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# WATER REUSE AND ENVIRONMENTAL CONSERVATION PROJECT

CONTRACT EDH-I-00-08-00024-00 ORDER 04

## POST-AUDITS SUMMARY REPORT: P2/EMS ASSESSMENTS OF PARTNER INDUSTRIAL FACILITIES (Revised)

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PREPARED BY AECOM

This document was produced for review by the United States Agency for International Development. It was prepared by AECOM.



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## **POST-AUDITS SUMMARY REPORT: P2/EMS ASSESSMENTS OF PARTNER INDUSTRIAL FACILITIES**

Submitted to:  
USAID Jordan

Prepared by:  
AECOM

### DISCLAIMER:

The authors' views expressed in this document do not necessarily reflect the views of the United States Agency for International Development or the United States Government.



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## LIST OF ACRONYMS

EMS	Environmental Management System
EPA	Environmental Protection Agency
EV	Evisceration
GoJ	Government of Jordan
HVAC	Heating, Ventilation and Air Conditioning
IQC	Indefinite Quantity Contract
ISO	International Organization for Standardization
JOD	Jordanian Dinar
KPI	Key Performance Indicator
kWh	Kilowatt Hours
MoEnv	Ministry of Environment
MOU	Memoranda of Understanding
MT	Metric Tons
P2	Pollution Prevention
PV	Photo Voltaic
RO	Reverse Osmosis
RSS	Royal Scientific Society
SME	Small and Medium Enterprises
USAID	United States Agency for International Development
VFD	Variable Frequency Drive
WRECP	Water Reuse and Environmental Conservation Project



## 1 INTRODUCTION

The purpose of this report is to summarize the audit activities completed by the United States Agency for International Development (USAID) Water Reuse and Environmental Conservation Project (WRECP or “the project”) as a follow-up to Pollution Prevention (P2) and Environmental Management System (EMS) assessments conducted at 31 industrial facilities (a.k.a., project partners) in the Hashemite Kingdom of Jordan (Jordan). One project goal is to improve industrial environmental management by providing technical and institutional support to expand P2 and EMS knowledge within industrial sectors in Jordan. This was achieved by identifying the industrial sectors where assistance would be most fruitful, providing training to a broad array of facilities within those industrial sectors, and then selecting and providing in-depth assistance to those industrial facilities where the project can make the greatest impact.

The P2/EMS assessment process completed by the project included the following steps:

- Survey
- Training
- P2 Assessments
- EMS Assessments
- P2/EMS Audits

To start the process, the project surveyed more than 400 industrial facilities across Jordan and provided training to technical staff from 120 of those facilities. Detailed survey findings are presented in the Industry Survey Report, prepared by AECOM under the project and submitted to USAID Jordan on 28 April 2012, ref. ACM-AID-0274.

In addition to the specific trainings provided by the project team, companies also benefit on an ongoing basis from the knowledge sharing facilitated by the Network for Jordanian Industrial Sustainability (The Network). The Network functions in two ways: through its interactive web portal ([www.JordanNetwork.net](http://www.JordanNetwork.net)) and through live events, such as workshops and training sessions, as well as site/facility visits. The Network was initially established and managed by the project and was then transitioned to the Royal Scientific Society (RSS), which is now hosting and managing it.

As participants in the project, 30 partners were selected for P2/EMS assessments; one of the 30 partners had three facilities, so that made a total of 32 in the first round of assessments; eventually one of the partners dropped out, so the follow-up audits were conducted at the remaining 31 facilities. The P2 assessments were carried out following the *Guide to Pollution Prevention in Selected Jordanian Industries* prepared by the project to facilitate the assessment. The guide is also based on international references, including “Guide to Industrial Assessment for Pollution Prevention and Energy Efficiency,” EPA/625/R- 99/003, June 2001 (EPA).

A methodology was prepared and used to define the industrial sectors that would be the project’s highest priorities. The following five sectors were selected:

1. Food supplies, agriculture and livestock (“Food”)
2. Engineering, electrical industries and information technology (“Engineering”)
3. Chemical and cosmetics (“Chemical”)
4. Therapeutics and medical devices (“Medical Devices”)
5. Packing, packaging, paper, carton and stationery (“Packaging”)

The geographical distribution of the 32 selected partners' facilities reflects the proportional distribution of the surveyed facilities: 18 were located in Amman, 2 in Aqaba, 2 in Irbid, 9 in Zarqa, and 1 in Mafraq.

The sector-based distribution is as follows: 12 facilities were classified under the "Chemical" sector; 5 under the "Engineering" sector; 8 under the "Food" sector; 2 under the "Medical Devices" sector; and 5 under the "Packaging" sector.

The project signed Memoranda of Understanding (MOUs) with 30 partners to assess 32 facilities within these sectors. Out of the 32 facilities, 31 have been P2 assessed and 26 were EMS assessed. One food sector partner did not respond or participate. Of the 31 facilities assessed for P2, 30 facilities developed P2 implementation plans (another food sector partner dropped out of the program following the P2 assessment of its facility).

The P2 and EMS assessments for one of the partners included three separate facilities that were combined into one P2 and one EMS assessment report, respectively. EMS assessments were completed at only 26 facilities, as three of the facilities were already certified with International Organization for Standardization (ISO) 14001; therefore, no EMS reports were prepared for those three partners. After the P2 and EMS assessment reports were finalized, the remaining 30 facilities were audited by the project to assess the level of implementation of the proposed P2 options and confirm the status of each facility's EMS implementation.

The follow-up audits were conducted approximately 9 to 18 months after the initial P2 and EMS assessment reports were issued. As a result of these audits, it was determined that many of the options that were proposed to the project partners and expected to result in savings in the water, energy, and material usage and waste disposal areas – commonly referred to as the proposed P2 options – had already been fully or partially implemented by the project partners at the time of the follow-up audit.

This report highlights the results of the P2/EMS follow-up audits conducted in the summer and fall of 2014 and also highlights the audits' findings related to the progress partner facilities made in correcting identified EMS gaps. In addition, this report includes analysis of P2/EMS audit results and presents the main findings sorted by industry sector, facility size and category of P2 options. This report was initially submitted in April 2015, but a workshop held in Jordan in May 2015 afforded an opportunity to update statistics in Section 4 and in the Success Stories, so those revisions have been made in this version, being submitted in July 2015.

The remaining sections in this report include:

- Project/task objectives
- Analysis of Audit Results
- Success Stories
- Conclusions

## 2 PROJECT/TASK OBJECTIVES AND TIMEFRAME

The USAID WRECP (the project) provides consulting engineering services to the Government of Jordan (GoJ), directed at specific targets consistent with USAID's Strategic Objective to achieve "Enhanced Integrated Water Resources Management." The project is a task order under the USAID Global Architecture and Engineering Indefinite Quantity Contract (IQC), EDH-I-00-08-00024-00. This five-year project began on 1 August 2010 and extends until 30 July 2015.

The project provides capacity-building technical assistance and training to support key institutions, such as the Ministry of Environment (MoEnv) and national laboratories, for improved environmental governance; engineering feasibility studies for industrial waste management and landfill rehabilitation; industrial wastewater treatment system designs; reclaimed water reuse pilot projects; and pollution prevention initiatives with selected industries. The project has four major tasks:

- Task 1: Institutional and Regulatory Strengthening
- Task 2: Pollution Prevention and Industrial Waste Management
- Task 3: Disposal Site Rehabilitation and Feasibility Studies
- Task 4: Water Reuse for Community Livelihood Enhancement

The scope of the P2/EMS assessments and follow-up audits are part of Task 2. Pollution prevention (P2) means reducing or eliminating waste at the source by modifying production processes, promoting the use of non-toxic or less-toxic substances, implementing conservation techniques, and re-using materials rather than putting them into the waste stream. Thus, it is a tool for improving the eco-efficiency of an industrial facility. In turn, the industrial facility can use fewer resources and generate less waste, while maintaining or increasing its rate of production.

Cost savings is typically the main motivator for industry to institute P2 and conservation measures. However, other benefits include: improved health and safety for workers and the community; community recognition for enhanced social responsibility; reduced consumption of energy, water, and raw materials; and reduced likelihood of pollution to the environment from wasteful practices and mismanaged waste. These benefits ultimately contribute to sustainable economic development in Jordan.

The P2 assessment is an integral component of the EMS assessment that has been conducted by the project EMS assessment team for the partner facilities. The P2 assessment provides a tool for each partner facility to achieve a comprehensive EMS, particularly in relation to sources of inefficiencies and ways to reduce them. The list of recommended P2 options in the related P2 assessment reports helps in identifying environmental aspects and impacts at the partner facilities, as well as objectives and targets that are recommended for each facility's EMS (and are requirements of the ISO 14001:2004 international standard).

The EMS assessment is intended to improve each facility's understanding of the elements of the EMS outlined in ISO 14001 and enable a quick review of the facility's operations to determine how it measures up to the standard. The EMS assessment serves as the starting point of a gap analysis to identify management tools or other changes that might be implemented in the organization to help improve overall environmental performance.

Note that the P2 and EMS assessment reports for each facility were officially submitted to the respective partner/facility representative(s) and to USAID Jordan as they were

completed. The Summary Report for P2/EMS Assessments of Partner Industrial Facilities was prepared under the project and submitted to USAID Jordan in December 2014.

In accordance with the terms of the MOU, the partner facilities have agreed to observe the findings of the P2/EMS assessment teams and follow up on the recommended set of improvements.

Now that all of the P2 and EMS assessments have been completed and the implementation plans developed and audited, the ongoing plan for each partner facility is to continue implementing partially completed or not-yet started P2 options from the P2 Implementation Plans, as well as any new options identified by the facilities as they proceed with continuous improvement. It is important that the facilities continue to detail and track the required resources, costs, timeframes, environmental benefits, and financial savings for P2 and EMS implementation on an ongoing basis, as well as the measurements needed to evaluate the benefits of implementation over time.

The partner facilities should also continue to seek additional P2 and EMS improvements by conducting on-going, routine self-assessments and coordination with other companies within Jordan and elsewhere, especially within the same industrial sector.

### 3 ANALYSIS OF AUDIT RESULTS

The results of the P2/EMS audits provide proof of the environmental and economic benefits that can be realized by companies taking practical actions to achieve savings in the water, energy, and material usage and waste disposal categories.

Of the 410 P2 options developed with the 31 partner facilities, 149 (36.3%) of the P2 options had already been fully implemented at the time the respective facilities were audited. An additional 134 (32.7%) of the P2 options had begun implementation and were partially completed, some as much as 90%. As such, all of the participating facilities have realized financial savings and environmental improvements, and additional savings and improvements are expected as more options are implemented and completed.

It should be noted that the actual savings achieved to-date and expected to result from continued implementation of P2 options is affected by the partners' proper implementation, as well as by other factors such as proper design, tariffs for water and electricity, raw material costs, and waste disposal costs. One of the audits noted that there was an obstacle to effectively implementing more P2 options due to constant replacement of the facility's point person for P2. Without this disruption, the environmental impacts and financial savings achieved by the facility would have been more substantial. In another example, the facility invested in new efficient equipment as recommended by the project; however, the facility workers were not fully committed to following best practices and the results at the time of the audit were not as significant as they could be. Facilities should provide ongoing training to educate staff on the importance of these P2 measures and possibly introduce incentives to encourage better performance.

According to *The Jordan Times*<sup>1</sup>: "In 2013, the government started applying a five-year plan that gradually increases electricity rates for most economic sectors by nearly 15 per cent in order to bring the state-owned National Electric Power Company to cost recovery." As a result, the savings from implementing and sustaining energy conservation options will likely increase as electricity rates increase. Payback periods will be shorter and should encourage facilities to implement additional energy conservation options that were set aside for future consideration. Such actions will improve their financial standings and competitiveness in the market.

*The Jordan Times* article went on to document that, "the Kingdom's industrial sector directly employs around 250,000 workers in its facilities, and also provides 250,000 indirect jobs for supportive professions such as handling and transportation." The lessons learned from the programs implemented by the 31 partner facilities that participated in this project can be adopted and adapted by all industry sectors throughout Jordan to improve P2 and EMS programs that will enhance the environment in Jordan and the region.

#### 3.1 Level of Facility Cooperation

Table 1 summarizes the partner facilities' cooperation level throughout P2/EMS assessments and follow-up audits. The table also details the number of total P2 options proposed to each facility, as well as the associated number of P2 options that were fully implemented, partially implemented, and for which no action was taken to-date, at the time of the audit. It is worth noting that some of the audits were conducted as many as 6 months before this report was written, so the current level of implementation is expected to be much higher than reported in Table 1. The table also profiles each facility in terms of size and industry sector. Note that in

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<sup>1</sup> *The Jordan Times*, "Industrialists want gov't to revisit scheduled electricity hike," by Merza Noghai; December 31, 2014.

order to maintain confidentiality since some of this information could be considered sensitive, each partner facility was assigned a generic number for inclusion in the table.

The combined P2 assessments of all 31 facilities generated a total of 410 P2 options. As reported in the Summary Report for P2/EMS Assessments of Partner Industrial Facilities prepared by AECOM under the project and submitted to USAID Jordan in December 2014, there were 13 categories of P2 options across 5 industrial sectors that had an overall estimated investment cost of approximately 7.8 million Jordanian Dinars (JOD) and financial savings estimated at 2.7 million JOD/yr.

The project developed a qualitative metric to rank each facility with its level of cooperation with the initial P2/EMS assessors. As shown in Table 1, 12 (i.e., around 39%) of the project partners showed an “excellent” level of cooperation; 12 (39%) of the facilities showed a “good” level of cooperation; and 7 (23%) showed a “fair” level of cooperation. No partners showed a poor level of cooperation (not counting the one facility that was not assessed at all due to its lack of responsiveness following the signing of the MOU).

In terms of the level of implementation of P2 options at the time of the project’s follow-up audits, 6 (i.e., around 19%) of the project partners showed an “excellent” level of implementation; 17 (55%) of the facilities showed a “good” level of implementation; 7 (23%) showed a “fair” level of implementation; and 1 partner showed a poor level of implementation, as it discontinued participation in the process after the P2 assessment report was issued to them. It is noteworthy that from the time of the MOUs through facilities’ participation in the follow-up audits, changes in many partner facilities’ management teams were significant and caused mostly negative impacts on those facilities’ overall assessments and implementation progress.

