MoEnv | Short term | Low (opex) | Public |
| **2** | Development of a new legal framework for ULAB management | Legislative | MoEnv | Short term | low (capex) | EBRD, Public |
| **3** | Creation of a Special Account for collecting fees and covering expenses for ULAB management | Institutional/ Administrative | MoEnv | Short term | low (opex) | n.a |
| **4** | Application of three fees:<br>• Producer fee<br>• Material recovery fee<br>• Collection fee for automotive ULABs at retailers / repair shops | Legislative & Financial | MoEnv | Short term to medium term | low (opex) | Public |
| **5** | Establishment of an Inter-Ministerial Committee (optional) | Institutional/ Administrative | MoEnv | Short term | low (opex) | Public |

| | | | | | | |
|---|---|---|---|---|---|---|
| **6** | Establishment of a separate entity for ULAB management - a PPP entity in the form of a Special Purpose Vehicle (SPV) is proposed | Institutional/ Administrative | MoEnv & MoF | Short term | medium (capex) | EBRD & Public funding |
| **7** | Reforming existing licensing mechanism for all ULAB management procedures includingrepair shops | Legislative | MoEnv, Municipalities and other authorities granting permits | Medium term | n.a | n.a |
| **8** | Incorporation of non-lead batteries in the same scheme | Institutional & Infrastructural | MoEnv | Medium term | medium (opex) | SPV |
| **9** | Promotion of social measures for supporting informal sector | Financial | MoEnv / Ministry of Interior | Long term | medium (opex) | Special Account |
| **10** | Contracting an Independent Certifier for the implementation of auditing mechanism | Institutional | SPV & MoEnv | Short term to medium term | medium (opex) | SPV |
| **11** | Organization of the SPV & Investments on new equipment (collection bins, vehicles) and infrastructures for the collection of ULABs, from different collection points (workshops, retailers, industries, etc.) till transferring ULABs to recycling facilities or exporters | Infrastructural | SPV | Medium term | high (capex) high (opex) | Private funding |
| **12** | Development of an Electronic Registration System (ERS) for monitoring the data on LABs placed on the market and the ULABs collected, sorted, recycled and exported | Administrative | SPV | Medium term | low (opex) | SPV |
| **13** | Implementation of training programmes | Informative/ Educational | SPV & MoEnv | Medium term | medium (capex) low (opex) | SPV |
| **14** | Implementation of public awareness campaigns | Informative/ Educational | SPV & MoEnv | Medium term | medium (capex) low (opex) | SPV |
| **15** | Maintenance and upgrading of the existing recycling facilities to meet high environmental standards and BATs | Infrastructural | Recycling Facilities | Medium and long term | high (capex) | Private funding |

## Results and Discussion

This section presents the financial analysis which took place in order to evaluate the efficiency, profitability, and sustainability of the scenarios. The evaluation was performed for the PPP project and for the total proposed scheme respectively. The financial model developed was based on the discounted cash flows method using ratios such as net present value (NPV), internal rate of return (IRR), profitability index, simple payback and discounted payback indicators. In this context, the total capital expenditures, the operational and maintenance costs and the prospective revenues were explicitly defined. Finally, a sensitivity analysis was conducted based on all the critical parameters that influence the project outcomes.

**Capital expenditures for the PPP**

The first step in establishing a budget for the proposed project was the preparation of the project's initial capital expenditure. Project implementation costs of the project were estimated for financial analysis and are shown in the following table. These costs included all related equipment and requirements, which had been estimated of around JOD 3.214 million. The following table illustrates the capital expenditures for the ULAB project.