### 3.2 Expected Payback Periods and Savings

The proposed options were typically considered by the partner facilities based on the payback periods and the investment costs. Table 2 presents payback periods and estimated savings from the 149 P2 options that were fully implemented, as determined through the follow-up audit process. For these fully-implemented P2 options for which the facilities tracked financials (or provided estimates), the range of payback periods was between 0 and 4.5 years, with a median payback period of 1.0 years. The estimated savings from the fully-implemented P2 options across the various facilities will total approximately 1.4 million JOD in the first year alone, with a median P2 option savings of 2,000 JOD. At the time of the respective audits, the chemical and food sector facilities had each saved over 400,000 JOD from fully-implemented improvements; the engineering sector facilities had saved over 175,000 JOD; the medical devices sector facilities had saved over 25,000 JOD, and the packaging sector facilities had saved over 300,000 JOD.

Some of the higher-cost P2 options are still in the development stages for some facilities and have longer implementation schedules; thus, those options and the associated savings have not been quantified yet. In addition, during the process of developing P2 implementation plans, some facilities identified additional P2 options above and beyond the ones developed by the initial assessment teams. These additional P2 options were not included in this post-audits analysis.

There is a high variation in the investment cost of the different options, due to the unique nature and variability of the options. Some options relate to general maintenance that requires low investment cost and has relatively short payback periods in general; other options, such as electricity generation through photo voltaic (PV) energy, require higher investment costs and longer payback periods.

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 Post-Audits Summary Report Regarding P2/EMS Assessments of Partner Industrial Facilities

**Table 1: Level of Project Partners' Cooperation with P2 Assessments and Implementation, and Follow-up Audit Results**

WRECP Partner Info.				Assessment Phase	Follow-up Audit Results			
No.	Facility Size	Sector	Total # of P2 Options Proposed	Partner's Cooperation Level with the Assessments	Partner's Cooperation Level with P2 Implementation	# of Options Fully Implemented (at the time of the audit*)	# of Options Partially Implemented (at the time of the audit*)	# of Options with No Action Taken (at the time of the audit*)
1	Large	Food	28	Good	Good	13	10	5
2	Small	Packaging	6	Good	Good	3	3	0
3	Medium	Chemical	24	Excellent	Excellent	14	3	7
4	Medium	Food	22	Excellent	Excellent	6	11	5
5	Large	Food	32	Excellent	Excellent	25	2	5
6	Medium	Chemical	19	Good	Good	5	5	9
7	Medium	Chemical	10	Excellent	Good	2	5	3
8	Large	Food	26	Excellent	Excellent	15	6	5
9	Medium	Medical Devices	14	Good	Excellent	8	5	1
10	Medium	Engineering	6	Fair	Fair	0	4	2
11	Medium	Packaging	5	Good	Good	3	0	2
12	Medium	Chemical	25	Excellent	Fair	3	4	18
13	Medium	Chemical	Included above	Excellent	Fair	Included above	Included above	Included in above
14	Medium	Chemical	Included above	Excellent	Fair	Included above	Included above	Included in above
15	Small	Food	12	Fair	Poor	0	0	12
16	Medium	Chemical	18	Excellent	Good	3	8	7
17	Medium	Engineering	10	Good	Good	3	2	5
18	Medium	Chemical	16	Fair	Good	1	10	5
19	Medium	Food	17	Excellent	Good	8	6	3
20	Medium	Packaging	12	Good	Good	4	3	5
21	Large	Engineering	7	Fair	Good	2	4	1
22	Large	Engineering	16	Excellent	Good	4	7	5

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WRECP Partner Info.				Assessment Phase	Follow-up Audit Results			
No.	Facility Size	Sector	Total # of P2 Options Proposed	Partner's Cooperation Level with the Assessments	Partner's Cooperation Level with P2 Implementation	# of Options Fully Implemented (at the time of the audit*)	# of Options Partially Implemented (at the time of the audit*)	# of Options with No Action Taken (at the time of the audit*)
23	Small	Chemical	5	Fair	Good	1	4	0
24	Medium	Chemical	10	Excellent	Excellent	6	3	1
25	Medium	Chemical	16	Fair	Good	8	5	3
26	Small	Chemical	5	Good	Fair	0	1	4
27	Large	Medical Devices	9	Good	Fair	1	4	4
28	Medium	Packaging	14	Good	Good	3	7	4
29	Medium	Food	8	Good	Good	3	3	2
30	Medium	Packaging	9	Good	Good	3	5	1
31	Medium	Engineering	9	Fair	Fair	2	4	3
<b>TOTALS:</b>			<b>410</b>			<b>149</b>	<b>134</b>	<b>127</b>
<b>PERCENTAGES:</b>						<b>36.3%</b>	<b>32.7%</b>	<b>31.0%</b>
<b>Summary</b>				* Note: The numbers of options fully implemented, partially implemented, or with no action taken to-date should be considered as a snap-shot in time for each facility when the project audit team performed the follow-up visit to the facility (typically 9 to 18 months after the P2 assessment report was issued). The audits of 30 facilities were completed over the course of several months in the summer and fall of 2014 and many additional options are likely to have been initiated and/or completed since that time.				
Number of small size facilities				4				
Number of medium size facilities				21				
Number of large size facilities				6				
# facilities with "Excellent" Level of Assessment Cooperation				12	Number of facilities that showed "Excellent" Level of P2 Implementation		6	
# facilities with "Good" Level of Assessment Cooperation				12	Number of facilities that showed "Good" Level of P2 Implementation		17	
# facilities with "Fair" Level of Assessment Cooperation				7	Number of facilities that showed "Fair" Level of P2 Implementation		7	
# facilities with "Poor" Level of Assessment Cooperation				0	Number of facilities that showed "Poor" Level of P2 Implementation		1	

**Table 2: Payback Periods and Savings from Fully Implemented Options**

WRECP Partner Info.							
No.	Facility Size	Sector	Total # of P2 Options Proposed	# of Options Fully Completed (at the time of the audit)	Completed P2 Option #	Payback Period Expected for Completed Options (in Years)	Year 1 Savings Expected for Completed Options (in JOD)
1	Large	Food	28	13	E2	1.7	2,156
1	Large	Food			E3	UNK	1,232
1	Large	Food			E4	3.0	3,684
1	Large	Food			E7	0.3	10,480
1	Large	Food			E8	1.0	2,090
1	Large	Food			E9	2.6	213
1	Large	Food			E10	UNK	2,835
1	Large	Food			E11	3.1	560
1	Large	Food			E13	3.9	1,701
1	Large	Food			E17	UNK	1,318
1	Large	Food			W2	UNK	239
1	Large	Food			W6	UNK	300
1	Large	Food			W7	UNK	4,000
2	Small	Packaging	6	3	M2	NA	NDS
2	Small	Packaging			E1	0.5	534
2	Small	Packaging			E2	UNK	667
3	Medium	Chemical	24	14	M3	UNK	9,600
3	Medium	Chemical			M5	UNK	12,000
3	Medium	Chemical			M6	NA	NDS
3	Medium	Chemical			M11	NA	NDS
3	Medium	Chemical			M12	UNK	9,500

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WRECP Partner Info.							
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3	Medium	Chemical			E1	UNK	12,000
3	Medium	Chemical			E2	1.6	1,350
3	Medium	Chemical			E3	UNK	1,350
3	Medium	Chemical			W1	UNK	8,600
3	Medium	Chemical			W2	UNK	8,600
3	Medium	Chemical			W5	NA	NDS
3	Medium	Chemical			W6	NA	NDS
3	Medium	Chemical			E5	0.8	8,700
3	Medium	Chemical			E6	UNK	30,000
4	Medium	Food	22	6	W6	1.2	2,590
4	Medium	Food			E1	4.5	436
4	Medium	Food			E3	3.8	56
4	Medium	Food			E4	3.0	106
4	Medium	Food			E5	3.3	96
4	Medium	Food			E7	2.0	1,121
5	Large	Food	32	25	M1	NA	NDS
5	Large	Food			M2	NA	NDS
5	Large	Food			M3	NA	NDS
5	Large	Food			M4	NA	NDS
5	Large	Food			M6	NA	NDS
5	Large	Food			M7	0.1	250,000
5	Large	Food			M8	NA	NDS
5	Large	Food			M9	NA	NDS

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WRECP Partner Info.							
No.	Facility Size	Sector	Total # of P2 Options Proposed	# of Options Fully Completed (at the time of the audit)	Completed P2 Option #	Payback Period Expected for Completed Options (in Years)	Year 1 Savings Expected for Completed Options (in JOD)
5	Large	Food			M10	NA	NDS
5	Large	Food			M11	NA	NDS
5	Large	Food			E1	UNK	937
5	Large	Food			E2	UNK	1,132
5	Large	Food			W1	UNK	7,321
5	Large	Food			W2	UNK	7,321
5	Large	Food			W4	UNK	UNK
5	Large	Food			W6	UNK	7,321
5	Large	Food			W7	UNK	7,321
5	Large	Food			W8	UNK	7,321
5	Large	Food			W9	UNK	7,321
5	Large	Food			W10	UNK	7,321
5	Large	Food			E3	2.5	3,143
5	Large	Food			E4	0.7	2,839
5	Large	Food			E5	3.3	763
5	Large	Food			E6	0.9	263
5	Large	Food			E11	2.9	5,339
6	Medium	Chemical	19	5	M2	NA	NDS
6	Medium	Chemical			M5	NA	1,387
6	Medium	Chemical			W1	UNK	455
6	Medium	Chemical			E2	0.2	9,922
6	Medium	Chemical			E4	UNK	1,967
7	Medium	Chemical	10	2	M3	NA	NDS

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No.	Facility Size	Sector	Total # of P2 Options Proposed	# of Options Fully Completed (at the time of the audit)	Completed P2 Option #	Payback Period Expected for Completed Options (in Years)	Year 1 Savings Expected for Completed Options (in JOD)
7	Medium	Chemical			M5	UNK	UNK
8	Large	Food	26	15	M2	UNK	UNK
8	Large	Food			M3	UNK	UNK
8	Large	Food			M4	UNK	UNK
8	Large	Food			M7	UNK	UNK
8	Large	Food			M8	UNK	UNK
8	Large	Food			M9	UNK	UNK
8	Large	Food			M10	UNK	UNK
8	Large	Food			M11	UNK	UNK
8	Large	Food			M12	UNK	1,350
8	Large	Food			E1	0.02	5,215
8	Large	Food			E2	1.1	1,125
8	Large	Food			E6	UNK	17,800
8	Large	Food			E7	0.3	10,817
8	Large	Food			E8	1.1	2,258
8	Large	Food			W1	0.01	4,923
9	Medium	Medical Devices	14	8	M1	UNK	UNK
9	Medium	Medical Devices			M2	UNK	UNK
9	Medium	Medical Devices			E1	UNK	467
9	Medium	Medical Devices			E2	0.9	875
9	Medium	Medical Devices			E3	UNK	3,000
9	Medium	Medical Devices			E8	1.2	1,043
9	Medium	Medical Devices			E9	UNK	6,000

USAID Water Reuse and Environmental Conservation Project  
 Post-Audits Summary Report Regarding P2/EMS Assessments of Partner Industrial Facilities

WRECP Partner Info.							
No.	Facility Size	Sector	Total # of P2 Options Proposed	# of Options Fully Completed (at the time of the audit)	Completed P2 Option #	Payback Period Expected for Completed Options (in Years)	Year 1 Savings Expected for Completed Options (in JOD)
9	Medium	Medical Devices			E10	2.6	1,232
10	Medium	Engineering	6	0		NA	NDS
11	Medium	Packaging	5	3	M1	0	480
11	Medium	Packaging			E2	0.2	18,000
11	Medium	Packaging			E4	0.2	18,000
12	Medium	Chemical	25	3	M4	0.4	2,000
12	Medium	Chemical			M5	0.4	2,000
12	Medium	Chemical			M6	0.4	2,000
13	Medium	Chemical	combined with above				
14	Medium	Chemical	combined with above				
15	Small	Food	12	0		NA	NDS
16	Medium	Chemical	18	3	E1	0.2	1,295
16	Medium	Chemical			E7	2.8	720
16	Medium	Chemical			E8	2.8	621
17	Medium	Engineering	10	3	W2	UNK	200
17	Medium	Engineering			W3	NA	NDS
17	Medium	Engineering			W4	NA	NDS
18	Medium	Chemical	16	1	E2	2.7	1,813
19	Medium	Food	17	8	M1	UNK	9,185
19	Medium	Food			W1	NA	NDS
19	Medium	Food			W3	NA	NDS
19	Medium	Food			W4	NA	NDS
19	Medium	Food			W6	NA	NDS

USAID Water Reuse and Environmental Conservation Project  
 Post-Audits Summary Report Regarding P2/EMS Assessments of Partner Industrial Facilities

WRECP Partner Info.							
No.	Facility Size	Sector	Total # of P2 Options Proposed	# of Options Fully Completed (at the time of the audit)	Completed P2 Option #	Payback Period Expected for Completed Options (in Years)	Year 1 Savings Expected for Completed Options (in JOD)
19	Medium	Food			W7	NA	NDS
19	Medium	Food			W8	NA	NDS
19	Medium	Food			W10	NA	NDS
20	Medium	Packaging	12	4	M1	UNK	UNK
20	Medium	Packaging			W1	UNK	250
20	Medium	Packaging			W2	UNK	62
20	Medium	Packaging			E2	0.2	293,760
21	Large	Engineering	7	2	M1	UNK	39,984
21	Large	Engineering			E2	3.4	3,096
22	Large	Engineering	16	4	E5	UNK	129,631
22	Large	Engineering			W1	1.8	277
22	Large	Engineering			W3	UNK	1,350
22	Large	Engineering			W4	UNK	1,100
23	Small	Chemical	5	1	E2	4.0	100
24	Medium	Chemical	10	6	M1	0.01	40,000
24	Medium	Chemical			M2	UNK	UNK
24	Medium	Chemical			M4	2.0	250,000
24	Medium	Chemical			E1	1.7	9,500
24	Medium	Chemical			E2	0.2	6,564
24	Medium	Chemical			W3	UNK	540
25	Medium	Chemical	16	8	M2	UNK	UNK
25	Medium	Chemical			M5	UNK	UNK
25	Medium	Chemical			E2	UNK	UNK

USAID Water Reuse and Environmental Conservation Project  
 Post-Audits Summary Report Regarding P2/EMS Assessments of Partner Industrial Facilities

<b>WRECP Partner Info.</b>							
<b>No.</b>	<b>Facility Size</b>	<b>Sector</b>	<b>Total # of P2 Options Proposed</b>	<b># of Options Fully Completed (at the time of the audit)</b>	<b>Completed P2 Option #</b>	<b>Payback Period Expected for Completed Options (in Years)</b>	<b>Year 1 Savings Expected for Completed Options (in JOD)</b>
25	Medium	Chemical			E3	0.1	3,500
25	Medium	Chemical			E4	0.2	350
25	Medium	Chemical			E5	UNK	476
25	Medium	Chemical			E6	UNK	344
25	Medium	Chemical			W1	0.9	442
26	Small	Chemical	5	0		NA	NDS
27	Large	Medical Devices	9	1	E1	0.1	8,476
28	Medium	Packaging	14	3	M2	0	500
28	Medium	Packaging			W1	0.01	1,716
28	Medium	Packaging			M4	NA	NDS
29	Medium	Food	8	3	E1	0.9	2,669
29	Medium	Food			E2	1.7	872
29	Medium	Food			W2	UNK	UNK
30	Medium	Packaging	9	3	M2	UNK	60
30	Medium	Packaging			M3	UNK	1,800
30	Medium	Packaging			W2	1.9	811
31	Medium	Medical Devices	9	2	E1	0.4	4,583
31	Medium	Medical Devices			W1	UNK	UNK
<b>TOTALS:</b>			<b>410</b>	<b>149</b>			<b>1,382,743</b>
<b>PERCENTAGE OF TOTAL:</b>				<b>36.3%</b>			

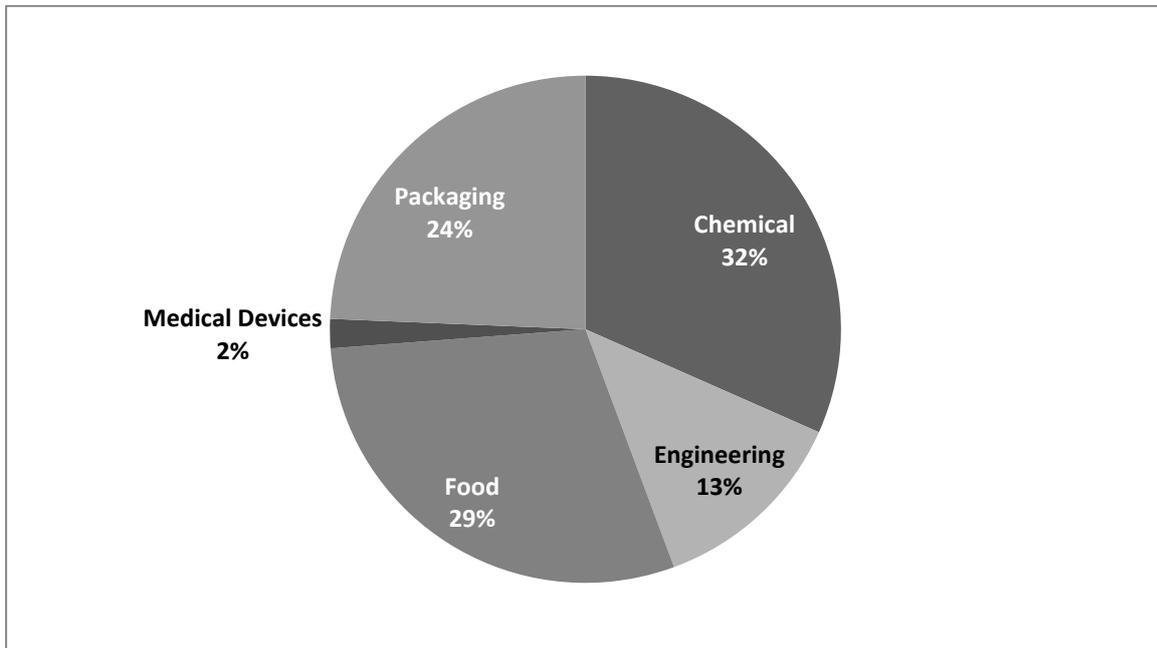
**LEGEND:** **E#** = Energy Options; **M#** = Materials/Waste Options; **W#** = Water options; **UNK** = Unknown;  
**NDS** = No direct savings, but may have indirect savings, such as reduced risks;  
**NA** = Not applicable for options with NDS

One partner facility reported to the project auditors that it reduced its benchmark (key performance indicator (KPI)) cost per metric ton of production from \$1,250/ton before implementing the P2 options to only \$800/ton after implementation, and is aiming to reduce the cost to below \$700/ton.

Table 3 and Figure 1 summarize the industry sector data shown in Table 2 above and show the total savings from fully implemented P2 options by the different sector types.

**Table 3: Total Savings from Fully Implemented P2 Options by Sector Type**

Sector Type	Total Savings from Fully Implemented P2 Options (JOD)	% of Total Savings
Chemical	437,696	31.7%
Engineering	175,638	12.7%
Food	407,093	29.4%
Medical Devices	25,676	1.9%
Packaging	336,640	24.3%
<b>TOTAL</b>	<b>1,382,743</b>	<b>100.0%</b>

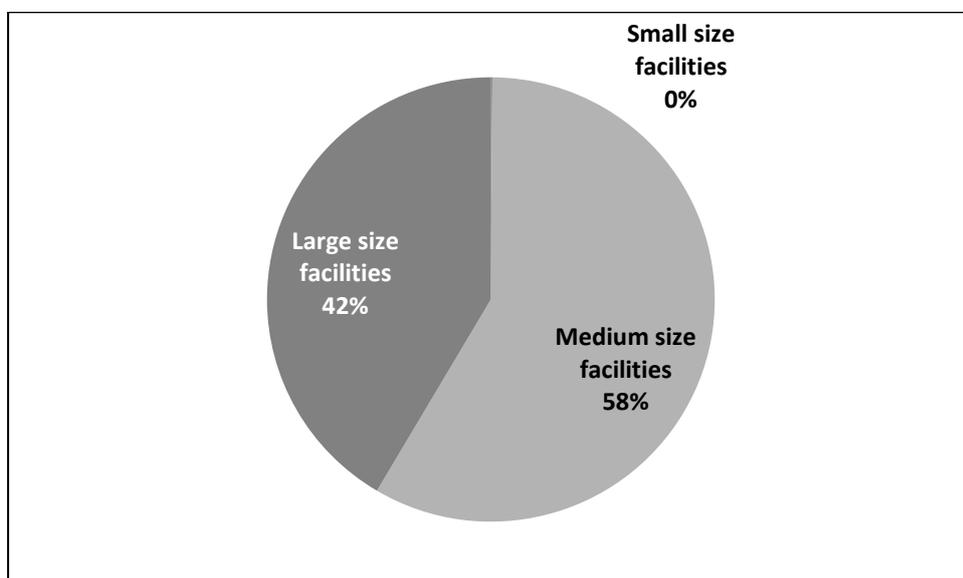


**Figure 1: Total Savings from Fully Implemented P2 Options by Sector Type**

Table 4 and Figure 2 summarize the facility size data shown in Table 2 above and show the total savings from fully implemented P2 options for each size category of facility.

**Table 4: Total Savings from Fully Implemented P2 Options by Facility Size**

Size of Facility	Total Savings from Fully Implemented P2 Options (JOD)	% of Total Savings
Small size facilities	1,301	0.1%
Medium size facilities	807,566	58.4%
Large size facilities	573,876	41.5%
<b>TOTAL</b>	<b>1,382,743</b>	<b>100.0%</b>



**Figure 2: Total Savings from Fully Implemented P2 Options by Facility Size**

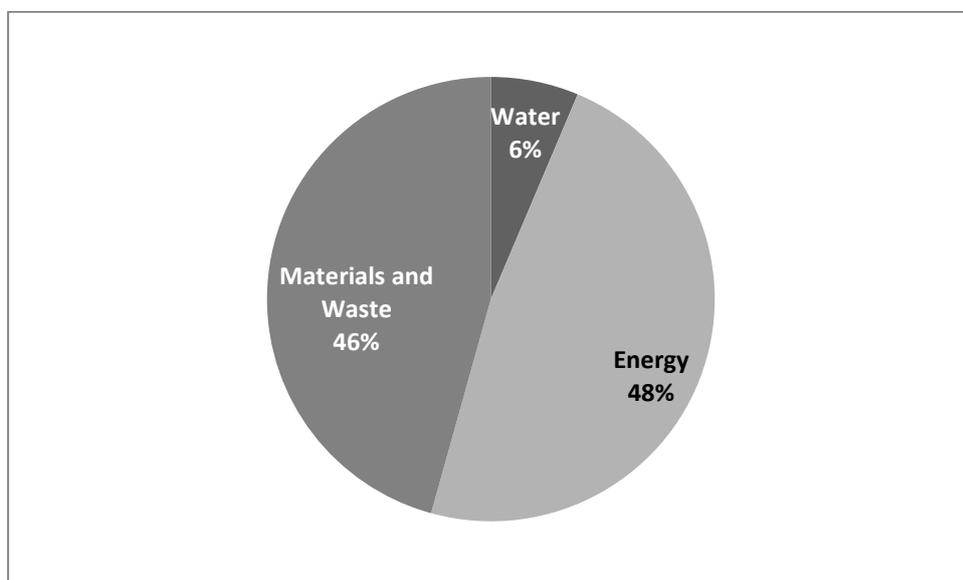
### 3.3 Tracking Progress

Some facilities did a good job at tracking financials and implementing measures (such as installing sub-meters) to assist in tracking energy and water consumption. In other cases, the details of the implemented P2 options were not provided to the project and thus could not be included in the post-audits financial analysis. For P2 options that were only partially completed or not initiated at the time of the audits, the benefits of such measures were not yet realized and could not be quantified in this report. One of the training items that the project has imparted to the companies is that the installation of sub-meters for incoming water resources, outgoing wastewater, and electricity usage will help facilities to better understand usage in different parts of their operations and highlights areas where conservation will be most effective.

As of the time of the follow-up audits (with a different schedule for each facility), Table 5 and Figure 3 summarize the P2 category data in Table 2 above and show the total savings from fully-implemented P2 options by P2 category.

**Table 5: Total Savings from Fully-Implemented P2 Options by P2 Category**

<b>P2 Category</b>	<b>Total Savings from Fully Implemented P2 Options (JOD)</b>	<b>% of Total Savings</b>
Water	87,705	6.3%
Energy	663,192	48.0%
Materials and Waste	631,846	45.7%
<b>TOTAL</b>	<b>1,382,743</b>	<b>100.0%</b>



**Figure 3: Total Savings from Fully-Implemented P2 Options by P2 Category**

As reported in the Summary Report for P2/EMS Assessments of Partner Industrial Facilities prepared by AECOM under the project and submitted to USAID Jordan in December 2014, the total cost of energy for industrial facilities depends on the cost of electricity and of other sources of energy, such as fuel oil, diesel, and liquefied petroleum gas (LPG). Using more than one source of energy (such as diesel fuel or heavy fuel oil to produce steam or hot water or to fuel the HVAC system, in addition to electricity or natural gas) significantly affects a facility's total production cost, since the consumption of other fuel (i.e., diesel fuel, heavy fuel oil) is relatively high compared to the consumption of electricity or natural gas.

As reported in the Industry Survey Report, prepared by AECOM under the project and submitted to USAID Jordan on 28 April 2012, it was determined that nearly 82% of industrial facilities surveyed that reported medium- or high-impacts of energy cost also reported monitoring their energy consumption. However, the survey data showed that this monitoring was done only by looking at energy use invoices and comparing them with previous months. Closer monitoring of energy use (e.g., by process or equipment) can indicate areas that would most benefit from energy-conserving improvements such as automating processes, controlling the operation of auxiliary systems (lighting, fans, pumps), and managing energy

use/demands at peak periods to avoid peak-demand rates. Most of these industrial facilities reported that they have never conducted an energy audit.

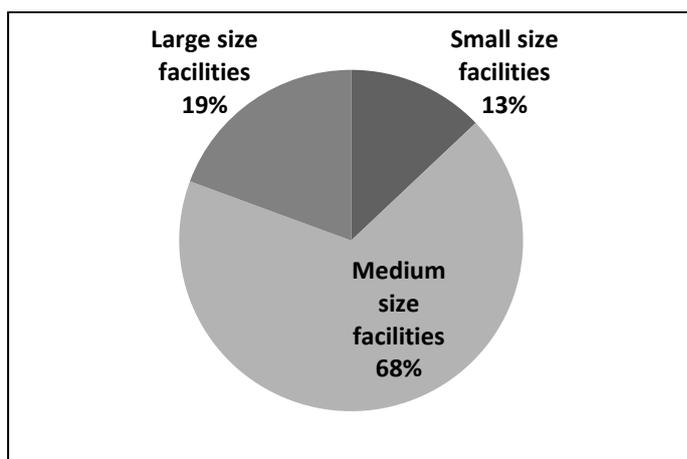
Most of the surveyed facilities reported that the cost of water results in a low impact on their overall facility operating costs. The majority (86%) of the surveyed industrial facilities do not monitor their water and/or energy consumption. This is a significant finding since current practices do not provide a system to identify process areas and auxiliary utilities with high water and energy consumption. Therefore, there is a lack of data on which to base specific actions to reduce consumption and operating costs.

### 3.4 P2 Options Implementation Compared to Facility Size and Sector Type

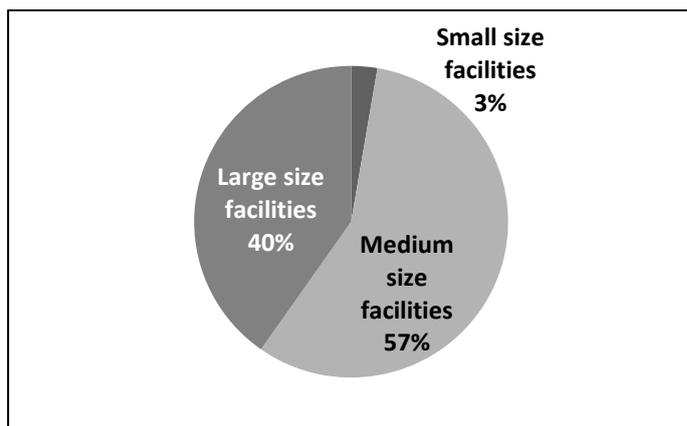
As shown in Table 6, Figure 4 and Figure 5, “Small” size facilities comprised 12.9% of the total number of facilities assessed; however, they accounted for only 2.7% of the fully implemented P2 options. “Medium” size facilities comprised 67.7% of the total number of facilities assessed; however, they accounted for only 57.0% of the fully implemented P2 options. “Large” size facilities comprised 19.4% of the total number of facilities assessed; however, they accounted for 40.3% of the fully implemented P2 options. This indicates that the larger the facility, the more likely it is to fully implement the P2 options, which could be due to a higher level of financial and personnel resources to tackle non-production related projects, such as these P2 options.