Table 3: Capital expenditure

| **No.** | **Description** | **Euro** | **JOD** | **%** |
|---|---|---|---|---|

| | | | | |
|---|---|---|---|---|
| 1 | Collection and Transfer Equipment | 3,204,000 | 2,707,380 | 84.2% |
| 2 | Electronic registration system | 120,000 | 101,400 | 3.2% |
| 3 | Initial Public environmental awareness plan | 180,000 | 152,100 | 4.7% |
| 4 | Initial Education and Training Work Program | 180,000 | 152,100 | 4.7% |
| 5 | Mobilization Costs (studies, administrative, SPV organization, bank guarantees, initial IC) | 120,000 | 101,400 | 3.2% |
| | **TOTAL** | **3,804,000** | **3,214,380** | **100.0%** |

The figures in this table include only basic capital expenditures and do not include financing or any other costs. A more detailed and precise estimation needs to be undertaken once the designs are complete and before the implementation phase. This will minimize the risk factors related to investment cost of this project.
In particular, the capital expenditures are analyzed in the following costs:

- **Collection and transfer equipment**

The stage of collection and transfer of used batteries represents the majority of the project components, this stage is the essence of the project, it consists of collection bins, containers for storing used batteries and trucks in several sizes to transfer the collected used battery containers to the collection centers, and to transfer used batteries from collection centers to recycling utilities. The cost of this phase which is calculated to JOD 3.2 million represents 84% of the total PPP capital of the project cost.

- **Electronic registration system**

The system of registration and follow-up of batteries in general will be implemented through this project in order to track and record the distribution and collection of batteries in general, and will have a great impact on the success and development of the project, the initial cost of this component has been estimated by JOD 101.4 thousands or 3.2% from the PPP total project capital cost.

- **Initial public environmental awareness plan**

The project will include plans for awareness campaigns for the project and its services to all stakeholders and beneficiaries of the project as well as the project's overall environmental benefits. The initial cost of this program is estimated to be JOD 152.1 thousand or 4.7% from the PPP total project capital cost.

- **Initial education and training work program**

One of the important steps to implement the ULAB project is a plan to train the project operators, at all administrative and operational levels, for batteries collectors, this will increase contribution to the success and development of the project, and contribute to the staff to do their work at a high level of accuracy and professionalism. The initial cost of this program has been estimated to be JOD 152.1 thousand or 4.7% from the PPP total project capital cost.

- **Mobilization costs**

The implementation of the project needs expenses to mobilize the community and stakeholders, to support the project and cooperation with those who operate it, through social mobilization teams and special previously prepared programs for this purpose. The implementation of the project will include various studies related to the stages of the project, the nature of the work of the project, the development of the project, the preparation of the systems that will control the activities of each stage of the project, to do the work perfectly, and the cost of other regulatory bodies and the systems of quality control related to this type of projects nature and special environmental impact. The initial cost of this program has been estimated to JOD 101.4 thousand or 3.2% from the PPP total project capital cost.

***Operational & Maintenance expenditures for the PPP***

Operation and maintenance costs are important for continued operation and revenue generation. These costs consist of all kinds of expenditures necessary for operation, maintenance, administrative and collection costs. The O&M costs consist of more than one operation stage and type of cost. The first type is the fixed cost which should be spent regardless of workload, level of battery collection, recycling or volume of production in general, like establishment, legal, licensing, salaries, insurance, rents, etc., and administrative expenses. The second type is the variable costs which are related to the workload and are affected by the work size, the level of battery collection and recycling, or the volume of production in general, like batteries charges, transportation, electricity and water expenses.
The following table includes the total operation and maintenance cost according the type of cost for selected years.

Table 4: Operation & maintenance cost

| **Calendar Year:** | **2019** | **2022** | **2026** | **2030** | **2033** |
|---|---|---|---|---|---|
| Project Year: | **Year 1** | **Year 4** | **Year 8** | **Year 12** | **Year 15** |
| **Operation & Maintenance, JOD** | | | | | |

| | | | | | |
|---|---|---|---|---|---|
| **Salaries expense** | 331,200 | 361,911 | 407,334 | 458,458 | 500,970 |
| **Fixed cost** | 1,224,766 | 1,338,335 | 1,506,308 | 1,695,363 | 1,852,568 |
| **Variable cost** | 530,447 | 970,664 | 1,223,509 | 1,443,300 | 1,554,277 |
| **Interest on loans** | 157,505 | 126,004 | 63,002 | 0 | - |
| **Depreciation cost** | 189,517 | 189,517 | 189,517 | 189,517 | 189,517 |
| **Total** | **2,102,234** | **2,624,519** | **2,982,335** | **3,328,179** | **3,596,362** |