**Table 6: Comparison of Size of Partner Facility to Fully Implemented P2 Options**

Size of Facility	# of Total Facilities	% of Total Facilities	# of Fully Implemented P2 Options	% of Fully Implemented P2 Options
Small size facilities	4	12.9%	4	2.7%
Medium size facilities	21	67.7%	85	57.0%
Large size facilities	6	19.4%	60	40.3%
<b>TOTAL</b>	<b>31</b>	<b>100.0%</b>	<b>149</b>	<b>100.0%</b>



**Figure 4: % of Total Number of Facilities Assessed for Each Size of Facility**

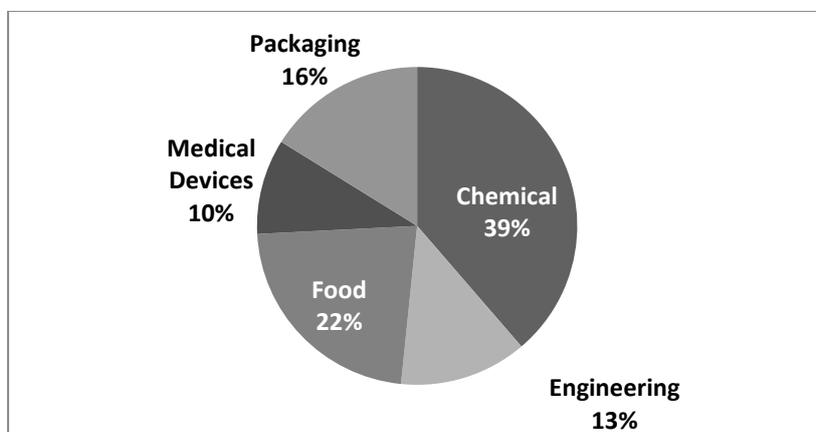


**Figure 5: % of Total Number of Fully Implemented P2 Options for Each Size of Facility**

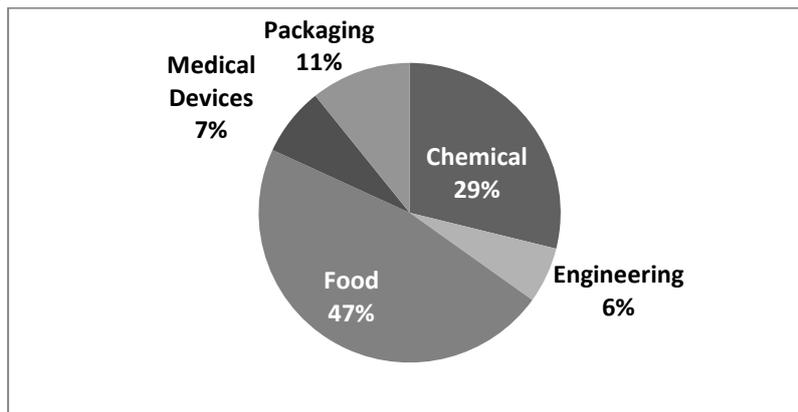
As shown in Table 7, Figure 6 and Figure 7, “Chemical” sector facilities comprised 38.7% of the total number of facilities assessed; however, they accounted for only 28.9% of the total number of fully implemented P2 options. “Engineering” sector facilities comprised 12.9% of the total number of facilities assessed; however, they accounted for only 6.0% of the total number of fully implemented P2 options. “Food” sector facilities comprised 22.6% of the total number of facilities assessed; however, they accounted for 47.0% of the fully implemented P2 options. “Medical devices” sector facilities comprised 9.7% of the total number of facilities assessed; however, they accounted for only 7.4% of the fully implemented P2 options. “Packaging” sector facilities comprised 16.1% of the total number of facilities assessed; however, they accounted for only 10.7% of the fully implemented P2 options.

**Table 7: Comparison of Sector Type to Fully Implemented P2 Options**

Sector Type	# of Total Facilities	% of total facilities	# of Fully Implemented P2 Options	% of Fully Implemented Options
Chemical	12	38.7%	43	28.9%
Engineering	4	12.9%	9	6.0%
Food	7	22.6%	70	47.0%
Medical Devices	3	9.7%	11	7.4%
Packaging	5	16.1%	16	10.7%
<b>TOTAL</b>	<b>31</b>	<b>100.0%</b>	<b>149</b>	<b>100.0%</b>



**Figure 6: % of the Total Number of Facilities Assessed for Each Sector**



**Figure 7: % of the Total Number of Fully Implemented P2 Options for Each Sector**

Clearly, the food sector facilities were the most successful at supporting and implementing P2 options. Of the 7 food sector facilities assessed, 3 were “Large,” 3 were “Medium,” and one was a “Small” size facility. As determined during the P2 assessments, the chemical sector facilities had by far the largest estimated investment costs (totaling 5.9 million JOD of P2 option improvements) for the five sectors; however, the chemical sector facilities’ relatively lower level of implementation may be due to those facilities having more higher-cost options with longer payback periods than the other sectors’ facilities.

### **3.5 Partners’ EMS Implementation Status**

As for EMS, a few of the selected partner facilities had current or past implementation of an EMS. Most of the facilities did not have any EMS, and at the start of this project, these facilities were not familiar with the concepts and benefits of a well-implemented EMS.

After receiving EMS awareness training and visits by project EMS experts, some of the partner facilities have embraced the EMS concept and are developing environmental management procedures and implementing programs to improve their systems on site. However, most partner facilities without previous EMS experience were not enthusiastic about implementing the project’s EMS recommendations and, as determined through the P2/EMS audits, had not followed-up on the recommended EMS improvements.

The project strongly recommends that the partner facilities continue to learn about the benefits of EMS and act on the EMS gaps identified by the project’s EMS experts.

## 4 SUCCESS STORIES

Of the 31 partner facilities audited by the project, 13 were highlighted for their P2 implementation in “Success Stories” prepared by the project and submitted to USAID in March 2015. Some of these are expected to be posted on a USAID website, and they are also expected to be posted on The Network. The goal is for industrial facilities throughout Jordan to see the financial benefits the partners have gained from making improvements and to see ways they, too, can make these gains. The 13 highlighted success stories are summarized below and the full Success Stories are included in Appendix A.

### 4.1 Arab Aluminum Industries (ARAL)

#### **Arab Aluminum Industries Co. Ltd (ARAL) Conserves Water and Energy**

By investing in pollution prevention improvements, Arab Aluminum Industries Co. Ltd (ARAL) in Ein Al Basha, Amman achieved a 30% reduction in both diesel consumption and wastewater treatment costs.

Established in 1976 and employing approximately 270 workers, the facility produces aluminum profiles. Its operations include extrusion, anodizing, powder coating and decoration. Water and energy are major resources.

ARAL had worked with USAID to prepare a pollution prevention plan. One suggestion was to service and/or replace the facility’s three steam boilers, to increase efficiency. ARAL replaced two 3.2-ton steam boilers with two 1.5-ton steam boilers and removed a third boiler from service. Annual consumption of diesel fuel has fallen by more than 249,000 liters. Other suggested changes to the management and use of chemicals in the factory’s process (including reducing drag-out) will save 5 m<sup>3</sup> of water for each ton of product produced. This in turn reduces the amount of sludge waste generated and reduces wastewater treatment costs by 30%.

ARAL plans to follow up these improvements with a monitoring process, looking at water balances and water demand management in its facility. With detailed unit-specific usage data, the facility will be able to target areas where the most significant improvement and savings can be gained. Plant Manager Eng. Ramzi Abu Surour concludes: “With USAID’s assistance, we have achieved the drive and momentum to renovate and improve our operations and the units used in our processes.”

### 4.2 Arab Center for Pharmaceutical and Chemical Industries (ACPC)

#### **Sahab Factory Improves Production, Saves Resources, and Investigates Solar Initiative**

The Arab Center for Pharmaceutical and Chemicals Industries (ACPC) facility in Jordan’s King Abdullah II Industrial Park in Sahab has reduced its energy and water consumption by acting on USAID-recommended improvements. The Managing Director at the 25-worker facility estimates that renovation on two old production lines and adjustments to operating settings have reduced maintenance costs by 40% while boosting the production rate by 17%.

One particularly successful suggestion was to adjust the production settings for capsule dipping and cutting for two production lines. ACPC made the investment to implement these improvements and will adopt the same configurations for dipping and cutting settings for two new production machines to be installed soon.

In addition to these improvements, ACPC achieved significant savings in electricity consumption and water usage by installing energy-efficient lighting, purchasing energy efficient chillers, implementing improved maintenance of boilers, steam lines, and compressed air networks, and installing water-saving devices in restrooms and production areas. The company is also investigating financial options to install a solar thermal system to pre-heat make-up water for its steam boiler system used in certain stages of the process, as well as for product drying. The use of a solar thermal system would reduce diesel consumption by an estimated 11,300 liters per year, which is equivalent to a reduction of carbon dioxide (CO<sub>2</sub>) emissions by over 30,000 kilograms per year.

“This USAID pollution prevention assistance opened our eyes to available opportunities to improve our old production lines, enhance our operation and all the while reduce consumption of resources and maintenance costs,” concluded the Managing Director at ACPC.

### 4.3 Arab Fertilizers & Chemicals Industries Ltd. (Kemapco®)

#### Water and Energy Conservation Reduce Costs for Kemapco®

Kemapco® has made several operational changes that lower energy consumption and prevent pollution at its fertilizer and animal feed additive production facility in the South Industrial Zone in Aqaba, Jordan. As a result, the company achieved the following reductions in 2014:

- Electricity consumption: 1,250,000 kWh
- Heavy Fuel Oil consumption: 13 metric tons
- Water consumption: 48,000 m<sup>3</sup>

The financial and environmental impacts are significant, with annual savings amounting to approximately 180,000 JOD.

The 126,000 m<sup>2</sup> plant has 230 employees and produces Potassium Nitrate (NOP) fertilizer and Dicalcium Phosphate (DCP) animal feed additive. It also produces Nitric Acid for its own consumption.

Once Kemapco® started thinking of ways to reduce waste, the operational expertise of the facility staff allowed them to identify more and more opportunities. Even small reductions in overall use of a given fuel or resource had considerable financial impacts – and helped improve the environment.

Eng. Ramzi Sinnokrot, Technical Sector Manager, appreciated the way that the USAID Water Reuse and Environmental Conservation Project motivated Kemapco® to look closely at energy, water, material handling, and waste management. He commented: “The pollution prevention program with USAID has helped us to focus more on the available opportunities and save more of our resources.”

### 4.4 The Arab Pesticides and Veterinary Drugs Mfg Co. (MOBEDCO)

#### MOBEDCO Finds Conservation Measures Increase Profitability

The Arab Pesticides and Veterinary Drugs Mfg Co. (MOBEDCO) produces agricultural pesticides and veterinary medicines in its facility at the Al Hassan Industrial Estate in Irbid, Jordan. MOBEDCO has achieved great results by implementing pollution prevention measures suggested by a USAID project – and by developing some of its own.

The company has saved more than 12,600 JOD in the first year alone from:

- Retrofitting lights to LED

- Installing a power factor correction unit (PFCU)
- Optimizing the compressed air and chilled water networks on site

Water consumption was also reduced by:

- Installing sub-meters at some units to calculate the water balance
- Installing water-saving faucets
- Re-using reject water from the deionized (DI) water system

MOBEDCO also made significant reductions in materials consumption by:

- Upgrading its storage system
- Providing awareness training for its workers

These changes not only saved the company money, but also reduced odors, air pollutant emissions, and the risk of spills, fires, and contamination.

Dr. Mohammad Owais, General Manager of MOBEDCO commented, “Working with the USAID program has helped us to reduce our environmental impact and costs, and become more competitive in the market.”

#### **4.5 Arabian Development for Food Industries Co. (ADFICO)**

##### **Water Conservation Measures Save Resources and Reduce Costs for ADFICO**

Arabian Development for Food Industries Co. (ADFICO) expects to save money, reduce its carbon footprint, and use less fuel by making operational changes suggested in a USAID-funded pollution prevention assessment. The main changes were to add sub-metering for water and wastewater lines and to upgrade thermal insulation for boilers.

Located in the Amman-Zarqa Free Zone in Jordan, ADFICO produces canned food products such as tomato paste and juice. Its operations include mixing, processing and pasteurization, filling, and packing. Water and energy are major resources.

Providing sub-meters for the water and wastewater lines allowed the company to pinpoint inefficiencies. By sub-metering only certain connections on the main production line, the facility was able to make adjustments that saved materials and workers’ time.

Eng. Marwan Abed Salam, ADFICO’s Plant Manager, estimates that the savings in resources could translate into 36,000 JOD/year during full operation. The number of lab tests needed to control the batches’ specifications has also been reduced.

Other changes include outsourcing boiler maintenance and calibration and installing the proper thermal insulation to reduce the dissipated heat of the steam valves. As a result, ADFICO has been able to reduce its consumption of diesel fuel by around 5,500 liters annually, which reduces CO<sub>2</sub>-equivalent emissions by an estimated 14,800 kg/yr.

Eng. Marwan Abed Salam, ADFICO Plant Manager, said: “With USAID’s assistance, we controlled water and material consumption, thus improving our competitiveness in the market.”

## 4.6 Al-Baha Company for Caustic Chlorine Industry

### Al-Baha Chlorine Plant shows Environmental Investments Boost Economic Performance

The Al-Baha Company for Caustic Chlorine Industry facility in Al Halabat (a private free zone) was established in 2004 and employs approximately 150 workers manufacturing caustic soda, liquid chlorine gas, hydrochloric acid and sodium hypochlorite. The company has been active in improving its performance. It is implementing the International Organization for Standardization (ISO) 9001 (Quality management system), ISO14000 (Environmental management system), as well as OHSAS 18001 (Health & Safety).

The Al-Baha is saving 293,000 JOD each year by cutting its water, fuel and energy consumption. The company has made multiple investments to improve environmental performance and reduce its carbon footprint:

- New equipment to create sodium hydroxide flakes uses 36,000 m<sup>3</sup> less water per year and 4,000 m<sup>3</sup> less wastewater per year, saving 46,800 JOD annually
- New hydrogen boiler uses 400 metric tons less heavy fuel oil per year, saving 250,000 JOD annually
- Installing variable frequency drives cut electricity consumption by 75,600 kWh/year, and is saving 7,000 JOD in the first year alone
- Materials handling improvements reduced the risk of chemical spills and generated a profit of 40,000 JOD

**Sodium hydroxide flakes.** Encouraged by USAID's Water Reuse and Environmental Conservation Project, company management made a significant investment in a new line for converting liquid sodium hydroxide product into solid flakes, which saved about 40% of the water previously wasted with the product – water that can now be used for other operations. This improvement was largely responsible for reducing water usage by 36,000 m<sup>3</sup> per year and to generate 40% less wastewater (a reduction of 4,000 m<sup>3</sup> per year), which translates into 46,800 JOD cash savings in the first year alone. From this one change, Al-Baha improved operations and was able to add 25 new jobs.

**Hydrogen boiler.** The facility installed a new hydrogen combustion boiler, which reduces heavy fuel oil use by 400 metric tons per year and reduces annual CO<sub>2</sub>-equivalent emissions by over 1.2 million kg. The boiler uses gas previously vented as a waste product from the facility's chlorine production line, reducing greenhouse gas emissions.

Plant Manager Dr. Al-Janabi commented: "We thought we could improve our systems, but it's hard to make a business case for change until you have the hard data to back up your hunch. With assistance from USAID, we were able to cost the installation of a new hydrogen boiler and estimate savings of 250,000 JOD per year due to reduced fuel and maintenance costs. We saw how to change our steam heating system in ways that improve performance, both environmental and economic."

**Variable frequency drives.** Electricity usage is also down following management's decision to invest in variable frequency drives (VFDs) on large cooling fans. The company projects that the drives will cut its annual electricity consumption by approximately 75,600 kWh, which equates to a reduction of about 39,000 kg per year in CO<sub>2</sub>-equivalent emissions.

"We expect to save approximately 7,000 JOD in electricity costs for the first year," says Eng. Ravinder Arora, the facility's Deputy General Manager. Furthermore, he notes that these savings will likely increase over time. "When the electricity tariff increases in 2015, the savings will be closer to 12,000 JOD for the year."

**Sub-metering.** Management’s decision to install numerous water sub-meters throughout the plant defined and located water use more specifically within any given process and this identified further water–saving options.

Dr. Khazal Al-Janabi noted that the meters had opened up “many opportunities for water saving and better water management practices. Water balance is better established at the facility, to track water-in-product and wastewater quantities for each process.”

**Materials handling.** Finally, applying best practices in materials handling proved to be a relatively easy and cost-effective improvement. A new computer-based system stores and tracks inventory items. Only items to be used are stored, so 40,000 JOD revenue was generated through the sale of unwanted spare parts and future waste generation from this area is expected to be minimal. The reorganization also helped reduce the risk of chemical spills and the consequent need for cleanups.

#### 4.7 Hijazi & Ghosheh Company

##### **Hijazi & Ghosheh Gains Competitive Edge by Reducing Environmental Impacts**

The Hijazi & Ghosheh (H&G) facility in Amman, Jordan, has reduced its water, diesel, and electricity bills by making pollution prevention improvements. The changes will save nearly 15,000 JOD/year.

Established in 1991, the plant employs 250 workers. Its meat products and pastries are sold locally and exported to regional and international markets. USAID Water Reuse and Environmental Conservation Project showed how H&G could reduce losses of raw materials by improving equipment maintenance. H&G went a step further by purchasing new machines (using clean technology) worth 300,000 JOD. The company estimates that this investment will be paid back in 24 months. The new machines have also reduced the demand for operators’ time by 50%, allowing for reallocation of staff to other parts of the facility.

H&G has also significantly reduced water consumption by optimizing cleaning and maintenance processes (including steam network repairs and cooling tower maintenance) and reducing the amount of water used in some process areas. These changes will save about 10,000 m<sup>3</sup> of fresh water as well as 7,000 liters of diesel fuel and 96,000 kWh/year of electricity, resulting in a potential savings of nearly 15,000 JOD/year. Such changes are expected to increase the facility’s competitive edge in both local and regional markets.

Eng. Mohammed Taysir, QA & QC manager at H&G, noted that the company had always tried to be environmentally responsible, but, “with USAID’s assistance, we found new ways to manage our resource and materials use. The changes have reduced both our environmental impact and our costs. We can increase the money we make and provide a greater benefit to consumers.”

#### 4.8 International Storage Battery Company (ISBCO)

##### **ISBCO Credits Teamwork for Savings in Water, Energy and Materials**

The International Storage Battery Company (ISBCO) facility, in Jordan’s Abdullah II Ibn Al-Hussein Industrial Estate at Sahab, made several improvements recommended in a USAID pollution prevention assessment. As a result, ISBCO:

- Reduced electricity consumption by 1.2 million kWh/year for a savings of 82,000 JOD
- Reduced CO<sub>2</sub>-equivalent emissions by 650,000 kg/year

- Reduced water consumption by 22 m<sup>3</sup> each working day
- Saves a total of 125,000 JOD/year

The electricity consumption was reduced by means of energy efficiency and systems upgrading measures, which in turn reduced the CO<sub>2</sub>-equivalent emissions.

ISBCO implemented a water conservation measure that the USAID assessment showed would have a payback period of less than a year. ISBCO now saves approximately 9,500 JOD/year in water use and wastewater discharge costs.

ISBCO was able to save another 37,000 JOD/year by improving their handling of materials, including both raw material and production waste. They improved the ways they handle lead resources, dross and dust piles, and the pasted grids used to manufacture batteries. They also improved the lead oxidation process and reduced indoor air emissions.

Eng. Elyas Elnajmeh, the Factory Director, appreciated the way that USAID assistance helped ISBCO look closely at energy, water, material handling and waste management. "With assistance from USAID's Water Reuse and Environmental Conservation Project," he says, "we saved water, energy and material resources at our facility. Together as a team, we have accomplished huge savings."

#### 4.9 Al-Thuraiya

##### **Al-Thuraiya Company Reduces Water and Energy Use Through Operational Improvements**

By making operational improvements suggested in a USAID assessment, the Al-Thuraiya Poultry facility in Mafraq, Jordan, expects to save 630,000 JOD annually.

The plant employs 244 workers and produces whole chickens, cut-up parts, and other poultry products. The products are sold locally and exported to regional markets.

Al-Thuraiya has significantly reduced its water consumption by optimizing operational and maintenance processes. These improvements to the reverse osmosis (RO) system will cut fresh water use by 198,000 m<sup>3</sup>/year, which will reduce wastewater processing by nearly one-third. Expected savings from these water improvements total 405,000 JOD/year.

Energy-saving measures were also implemented at the facility, reducing electricity use by nearly one-third (i.e., 2,770,000 kWh/year) and diesel consumption by 6,700 liters/year:

- Increased production speed to reduce the average kWh needed to process each bird
- Increased Power Factor (added new panels)
- Installed harmonics filters for inverters
- Trained operators on refrigeration plant efficiencies
- Improved insulation on cooling system doors/pipes
- Installed controls for internal and external lighting

Expected savings from these energy improvements total 225,000 JOD/year.

Research and Development Manager Dr. Wisam expects these environmentally friendly changes to increase the facility's competitive edge in the local and regional markets. "We can increase the money we make," he said, "and provide a greater benefit to customers. The changes made with USAID's assistance have helped us to reduce our environmental impact and costs, while providing excellent products that can be sold at an affordable price."

#### 4.10 Mudieb Haddad and Sons Company

##### **Jordan Potato & Corn Chips Co. Improves Production, Reduces Environmental Impact**

The Mudieb Haddad and Sons Group (Jordan Potato & Corn Chips Plant), which owns the “Mr. Chips” brand, has lowered its consumption of electricity, water, and diesel fuel and reduced the amount of waste it generates.

Changes made at the company’s facility in Al Zarqa include:

- Insulating steam lines
- Cleaning and calibrating boilers
- Installing more energy-efficient equipment
- Managing equipment settings to achieve more efficient operations
- Improving procedures to minimize water use
- Improving procedures to generate less solid waste and waste water
- Installing guards and equipment to minimize product losses

Eng. Tareq Abu Jaber, Plant Manager, oversees more than 300 workers operating several different production lines at the facility. He comments: “Encouraged by discussions with USAID’s Water Reuse and Environmental Conservation Project, we were able to adjust our operating settings and enhance performance. The measures have lowered electrical consumption by 8%, diesel consumption by 3%, and water consumption by 4%, while at the same time reducing waste by 7%.”

Eng. Imad Haddad, Engineering & Technical Manager of Jordan Potato & Corn Chips Co., says that the USAID program stimulated the factory to take a more focused look at pollution prevention: “After working with USAID, our improved Pollution Prevention Program has made our factory more oriented towards energy, water and raw materials savings, and helped us with our production benchmarking.”

#### 4.11 National Chlorine Industries Company (NCI)

##### **National Chlorine Plant Improves Production with Membrane Technology and VFDs**

National Chlorine Industries (NCI) in Almowaqqar, Jordan, has made operational improvements that reduce its energy consumption and its carbon footprint – while increasing production.

Encouraged by discussions about reducing waste with the staff of USAID’s Water Reuse and Environmental Conservation Project, NCI management embarked on a comprehensive internal audit of the facility. They determined that two improvements stood out in terms of combining environmental benefits and speedy pay back of investment:

- Using energy-efficient production equipment, including new membrane technology
- Installing variable frequency drives (VFDs) and temperature sensors on cooling tower fans

By investing in these improvements, the NCI facility has increased its production and is reducing its consumption of electricity by approximately 9 megawatts per year. The majority of the savings are associated with the new membrane technology. However, the installation of VFDs and temperature sensors also reduced the energy consumption of the cooling towers by about 20%. Overall, these improvements reduce CO<sub>2</sub>-equivalent emissions by an estimated 4,700 metric tons per year.

In addition to saving energy, NCI is reducing its risk of environmental exposure; lowering fuel oil consumption by 58,000 liters per year; and reducing water consumption by 120 cubic meters per year.

Maintenance Section Head Eng. Farid Talal says: “Now we will be able to reduce our electricity consumption by 20% and achieve expected savings of 630,000 JOD per year.” With the increase in the electricity tariff for 2015, the expected savings will be closer to 720,000 JOD.

#### 4.12 White Plastic Company

##### **Air Compressor Replacement/Repair Saves Energy and Money for White Plastic**

By replacing two old air compressors with a new larger model with automatic operation, White Plastic Co. reduced its energy use significantly. This reduction is expected to save the company approximately 36,000 JOD in the first year alone.

White Plastic’s electricity consumption is being reduced by approximately 500,000 kWh/year. This is equivalent to eliminating over 260,000 kilograms of CO<sub>2</sub>-equivalent emissions.

Other changes included repairing leaks in the compressed air network. The facility also began collecting its used cartons and cardboard, and offered them for free to paper collection companies for recycling.

The changes had been recommended in a USAID-sponsored pollution prevention and environmental management assessment.

Established in 1973 in Amman, Jordan, the White Plastic Co. facility in Amman makes plastic cups, containers, trays and bowls, such as those used for yogurt, ice cream, soft drinks, and hot drinks. It employs 40 workers.

General Manager Mr. Majed Al-Baghdadi said, “Through USAID’s program, we have gained additional knowledge that helped us to cut down our costs and reduce our usage of raw materials.”

#### 4.13 OMCE-Jordan

##### **OMCE-Jordan Improves Safety and Saves Money by Reducing Hazardous Chemicals Use**

By using a 50/50 water/solvent-based paint rather than solvent-based paint in its manufacturing process, OMCE-Jordan reduced gaseous emissions and achieved an annual savings of 23,000 JOD. Other operational changes have reduced the risk of human health exposure, environmental contamination, and fire.

Located in the Al-Hashimiyeh Industrial Zone in Zarqa, Jordan, OMCE-Jordan produces cylindrical drums, tapered drums and metal rings. Operations include metal cutting, rolling, welding, flanging, beading, seaming, painting, curing and marking.

In addition to the paint substitution, OMCE-Jordan has made several other changes recommended in a USAID-funded pollution prevention assessment of the factory’s operations:

- Modified pressure settings on air compressor
- Repaired leaks from air compressor lines

- Improved the handling of paints and solvents in paint mixing room

The air compressor and compressor line changes will save an estimated 7,500 kWh/yr in electricity (approximately 500 JOD), which is equivalent to 4,000 kg of CO<sub>2</sub> emissions. The handling modifications have reduced emissions, odors, and potential chemical exposure to workers, as well as the risk of fire and related environmental and human health consequences.

Cost savings from using the less expensive 50/50 water/solvent-based paint will increase if OMCE-Jordan begins producing water-based paint internally instead of purchasing it from suppliers.

Dr. David Manneh, OMCE-Jordan Plant Manager, said, “With USAID’s assistance, we accelerated the process of substituting solvent-based paint with water-based paint in our processes. USAID helped our facility make operational changes that significantly reduce gaseous emissions and protect workers’ health.”

## 5 CONCLUSIONS

The P2/EMS audits conducted by the project show that nearly all of the partner facilities that signed MOUs have actively participated in the process and have fully or partially implemented many of the P2 options recommended by the project; however, the participation level of the EMS project recommendations has not been nearly as active. The follow-up audits were completed 9 to 18 months after the respective P2 assessment reports were issued by the project; therefore, many of the documented “partially implemented” P2 options may have been fully implemented by the date of publication of this report.

### SAVINGS TO DATE

As of the time of the audits, total savings to the partner facilities from fully implemented P2 options had amounted to 1.38 Million JOD.

This report contains data that can be used to inform a wide variety of interests and perspectives. Ultimately, in addition to the 31 partner facilities, other entities and individuals will benefit from the project, as other facilities and industries across Jordan become aware of the success stories and implement similar changes to become more globally competitive through reduced costs associated with lower energy consumption, lower water usage, lower raw materials usage, and reduced waste generation.

As of the time of the follow-up audits (with a different schedule for each facility), it was determined that 31.5% of the fully-implemented P2 options involved improvements in materials and/or waste management and accounted for over 630,000 JOD of estimated savings; 42.3% involved reductions in energy consumption and accounted for over 660,000 JOD of estimated savings; and 26.2% involved reductions in water consumption and/or wastewater improvements/reductions and accounted for over 85,000 JOD of estimated savings.

Conclusions based on the experience gained through auditing the assessed project partners are summarized below.

### Water

As reported in the Summary Report for P2/EMS Assessments of Partner Industrial Facilities submitted to USAID Jordan in December 2014, current water prices appear to have a minor effect on the overall cost of most products manufactured in Jordan. This conclusion is supported by survey results indicating that almost 79% of the facilities’ owners/managers share this belief. The current water tariff does not incentivize facility owners to invest in water-reducing devices or other water usage reduction techniques/processes.

### WATER

The current water tariff does not incentivize facility owners to invest in water-saving improvements.

The following conclusions and recommendations from the Summary Report for P2/EMS Assessments regarding water conservation are still valid following the audit phase of the project, as the number/percentage and total savings of the fully implemented water options were lower than for the materials/waste and energy options:

- It is challenging to convince facilities’ owners/management to adopt water-saving measures based on the current water tariffs.
- Increasing the water tariff for industrial users could incentivize the industrial sector to use water more efficiently (i.e., using less fresh water and recycling/reusing certain industrial wastewaters).