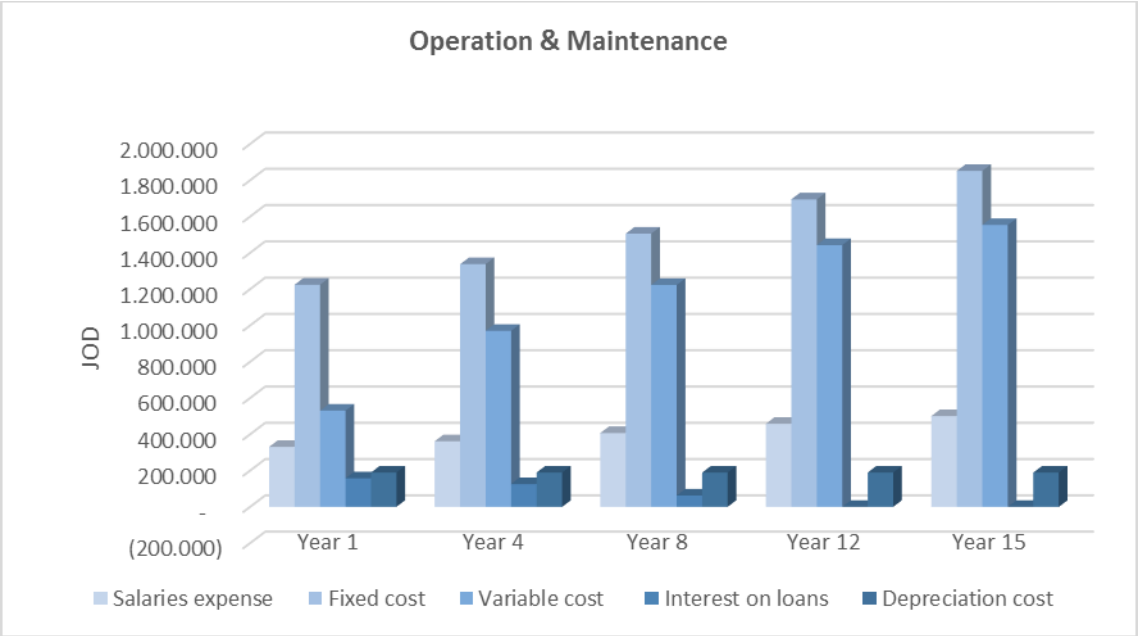


Figure 3: Operation & Maintenance

***Financial expenses of the PPP***

Financial costs of the proposed ULAB project consist of initial investment cost and operation and maintenance cost. Initial investment cost is composed of equipment acquisition, without price escalation. Operation and maintenance costs consist of personnel cost, electricity & water cost, stationary and other miscellaneous costs. The operation and maintenance costs cover all components, since financial revenue is also covers all revenues.

The project can easily be financed using debt or equity or any combination of the two. In general, debt financing is cheaper, so it should be maximized. Currently, financial institutions are demanding high amounts of equity in the range of 30% to 40 %. For the project to be financed by the private sector, the equity stake would likely be in this range. The capital structure in this project is based as 70% as a long-term loan, and the other 30 % as an equity as illustrated in the financial model.

**Analysis Results**

The following table and figures illustrates the analysis results.