- Ministry of Water and Irrigation and the related bodies may want to consider factors other than financial ones in determining current and future water tariffs for the industrial sector in order to increase/incentivize water conservation. Other drivers in this regard may include scarcity of water resources, sustainability, and investors' responsibilities to the community.
- Legislation regarding fresh and reclaimed water use for the industrial sector, and industrial wastewater effluent quality, may need to be revised in order to provide clear direction and standards for facilities to follow and to set limits on the use and polluting of scarce water supplies.

## Energy

As reported in the Summary Report for P2/EMS Assessments, the total cost of energy for industrial facilities depends on the cost of electricity and of other sources of energy, such as fuel oil, diesel, and liquefied petroleum gas (LPG). Using more than one source of energy (such as diesel fuel or heavy fuel oil to produce steam or hot water or to fuel an HVAC system, in addition to electricity or natural gas) significantly affects a facility's total production cost, since the consumption of supplemental fuels (i.e., diesel fuel, heavy fuel oil) is relatively high compared to the consumption of electricity or natural gas.

### ENERGY

P2 options related to energy were the most likely to be implemented and yielded the highest combined savings.

The results of the follow-up audits indicate that the P2 options related to energy were the most likely to be implemented and yielded the highest savings compared to the material/waste and water options. These savings can provide a roadmap and serve as incentive for non-partner facilities to achieve similar savings and pollution reductions.

Based on the tariffs and prices for selling electricity back to the grid at the time of the initial assessments, the payback periods for the proposed PV electricity generation system options were as high as 10 years. Based on the information gathered during the audits, the five partner facility owners/managers that received suggestions to adopt the use of PV systems, did not choose to install the PV systems as the cost was still too high and the payback period still too long to make adopting such systems financially feasible.

According to The Jordan Times<sup>2</sup>, "In 2013, the government started applying a five-year plan that gradually increases electricity rates for most economic sectors by nearly 15 per cent in order to bring the state-owned National Electric Power Company to cost recovery." However, financial analysis carried out by the project for the investigated PV systems showed that these options will likely remain infeasible even if the electricity rates were to increase by the projected amount.

As reported in the Summary Report for P2/EMS Assessments, incentive schemes developed and promoted by the GoJ are worth further consideration to attract the industrial sector to investments in renewable energy. Such schemes may include implementing more favorable rates for buying/selling electricity from off-grid PV systems for the industrial sector. More broadly, governmental incentives for investments in renewable energy sources within Jordan could provide relief from Jordan's dependence on natural gas imports, which are under threat from regional instability, and ease financial pressure on the GoJ treasury resulting from its subsidizing the cost of electricity to consumers.

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<sup>2</sup> The Jordan Times, "Industrialists want gov't to revisit scheduled electricity hike," by Merza Noghai; December 31, 2014

The fact that energy use prices are supplemented by the government and that there is a lack of incentive to reduce energy use, may explain the circumstance whereby the majority of industrial facilities (86%) in Jordan do not monitor their energy consumption. While the industries monitor overall energy consumption (i.e., via their main facility meters), they generally do not utilize meters on significant consumptive units (e.g., hot water systems, HVAC systems and production lines) to monitor the energy balance in their facilities. Without the more detailed unit-specific usage data, it is difficult to target where the most significant improvement/savings could be gained.

Further, many facilities are not attentive to maintenance activities, in general, despite the low investment cost and, in many cases, relatively high cost savings that could result. However, from the training and awareness the project has brought to the partner facilities, the audit results show that many investment options that relate to general maintenance have been implemented by the partner facilities, with energy and financial savings evident in relatively short payback periods. The demonstrated value of such maintenance activities should provide significant incentive for implementation of these options by other Jordanian industrial facilities.

#### **MAINTENANCE**

Low-cost improvements in maintenance reduced water and energy use, yielding relatively high cost savings.

There were also ancillary benefits identified from implementation of energy options, such as:

- Reduced risk of employee (and facility neighbors') exposure to fuel combustion exhaust emissions
- Improved housekeeping and facility cleanliness
- Reduced odors
- Reduced risk of fires
- Reduced risk of spills, lowering the risk of air, soil and groundwater contamination
- Improved community relations

### **Materials and Waste**

The P2 assessments identified many options for partner facilities to reduce raw materials consumption and waste generation. The types of reductions proposed were very site specific and not easily quantified and/or compared from facility to facility; however, audit results indicate that a good share of the fully implemented options for the partner facilities were for material/waste-related improvements.

#### **MATERIALS AND WASTE**

Improvements in materials and waste handling produced not just cost savings but also ancillary benefits, such as reduced risk, improved health and safety of workers and communities, and reduced odors.

Although the estimated savings from the fully implemented material/waste options totaled over 630,000 JOD in the first year alone, there were also ancillary benefits identified from these options, such as:

- Reduced risk of employee (and facility neighbors') exposure to toxic and other harmful chemicals
- Improved industrial hygiene of facility workers
- Improved housekeeping
- Improved inventory systems
- Reduced odors
- Reduced risk of fires and explosions

- Reduced risk of spills and losses (including dusts), lowering the risk of air, soil and groundwater contamination
- Reduced demand/pressure on landfills
- Improved employee job satisfaction
- Improved community relations

### **Environmental Management Systems**

There was a wide range of understanding of EMS among the facility partners visited. Some already had or used to maintain ISO 14001:2004 certification. Others were not familiar at all with the concepts and principles of EMS. The project provided training in the ISO 14001 requirements.

The vast majority of the 26 facilities visited by the project's EMS experts had little-to-no conformity with the sub-clauses of the ISO 14001:2004 standard. The one-on-one meetings held between the project EMS experts and the partners served as an educational outreach, heightening awareness of the concepts and elements of a comprehensive EMS to the partner facilities' management; however, during the follow-up audits, many of the facility personnel had changed positions or had not retained much of the EMS concepts shared with them. As a consequence, the auditors did not find many new EMS programs being developed by those partner facilities that did not already have such systems in place.

It remains an opportunity for Jordanian industrial facilities to implement EMS, not necessarily a fully certified ISO 14001 program, but at least something similar in order to improve their overall environmental performance and competitiveness in the world market.

### **Access to Finance**

Recent surveys revealed that small and medium enterprises (SMEs) have to pay attention to environmental issues as one of the most important aspects of sustainability. SME owners are concerned about the environment; however, it is not a simple task to convert their concern into implementing P2 and/or EMS actions.

SMEs may lack the financial resources and/or the knowledge of how to implement environmentally friendly practices. Increasing SMEs awareness of environment regulations and standards is a challenge. In the surveys, a minority of SMEs adopted environmentally-friendly actions to deal with issues such as recycling, renewable energy, energy savings and water conservation and reuse. The survey results were similar to the project's audit results, which showed that "Small" size facilities comprised 12.9% of the total number of facilities assessed; however, they accounted for only 2.7% of the fully implemented P2 options. "Medium" size facilities comprised 67.7% of the total number of facilities assessed; however, they accounted for only 57.0% of the fully implemented P2 options.

According to "Access to Finance for Small and Medium Enterprises in Jordan," August 2012, prepared as part of the project, the most critical issue facing most SME owners was financing environmental conservation and water treatment. SMEs experience difficulties in accessing banks and financial institutions to finance their projects. Possibly, the SMEs lack knowledge of finance, banking and/or the accounting techniques necessary to seek and obtain financing. To overcome these obstacles, USAID WRECP is providing interested SMEs with technical assistance and access to green financial mechanisms from commercial banks and donors in Jordan.

This project provided technical support to assist in the completion of applications for financing upon request by an interested partner.

The project produced a report called “Access to Finance for Small and Medium Enterprises in Jordan,” August 2012, and a leaflet entitled, “How to Obtain Funding for Green Water and Energy Investments” (See Appendix B for a copy of the leaflet). This information is intended to present SMEs’ P2/EMS Implementation Plans to the agencies and banks that offer affordable financing for such investments. Significant sources of financing were identified, and detailed guidance for obtaining financing for implementation of P2 and environmental conservation measures was provided, to enable the selected project partners to pursue the suggested P2 measures. Additional information on the financing aspects of implementation was provided in training modules.

### **Toolkits**

Toolkits to help other industrial facilities (i.e., non-project partners) conduct their own P2/EMS assessments are being prepared by the project. These toolkits will be published under The Network for Jordanian Industrial Sustainability web portal: [www.JordanNetwork.net](http://www.JordanNetwork.net).

### **Summary**

In summary, the audit activities completed by WRECP as a follow-up to the surveying of Jordanian industries, training of interested parties, and P2 and EMS assessments conducted at 31 industrial partner facilities has confirmed and documented definitive improvements in industrial environmental management by these facilities, yielding reductions in energy consumption, water and raw material usage, and waste generation. With these reductions, the partner facilities also realized significant financial savings and other ancillary benefits.

Through the partners’ ongoing implementation of P2 and EMS at the partner facilities and through the sharing of the success stories with other facilities and industries across Jordan, improvements in industrial environmental management can become mainstream practices in Jordan. Additional support and guidance from The Network for Jordanian Industrial Sustainability will facilitate this transition and help establish improved environmental management standards.

## **ATTACHMENTS**

- A Success Stories for 13 Partner Facilities
- B How to Obtain Funding for Green Water and Energy Investments

**ATTACHMENT A**  
**SUCCESS STORIES FOR 13 PARTNER FACILITIES**



## SUCCESS STORY

# Sahab Factory Improves Production, Saves Resources, and Investigates Solar Initiative

**Changes in production settings and investment in new equipment cut maintenance costs.**



*Improved maintenance of the HVAC system achieved savings.*

*“This USAID pollution prevention assistance opened our eyes to available opportunities to improve our old production lines, enhance our operation and all the while reduce consumption of resources and maintenance costs,” concluded the Managing Director at ACPC.*

The Arab Center for Pharmaceutical and Chemicals Industries (ACPC) facility in Jordan’s King Abdullah II Industrial Park in Sahab has reduced its energy and water consumption by acting on USAID-recommended improvements. The Managing Director of the 25-worker facility estimates that renovation of two old production lines and adjustments to operating settings have reduced maintenance costs by 40% while boosting the production rate by 17%.

ACPC made the investment to implement these improvements and will adopt the same configurations for dipping and cutting settings on two new production machines to be installed soon.

ACPC achieved additional significant savings in electricity consumption and water usage by installing energy-efficient lighting, purchasing energy efficient chillers, implementing improved maintenance of boilers, steam lines, and compressed air networks, and installing water-saving devices in restrooms and production areas.

The company is also investigating financial options to install a solar thermal system to pre-heat make-up water for its steam boiler system used in certain stages of the process, as well as for product drying. The use of a solar thermal system would reduce diesel consumption by an estimated 11,300 liters per year, which is equivalent to a reduction of CO<sub>2</sub> emissions by over 30,000 kilograms per year.

*The Arab Center for Pharmaceutical and Chemicals Industries (ACPC) facility in Jordan’s King Abdullah II Industrial Park in Sahab is one of 30 industrial partners working with USAID to reduce industrial pollution and conserve scarce water and energy resources – in ways that benefit the bottom line. The Water Reuse and Environmental Conservation Project examined water and energy use, material and waste flow, production processes, quality control, and other aspects of each facility’s operations. The assessments suggested options for minimizing pollution and saving water, energy, and money. Costs and payback periods for various options were also analyzed.*



## SUCCESS STORY

# Water Conservation Measures Save Resources and Reduce Costs for ADFICO

### New water meters pinpointed inefficiencies.



*With USAID assistance, this production line was reactivated.*

Eng. Marwan Abed Salam, ADFICO Plant Manager, said: “With USAID’s assistance, we controlled water and material consumption, thus improving our competitiveness in the market.”

Arabian Development for Food Industries Co. (ADFICO) expects to save money, reduce its carbon footprint, and use less fuel by making operational changes suggested in a USAID-funded pollution prevention assessment. The main changes were to add sub-metering for water and wastewater lines and to upgrade thermal insulation for boilers.

Located in the Amman-Zarqa Free Zone in Jordan, ADFICO produces canned food products such as tomato paste and juice. Its operations include mixing, processing, pasteurization, filling, and packing. Water and energy are major resources.

Providing sub-meters for the water and wastewater lines allowed the company to pinpoint inefficiencies. By sub-metering only certain connections on the main production line, the facility was able to make adjustments that saved materials and workers’ time.

Eng. Marwan Abed Salam, ADFICO’s Plant Manager, estimates that the savings in resources could translate into 36,000 JOD/year during full operation. The number of lab tests needed to control the batches’ specifications has also been reduced.

Other changes include outsourcing boiler maintenance and calibration and installing the proper thermal insulation to reduce the dissipated heat of the steam valves. As a result, ADFICO has been able to reduce its consumption of diesel fuel by around 5,500 liters annually, which reduces CO<sub>2</sub>-equivalent emissions by an estimated 14,800 kg/yr.

*ADFICO is one of 30 industrial partners working with USAID to reduce industrial pollution and conserve scarce water and energy resources – in ways that benefit the bottom line. The Water Reuse and Environmental Conservation Project examined water and energy use, material and waste flow, production processes, quality control, and other aspects of each facility’s operations. The assessments suggested options for minimizing pollution and saving water, energy, and money. Costs and payback periods for options were also analyzed.*



## SUCCESS STORY

# Al-Baha Chlorine Plant Shows Environmental Investments Boost Economic Performance

**Multiple initiatives reduce environmental impact while increasing profits.**



*Al-Baha's new line converts liquid sodium hydroxide into solid flakes.*



*Al-Baha's new boiler runs on hydrogen gas.*

The Al-Baha Company for Caustic Chlorine facility in Jordan's Al Hallabat Industrial Park is saving 293,000 JOD each year by cutting its water, fuel and energy consumption. The company has made multiple investments to improve environmental performance and reduce its carbon footprint:

- New equipment to create sodium hydroxide flakes uses 36,000 m<sup>3</sup> less water per year, saving 46,800 JOD annually
- New hydrogen boiler uses 400 metric tons less heavy fuel oil per year, saving 250,000 JOD annually
- Installing variable frequency drives cut electricity consumption by 75,600 kWh/year, and is saving 7,000 JOD in the first year alone
- Materials handling improvements reduced the risk of chemical spills and generated a profit of 40,000 JOD

**Sodium hydroxide flakes.** Encouraged by USAID's Water Reuse and Environmental Conservation Project, company management made a significant investment in a new line for converting liquid sodium hydroxide product into solid flakes, which saved about 40% of the water previously wasted with the product – water that can now be used for other operations. This improvement was largely responsible for reducing water usage by 36,000 m<sup>3</sup> per year, which translates into 46,800 JOD cash savings in the first year alone.

**Hydrogen boiler.** The facility installed a new hydrogen combustion boiler, which reduces heavy fuel oil use by 400 metric tons per year and reduces annual CO<sub>2</sub> emissions by over 1.2 million kg. The boiler uses gas previously vented as a waste product from the facility's chlorine production line, reducing greenhouse gas emissions.

Plant Manager Dr. Al-Janabi commented: "We thought we could improve our systems, but it's hard to make a business case for change until you have the hard data to back up your hunch. With assistance from USAID, we were able to cost the installation of a new hydrogen boiler and estimate savings of 250,000 JOD per year due to reduced fuel and maintenance costs. We saw how to change our steam heating system in ways that improve performance, both environmental and economic."



Plant staff examine new VFDs for cooling towers.



The new storage system at the Al-Baha warehouse reduces risk of spills.

**Variable frequency drives.** Electricity usage is also down following management's decision to invest in variable frequency drives (VFDs) on large cooling fans. The company projects that the drives will cut its annual electricity consumption by approximately 75,600 kWh, which equates to a reduction of about 40,000 kg per year in CO<sub>2</sub>-equivalent emissions.

"We expect to save approximately 7,000 JOD in electricity costs for the first year," says Eng. Ravinder Arora, the facility's Deputy General Manager. Furthermore, he notes that these savings will likely increase over time. "When the electricity tariff increases in 2015, the savings will be closer to 12,000 JOD for the year."

**Sub-metering.** Management's decision to install numerous water sub-meters throughout the plant defined and located water use more specifically within any given process and this identified further water-saving options.

Dr. Khazal Al-Janabi noted that the meters had opened up "many opportunities for water saving and better water management practices. Water balance is better established at the facility, to track water-in-product and wastewater quantities for each process."

**Materials handling.** Finally, applying best practices in materials handling proved to be a relatively easy and cost-effective improvement. A new computer-based system stores and tracks inventory items. Only items to be used are stored, so 40,000 JOD revenue was generated through the sale of unwanted spare parts, and future waste generation from this area is expected to be minimal. The reorganization also helped reduce the risk of chemical spills and the consequent need for cleanups.

*The Al-Baha Company for Caustic Chlorine in Jordan's Hallabat Industrial Park is one of 30 industrial partners working with USAID to reduce industrial pollution and conserve scarce water and energy resources – in ways that benefit the bottom line. The Water Reuse and Environmental Conservation Project examined water and energy use, material and waste flow, production processes, quality control, and other aspects of each facility's operations. The assessments suggested options for minimizing pollution and saving water, energy, and money. Costs and payback periods for various options were also analyzed.*



## SUCCESS STORY

# Al-Baha Chlorine Plant Improves Energy Efficiency with Variable Frequency Drives

**Industrial facility reduces electricity costs for cooling tower operations.**



Plant staff examine new VFDs for cooling towers.

*Eng. Ravinder Arora (the facility's Deputy General Manager) notes that his company already knew it could improve facility systems, but found it hard to quantify expected benefits.*

*"With the project's assistance," he continues, "we were able to see the benefits (both financially and environmentally) of installing VFDs and make an informed decision to move forward."*

The Al-Baha Company for Caustic Chlorine facility in Jordan's Al Hallabat Industrial Park has reduced both its energy costs and its carbon footprint by installing variable frequency drives (VFDs) on cooling fans, as suggested in a USAID-sponsored assessment.

The assessment recommended a variety of options for saving water and energy. Installing VFDs on the cooling tower fans stood out as having a relatively short payback period and generating significant long-term savings.

Al-Baha invested in two VFDs for two large fans (15kW each) for the on-site cooling towers. Each VFD cost 8,000 JOD. The price included a control unit and feedback thermo-sensor. The company projects that it will reduce its annual electricity consumption by approximately 75,600 kWh, which equates to a reduction of about 39,000 kg per year in CO<sub>2</sub>-equivalent emissions.

"We expect to save approximately 7,000 JOD in electricity costs for the first year," says Eng. Ravinder Arora, the facility's Deputy General Manager. Furthermore, he notes that these savings will likely increase over time. "When the electricity tariff increases in 2015, the savings will be closer to 12,000 JOD for the year."

Eng. Arora concludes: "Now that the installation is complete for the cooling tower fan motors and we are realizing actual savings, we are considering the installation of VFDs on other equipment as well."

*The Al-Baha Company for Caustic Chlorine in Jordan's Hallabat Industrial Park is one of 30 industrial partners working with USAID to reduce industrial pollution and conserve scarce water and energy resources – in ways that benefit the bottom line. The Water Reuse and Environmental Conservation Project examined water and energy use, material and waste flow, production processes, quality control, and other aspects of each facility's operations. The assessments suggested options for minimizing pollution and saving water, energy, and money. Costs and payback periods for various options were also analyzed.*



## SUCCESS STORY

# Al-Baha Chlorine Plant Installs Hydrogen Combustion Boiler – First in Jordan!

**Installing hydrogen boiler reduces heavy fuel oil consumption and CO<sub>2</sub> emissions.**



*Al-Baha's new boiler runs on hydrogen gas.*

*Eng. Mofeed Al-Gaood, CEO of Al-Baha Company, says that USAID assistance helped Al-Baha take a waste by-product from the chlorine manufacturing process and use it as a fuel: "Our old steam boiler was oversized, costly, and inefficient. Now, we have a steam production system using modern, highly efficient equipment."*

By using hydrogen gas by-product as a fuel source on site, the Al-Baha Company for Caustic Chlorine facility in Jordan is reducing its consumption of heavy fuel oil by 400 metric tons a year. This will both save money and reduce carbon dioxide (CO<sub>2</sub>) equivalent emissions by over 1 million kg/yr.

Al-Baha has acted on several pollution prevention suggestions made in a recent USAID-sponsored assessment. This one in particular will pay back the investment quickly. Installation of a new hydrogen combustion boiler (the first in Jordan) will significantly reduce usage of an older, over-sized fuel oil boiler and thus reduce overall consumption of heavy fuel oil by almost 400 metric tons per year. This will cut CO<sub>2</sub> equivalent emissions by an estimated 1,267,000 kg/yr. Additional environmental benefits will also be achieved by reducing diesel fuel emissions, since there will be less transportation of water to the site via tankers.

The new boiler runs on hydrogen gas, previously vented to the atmosphere as a waste by-product from the facility's chlorine production line. This new use of the hydrogen thus reduces greenhouse gas emissions.

Plant Manager Dr. Khazal Al-Janabi, who manages the approximately 150 workers at the facility, says: "We thought we could improve our systems, but it's hard to make a business case for change until you have the hard data to back up your hunch. With assistance from USAID, we were able to cost the installation of a new hydrogen boiler and estimate savings of 250,000 JOD per year due to reduced fuel and maintenance costs. We saw how to change our steam heating system in ways that improve performance, both environmental and economic."

*Al-Baha, located in Jordan's Hallabat Industrial Park, is one of 30 industrial partners working with USAID to reduce industrial pollution and conserve scarce water and energy resources – in ways that benefit the bottom line. The Water Reuse and Environmental Conservation Project examined water and energy use, material and waste flow, production processes, quality control, and other aspects of each facility's operations. The assessments suggested options for minimizing pollution and saving water, energy, and money. Costs and payback periods for options were also analyzed.*



## SUCCESS STORY

# Improved Materials Handling Reaps Multiple Benefits for Al-Baha Chlorine Plant

**Industrial facility stores and tracks supplies more efficiently.**



*The new storage system at the Al-Baha warehouse reduces risk of spills.*

*Eng. Mofeed Al-Gaood, the CEO of Al-Baha Company, is happy that valuable space has been freed up and that unwanted parts and equipment have been sold for a profit.*

Applying best practices in materials handling proved to be a relatively easy and cost-effective improvement for the Al-Baha Company for Caustic Chlorine in Jordan's Hallabat Industrial Park. Aside from generating revenue through the sale of unwanted spare parts, the reorganization helped reduce the risk of chemical spills and the consequent need for cleanups.

Eng. Ravinder Arora, the Deputy General Technical Manager who supervises approximately 150 workers at the facility, notes: "We knew we could improve our systems, but it's hard to prioritize the possible actions to take. With assistance from USAID's Water Reuse and Environmental Conservation Project, we were able to see the benefits of re-organizing our storage area. In the end, we not only improved our efficiency and housekeeping, but also made a profit of 40,000 JOD along the way."

The Al-Baha Company's material storage system now uses a new computer-based system to store and track inventory items. Only items to be used are stored, so future waste generation from this area is expected to be minimal.

"We organized the storage area according to the type of material and logged the items and their locations into the computer. Through this better management of the chemicals stored on site, we also reduced the risk of chemical spills and cleanups," concluded Eng. Arora.

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## SUCCESS STORY

# Al-Baha Chlorine Plant Conserves Water in Production of Sodium Hydroxide

### Industrial facility reduces water consumption by dewatering NaOH



*Al-Baha's new line converts liquid sodium hydroxide into solid flakes.*

*Eng. Mofeed Al-Gaood, CEO of Al-Baha Company, says that USAID assistance helped the facility look at ways to reduce water consumption and improve operations at the same time.*

*"By removing the water from the sodium hydroxide product, we not only saved money, but also improved operations and added 25 new jobs!"*

The investment in equipment to dewater sodium hydroxide (NaOH) was significant, but it has allowed the Al-Baha Company for Caustic Chlorine plant in Jordan to cut its on-site water use by 40% (36,000 m<sup>3</sup> per year) and to generate 40% less wastewater (a reduction of 4,000 m<sup>3</sup> per year).

The facility had already made several other less costly improvements recommended by a USAID-sponsored assessment. Eng. Ravinder Arora, the Deputy General Technical Manager, says: "We saw the savings and pollution prevention results from other improvements recommended by the USAID team, so it helped us move forward on this water-saving change."

The company developed a new line for converting a liquid sodium hydroxide product into solid flakes. This reduced the required storage area and transportation problem. Moreover, it saved 40% of the water that was previously wasted with the product, which can now be reused for other operations.

Eng. Arora manages the approximately 150 workers at the facility. He notes that the change represents a significant investment. "However," he adds, "we expect to save about 46,800 JOD in the first year from this one improvement. In the end, we reduce our environmental impact, we make more money, and consumers benefit."

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## SUCCESS STORY

# Al-Baha Chlorine Plant Significantly Reduces Water Usage and Costs

**Modest investment in water sub-meters helps pinpoint areas of greatest potential savings.**



*Sub-meters were installed throughout the plant.*

*The facility will cut its use of water by almost 40% (equal to approximately 36,000 m<sup>3</sup> per year, based on 2012 water consumption rates) and significantly reduce wastewater generation.*

The Al-Baha Company for Caustic Chlorine Industry facility, located in Jordan's Al Hallabat Industrial Park, made a fairly small initial investment that has yielded great results. Installing 10 water meters throughout the plant allowed Al-Baha to tell how much water is used in different parts of the manufacturing process and thus identify water-saving options with particularly high potential for savings.

The sub-metered areas are monitored by the quality department and the information is recorded regularly. These meters cost about 3,000 JOD, including parts and installation, as well as operations' stop-time cost. Manager Dr. Khazal Al-Janabi noted that the meters had opened up "many opportunities for water saving and better water management practices. Water balance is better established at the facility, to track water-in-product and wastewater quantities for each process."

For example, the sub-meters revealed that the facility was consuming a significant amount of water in the daily washing down of equipment. This daily washing was necessary because the water brought in via tankers was of poor quality. The facility management team therefore decided to install a reverse osmosis (RO) system at the facility-owned water well. The higher quality water from the RO system could then be used for all the facility's industrial water needs, so flushing and washing were required only weekly or biweekly rather than daily.

Additional environmental benefits were also achieved by reducing diesel fuel emissions, since there was less need to transport water to the site via tankers.

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## SUCCESS STORY

# Al-Thuraiya Reduces Water and Energy Use Through Operational Improvements

**Pollution prevention yields 630,000 JOD in annual savings for poultry facility.**



*Dr. Wisam tests treated water at the facility.*

*Dr. Wisam (R&D Manager) of Al-Thuraiya commented, “The changes made with USAID’s assistance have helped us to reduce our environmental impact and costs, while providing excellent products that can be sold at an affordable price.”*

By making operational improvements suggested in a USAID assessment, the Al-Thuraiya Poultry facility in Mafraq, Jordan, expects to save 630,000 JOD annually.

The plant employs 244 workers and produces whole chickens, cut-up parts, and other poultry products. The products are sold locally and exported to regional markets.

Al-Thuraiya has significantly reduced its water consumption by optimizing operational and maintenance processes. These improvements to the reverse osmosis (RO) system will cut fresh water use by 198,000 m<sup>3</sup>/year, which will reduce wastewater processing by nearly one-third. Expected savings from these water improvements total 405,000 JOD/year.

Energy-saving measures were also implemented at the facility, reducing electricity use by nearly one-third (i.e., 2,770,000 kWh/year) and diesel consumption by 6,700 liters/year:

- Increased production speed to reduce the average kWh needed to process each bird
- Increased Power Factor (added new panels)
- Installed harmonics filters for inverters
- Trained operators on refrigeration plant efficiencies
- Improved insulation on cooling system doors/pipes
- Installed controls for internal and external lighting

Expected savings from these energy improvements total 225,000 JOD/year.

Research and Development Manager Dr. Wisam expects these environmentally friendly changes to increase the facility’s competitive edge in the local and regional markets. “We can increase the money we make,” he said, “and provide a greater benefit to customers.”

*The Al-Thuraiya Poultry facility is one of 30 industrial partners working with USAID to reduce industrial pollution and conserve scarce water and energy resources – in ways that benefit the bottom line. The Water Reuse and Environmental Conservation Project examined water and energy use, material and waste flow, production processes, quality control, and other aspects of each facility’s operations. The assessments suggested options for minimizing pollution and saving water, energy, and money. Costs and payback periods for options were also analyzed.*



## SUCCESS STORY

# Arab Aluminum Industries Co. Ltd (ARAL) Conserves Water and Energy

**Facility reduces  
wastewater treatment  
costs by 30%.**



*Boiler pipes are now insulated.*

*ARAL Plant Manager Eng. Ramzi Abu Surour said, "USAID's assistance helped us use less diesel fuel and less water, thus reducing wastewater treatment costs. We are thrilled to see the substantial impacts to our bottom line!"*

By investing in pollution prevention improvements, Arab Aluminum Industries Co. Ltd (ARAL) in Ein Al Basha, Amman achieved a 30% reduction in both diesel consumption and wastewater treatment costs.