Table 5: Analysis results

| Options | Scenarios | Project IRR | Project NPV discounted at 10% | Project NPV discounted at 9% | Project NPV discounted at 8% | Equity IRR | Simple Pay Back Period | Discounted Payback Period | Profitability Index |
|---|---|---|---|---|---|---|---|---|---|
| Quantities Collection Scenario | **100%** | 24.1% | 5,355,528 | 6,175,671 | 7,109,713 | 51.3% | 5.15 | 5.72 | 6.39 |
| | **85%** | 16.1% | 2,482,031 | 3,032,476 | 3,663,399 | 33.9% | 7.14 | 7.75 | 4.34 |
| | **75%** | 10.2% | 542,305 | 912,113 | 1,340,082 | 22.7% | 9.24 | 9.75 | 2.95 |
| | | | | | | | | | |
| | **7%** | 24.1% | 5,355,528 | 6,175,671 | 7,109,713 | 51.3% | 5.15 | 5.72 | 6.39 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Interest Rates Scenarios Indicators at 100% collection | **6%** | 24.4% | 5,426,940 | 6,251,076 | 7,189,419 | 52.3% | 5.11 | 5.72 | 6.43 |
| | **5%** | 24.6% | 5,498,352 | 6,326,481 | 7,269,125 | 53.3% | 5.07 | 5.72 | 6.46 |
| Interest Rates Scenarios at 85% collection | **7%** | 16.1% | 2,482,031 | 3,032,476 | 3,663,399 | 33.9% | 7.14 | 7.75 | 4.34 |
| | **6%** | 16.4% | 2,560,230 | 3,114,891 | 3,750,348 | 34.8% | 7.08 | 7.75 | 4.37 |
| | **5%** | 16.7% | 2,638,429 | 3,197,306 | 3,837,296 | 35.7% | 7.03 | 7.76 | 4.41 |
| Interest Rates Scenarios at 75% collection | **7%** | 10.2% | 542,305 | 912,113 | 1,340,082 | 22.7% | 9.24 | 9.75 | 2.95 |
| | **6%** | 10.5% | 620,505 | 994,528 | 1,427,030 | 23.4% | 9.17 | 9.76 | 2.99 |
| | **5%** | 10.8% | 698,704 | 1,076,943 | 1,513,978 | 24.1% | 9.10 | 9.77 | 3.03 |

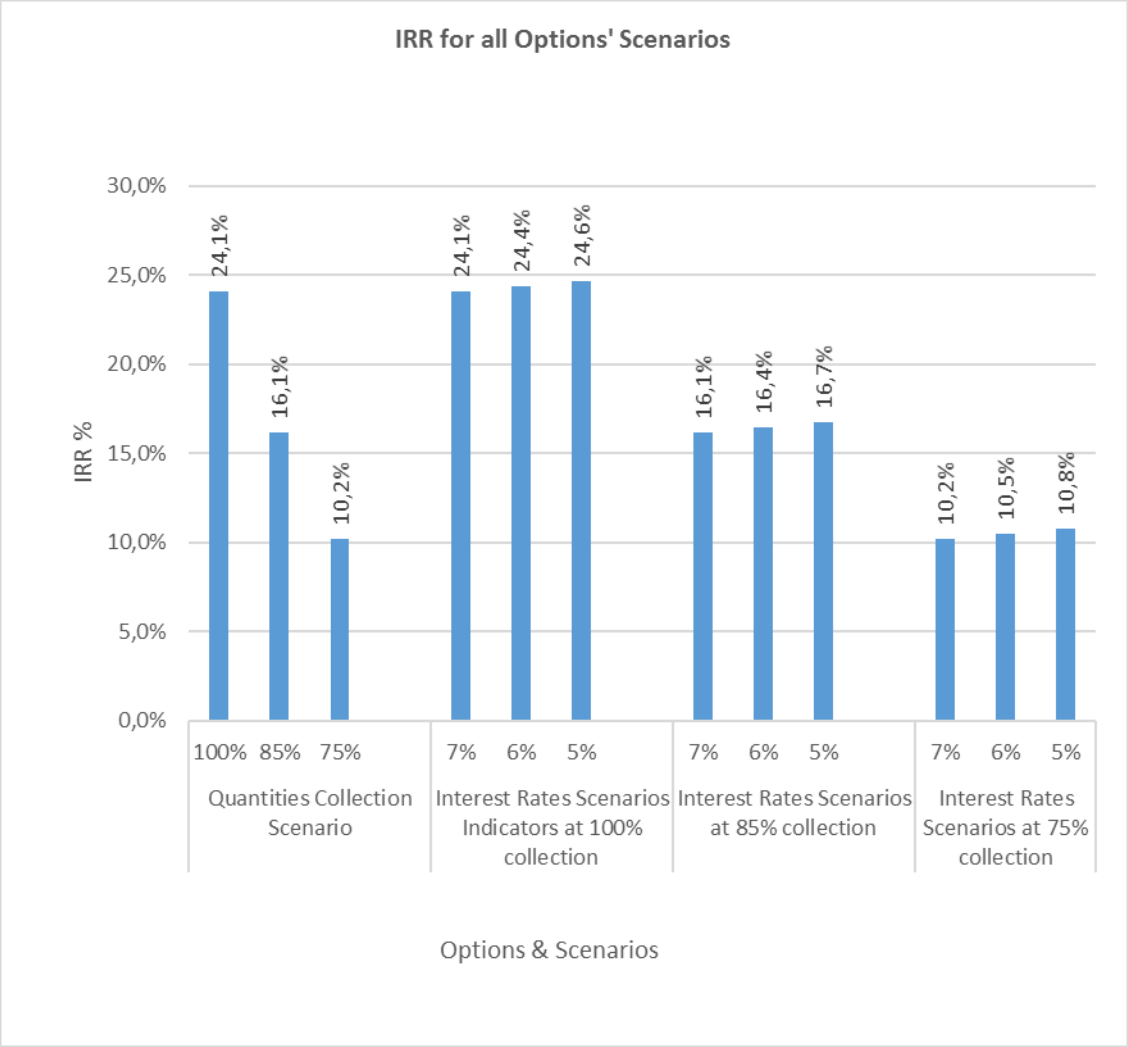


Figure 4: IRR for all option scenarios

In light of the positive analysis results, the financial situation, sensitivity analysis, quantity scenarios analysis, interest rate scenarios analysis and discount rate scenarios analysis, the determined income price of one ton of collected ULAB, results to JOD 245 in order to achieve a fair return in terms of:

- ➔ Project IRR of at least 10%
- ➔ Equity IRR of at least 22.7%
- ➔ Discounted payback period of 9 yrs
- ➔ Profitability index of 3 and

➔ Positive Project NPV

taking into account the worst-case quantity scenario (of 75% of quantities).

## Conclusions

Based on the financial analysis undertaken, the following main conclusions can be made:

1. The project is financially attractive in terms of IRR, NPV, even if lower than 100% revenue is realized or LME (London Metal Exchange) price drops down.
2. Since the CAPEX value is relatively high (both for PPP and total scheme) it is recommended that the Government of Jordan should explore potential financing opportunities from international investors / donors.
3. The proposed ULAB management scheme is economically sustainable. The following elements will secure the affordability of the PPP and the total ULAB management scheme:

   Quantities

   ➔ the collection % of the ULAB management scheme as well as the PPP, with measures such as new legislative framework, intense audits, systematic awareness & training, new electronic registry etc.

   Financing

   ➔ potential institutional funding with attractive terms for the final PPP preferred bidder in order to comply with the new ULAB management scheme.

   ➔ to create reserve in the special account to absorb revenues losses of the scheme from the reduction of the breakeven LME price (462 JOD/tn) but also to invest in PPP changes that affect positively both Public and Private Sector (i.e. if 0.5-1 year before the initial operation and payments of the Scheme-PPP, the revenues are gathered to the special account as a reserve).

   Business

   ➔ to attract the private sector and also to increase the benefits of the project for the ministry and the public, it is recommended that during the competitive dialogue it should be assessed potential extra scope of the PPP i.e. tyres collection for recycling, or oils collection for recycling etc.

   Vehicles' Owners

   ➔ The cost of the new battery is JOD 50 paid every 2 years (battery lifetime). Assuming that the average monthly salary is JOD 500, the proportion of battery price of annual income is equal to 0.4% . The project new fee for the new battery is JOD 0.5 to be added to battery price, thus the rate of increase compared to the battery price is about 1%.
4. The PPP proposed scheme yields Value for Money, as it has been calculated by comparing the NPV of the Public Sector Comparator (PSC) cost with NPV of the PPP project payments. The PPP option provides Value for Money of nearly JOD 33.7 million whereas the PSC Value for Money of approximately JOD 35.35 million

Finally, the Government will have significant financial benefits, indirectly linked to the scheme, which are not included in the financial feasibility, like taxes and VAT.

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