Established in 1976 and employing approximately 270 workers, the facility produces aluminum profiles. Its operations include extrusion, anodizing, powder coating and decoration. Water and energy are major resources.

ARAL had worked with USAID to prepare a pollution prevention plan. One suggestion was to service and/or replace the facility's three steam boilers, to increase efficiency. ARAL replaced two 3.2-ton steam boilers with two 1.5-ton steam boilers and removed a third boiler from service. Annual consumption of diesel fuel has fallen by more than 249,000 liters.

Other suggested changes to the management and use of chemicals in the factory's process (including reducing drag-out) will save 5 m<sup>3</sup> of water for each ton of product produced. This in turn reduces the amount of sludge waste generated and reduces wastewater treatment costs by 30%.

ARAL plans to follow up these improvements with a monitoring process, looking at water balances and water demand management in its facility. With detailed unit-specific usage data, the facility will be able to target areas where the most significant improvement and savings can be gained. Plant Manager Eng. Ramzi Abu Surour concludes: "With USAID's assistance, we have achieved the drive and momentum to renovate and improve our operations and the units used in our processes."

*Arab Aluminum Industries Co. Ltd (ARAL) in Ein Al Basha, Amman, is one of 30 industrial partners working with USAID to reduce industrial pollution and conserve scarce water and energy resources – in ways that benefit the bottom line. The Water Reuse and Environmental Conservation Project examined water and energy use, material and waste flow, production processes, quality control, and other aspects of each facility's operations. The assessments suggested options for minimizing pollution and saving water, energy, and money. Costs and payback periods for options were also analyzed.*



## SUCCESS STORY

# Hijazi & Ghosheh Gains Competitive Edge by Reducing Environmental Impact

**Facility reduces material losses and uses less water.**



Using a water gun during cleaning reduced water consumption.

*ENG. Mohammed Taysir, H&G's Quality Manager, comments: "The changes made with USAID's assistance have reduced both our environmental impact and our costs. We can increase the money we make and provide a greater benefit to consumers."*

The Hijazi & Ghosheh (H&G) facility in Amman, Jordan, has reduced its water, diesel, and electricity bills by making pollution prevention improvements. The changes will save nearly 15,000 JOD/year.

Established in 1991, the plant employs 250 workers. Its meat products and pastries are sold locally and exported to regional and international markets.

USAID Water Reuse and Environmental Conservation Project showed how H&G could reduce losses of raw materials by improving equipment maintenance. H&G went a step further by purchasing new machines (using clean technology) worth 300,000 JOD. The company estimates that this investment will be paid back in 24 months. The new machines also reduced demand for operators' time by 50%, allowing for reallocation of staff to other parts of the facility.

H&G has also significantly reduced water consumption by optimizing cleaning and maintenance processes (including steam network repairs and cooling tower maintenance) and reducing the amount of water used in some process areas. These changes will save about 10,000 m<sup>3</sup> of fresh water as well as 7,000 liters of diesel fuel and 96,000 kWh/year of electricity, resulting in a potential savings of nearly 15,000 JOD/year. Such changes are expected to increase the facility's competitive edge in both local and regional markets.

Eng. Mohammed Taysir, QAQC manager at H&G, noted that the company had always tried to be environmentally responsible, but "with USAID's assistance, we found new ways to manage our resource and materials use."

*The Hijazi & Ghosheh (H&G) facility in Marka Al Shamalieh, Amman, is one of 30 industrial partners working with USAID to reduce industrial pollution and conserve scarce water and energy resources – in ways that benefit the bottom line. The Water Reuse and Environmental Conservation Project examined water and energy use, material and waste flow, production processes, quality control, and other aspects of each facility's operations. The assessments suggested options for minimizing pollution and saving water, energy, and money. Costs and payback periods for options were also analyzed.*



## SUCCESS STORY

# ISBCO Credits Teamwork for Savings in Water, Energy, and Materials

**Changes in energy consumption, water use, and material handling save ISBCO 125,000 JOD/year.**



*Eng. Elyas Elnajmeh with a compression gas analyzer to measure emissions of CO<sub>2</sub>.*

*Eng. Elyas Elnajmeh (pictured above with a newly purchased portable combustion and emissions analyzer), oversees 120 workers at the facility. “Together as a team,” he says, “we have accomplished huge savings.”*

The International Storage Battery Company (ISBCO) facility, in Jordan’s Abdullah II Ibn Al-Hussein Industrial Estate at Sahab, made several improvements recommended in a USAID pollution prevention assessment. As a result, ISBCO:

- Reduced electricity consumption by 1.2 million kWh/year for a savings of 82,000 JOD
- Reduced carbon dioxide (CO<sub>2</sub>) equivalent emissions by 650,000 kg/year
- Reduced water consumption by 22 m<sup>3</sup> each working day
- Saves a total of 125,000 JOD/year

The electricity consumption was reduced by means of energy efficiency and systems upgrading measures, which in turn reduced the carbon dioxide (CO<sub>2</sub>) equivalent emissions.

ISBCO implemented a water conservation measure that the USAID assessment showed would have a payback period of less than a year. ISBCO now saves approximately 9,500 JOD/year in water use and wastewater discharge costs.

ISBCO was able to save another 37,000 JOD/year by improving their handling of materials, including both raw material and production waste. They improved the ways they handle lead resources, dross and dust piles, and the pasted grids used to manufacture batteries. They also improved the lead oxidation process and reduced indoor air emissions.

Eng. Elyas Elnajmeh, the Factory Director, appreciated the way that USAID assistance helped ISBCO look closely at energy, water, material handling and waste management. “With assistance from USAID’s Water Reuse and Environmental Conservation Project,” he says, “we saved water, energy and material resources at our facility.”

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## SUCCESS STORY

# Jordan Potato & Corn Chips Co. Improves Production, Reduces Environmental Impact

**Operational changes reduce waste and conserve resources.**



Replacing 400W light fixtures with 250W fixtures saved energy.

*Eng. Imad Haddad, Engineering & Technical Manager of Jordan Potato & Corn Chips Co., says that the USAID program stimulated the factory to take a more focused look at pollution prevention: “After working with USAID, our improved Pollution Prevention Program has made our factory more oriented towards energy, water and raw materials savings, and helped us with our production benchmarking.”*

Jordan Potato & Corn Chips Co., which owns the “Mr. Chips” brand, has lowered its consumption of electricity, water, and diesel fuel and reduced the amount of waste it generates.

Changes made at the company’s facility in Al Zarqa include:

- Insulating steam lines
- Cleaning and calibrating boilers
- Installing more energy-efficient equipment
- Managing equipment settings to achieve more efficient operations
- Improving procedures to minimize water use
- Improving procedures to generate less solid waste and waste water
- Installing guards and equipment to minimize product losses

Eng. Tareq Abu Jaber, Plant Manager, oversees more than 300 workers operating several different production lines at the facility. He comments: “Encouraged by discussions with USAID’s Water Reuse and Environmental Conservation Project, we were able to adjust our operating settings and enhance performance. The measures have lowered electrical consumption by 8%, diesel consumption by 3%, and water consumption by 4%, while at the same time reducing waste by 7%.”

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## SUCCESS STORY

# Water and Energy Conservation Reduce Costs for Kemapco®

**Energy and water changes alone saved 180,000 JOD per year**



*Ion exchange unit at KEMAPCO has been improved to reduce water consumption.*

*Once Kemapco started thinking of ways to reduce waste, the operational expertise of the facility staff allowed them to identify more and more opportunities. Even small reductions in overall use of a given fuel or resource had considerable financial impacts – and helped improve the environment.*

Arab Fertilizers & Chemicals Industries Ltd. (Kemapco®) has made several operational changes that lower energy consumption and prevent pollution at its fertilizer and animal feed additive production facility in the South Industrial Zone in Aqaba, Jordan. As a result, the company achieved the following reductions in 2014:

- Electricity consumption: 1,250,000 kWh
- Heavy Fuel Oil consumption: 13 metric tons
- Water consumption: 48,000 m<sup>3</sup>

The financial and environmental impacts are significant, with annual savings amounting to approximately 180,000 JOD.

The 126,000 m<sup>2</sup> plant has 230 employees and produces Potassium Nitrate (NOP) fertilizer and Dicalcium Phosphate (DCP) animal feed additive. It also produces Nitric Acid for its own consumption.

Eng. Ramzi Sinnokrot, Technical Sector Manager, appreciated the way that the USAID Water Reuse and Environmental Conservation Project motivated Kemapco® to look closely at energy, water, material handling, and waste management. He commented: “The pollution prevention program with USAID has helped us to focus more on the available opportunities and save more of our resources.”

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## SUCCESS STORY

# MOBEDCO Finds Conservation Measures Increase Profitability

**Pollution prevention measures reduce water use, odors, and emissions .**



*Improved maintenance on this boiler saved energy.*

*Dr. Mohammad Owais, General Manager of MOBEDCO commented, “Working with the USAID program has helped us to reduce our environmental impact and costs, and become more competitive in the market.”*

The Arab Pesticides and Veterinary Drugs Mfg Co. (MOBEDCO) produces agricultural pesticides and veterinary medicines in its facility at the Al Hassan Industrial Estate in Irbid, Jordan. MOBEDCO has achieved great results by implementing pollution prevention measures suggested by a USAID project – and by developing some of its own.

The company has saved more than 12,600 JOD in the first year alone from:

- Retrofitting lights to LED
- Installing a power factor correction unit (PFCU)
- Optimizing the compressed air and chilled water networks on site

Water consumption was also reduced by:

- Installing sub-meters at some units to calculate the water balance
- Installing water-saving faucets
- Re-using reject water from the deionized (DI) water system

MOBEDCO also made significant reductions in materials consumption by:

- Upgrading its storage system
- Providing awareness training for its workers

These changes not only saved the company money, but also reduced odors, air pollutant emissions, and the risk of spills, fires, and contamination.

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## SUCCESS STORY

# National Chlorine Plant Improves Production with Membrane Technology and VFDs

**Industrial facility installs energy-efficient equipment.**



*Energy-efficient membrane technology reduced costs.*

*In addition to saving energy, NCI is reducing its risk of environmental exposure; lowering fuel oil consumption by 58,000 liters per year; and reducing water consumption by 120 cubic meters per year.*

*Eng. Yosef Bader, Quality Manager, says: "It is very satisfying to tell my children our company is being environmentally responsible, helping Jordan's environment by reducing our electricity, fuel and water usage."*

National Chlorine Industries (NCI) in Almowaqqar, Jordan, has made operational improvements that reduce its energy consumption and its carbon footprint – while increasing production.

Encouraged by discussions about reducing waste with the staff of USAID's Water Reuse and Environmental Conservation Project, NCI management embarked on a comprehensive internal audit of the facility. They determined that two improvements stood out in terms of combining environmental benefits and speedy payback of investment:

- Using energy-efficient production equipment, including new membrane technology
- Installing variable frequency drives (VFDs) and temperature sensors on cooling tower fans

By investing in these improvements, the NCI facility has increased its production and is reducing its consumption of electricity by approximately 9 megawatts per year. The majority of the savings are associated with the new membrane technology. However, the installation of VFDs and temperature sensors also reduced the energy consumption of the cooling towers by about 20%. Overall, these improvements reduce carbon dioxide (CO<sub>2</sub>) equivalent emissions by an estimated 4,700 metric tons per year.

Maintenance Section Head Eng. Farid Talal says: "We have always tried to be environmentally responsible, and now we will be able to reduce our electricity consumption by 20% and achieve expected savings of 630,000 JOD per year." With the increase in the electricity tariff for 2015, the expected savings will be closer to 720,000 JOD.

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## SUCCESS STORY

# OMCE-Jordan Improves Safety and Saves Money by Reducing Hazardous Chemicals Use

**Drum manufacturing plant reduces use of harmful solvents and improves operations.**



*Painting oven at OMCE-Jordan.*

*Dr. David Manneh, OMCE-Jordan Plant Manager, said, “With USAID’s assistance, we accelerated the process of replacing solvent-based paint with water-based paint in our processes. USAID helped our facility make operational changes that significantly reduce gaseous emissions and protect workers’ health.”*

By using a 50/50 water/solvent-based paint rather than solvent-based paint in its manufacturing process, OMCE-Jordan reduced gaseous emissions and achieved an annual savings of 23,000 JOD. Other operational changes have reduced the risk of human health exposure, environmental contamination, and fire.

Located in the Al-Hashimiyeh Industrial Zone in Zarqa, Jordan, OMCE-Jordan produces cylindrical drums, tapered drums and metal rings. Operations include metal cutting, rolling, welding, flanging, beading, seaming, painting, curing and marking.

In addition to the paint substitution, OMCE-Jordan has made several other changes recommended in a USAID-funded pollution prevention assessment of the factory’s operations:

- Modified pressure settings on air compressor
- Repaired leaks from air compressor lines
- Improved the handling of paints and solvents in paint mixing room

The air compressor and compressor line changes will save an estimated 7,500 kWh/yr in electricity (approximately 500 JOD), which is equivalent to 4,000 kg of CO<sub>2</sub> emissions. The handling modifications have reduced emissions, odors, and potential chemical exposure to workers, as well as the risk of fire and related environmental and human health consequences.

Cost savings from using the less expensive 50/50 water/solvent-based paint will increase if OMCE-Jordan begins producing water-based paint internally instead of purchasing it from suppliers.

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## SUCCESS STORY

# Air Compressor Replacement/Repair Saves Energy and Money for White Plastic

**Facility makes operational changes that reduce costs.**



*Improved maintenance of air compressor and air system saves electricity.*

*Mr. Majed Al-Baghdadi, White Plastic Co. General Manager, commented, "Working with the USAID program has helped us to reduce raw material usage and cut down our bills."*

By replacing two old air compressors with a new larger model with automatic operation, White Plastic Co. reduced its energy use significantly. This reduction is expected to save the company approximately 36,000 JOD in the first year alone.

White Plastic's electricity consumption is being reduced by approximately 500,000 kWh/year. This is equivalent to eliminating over 260,000 kilograms of CO<sub>2</sub> emissions.

Other changes included repairing leaks in the compressed air network. The facility also began collecting its used cartons and cardboard, and offered them for free to paper collection companies for recycling.

The changes had been recommended in a USAID-sponsored pollution prevention and environmental management assessment.

Established in 1973 in Amman, Jordan, the White Plastic Co. facility in Amman makes plastic cups, containers, trays and bowls, such as those used for yogurt, ice cream, soft drinks, and hot drinks. It employs 40 workers.

General Manager Mr. Majed Al-Baghdadi said, "Through USAID's program, we have gained additional knowledge that helped us to cut down our costs and reduce our usage of raw materials."

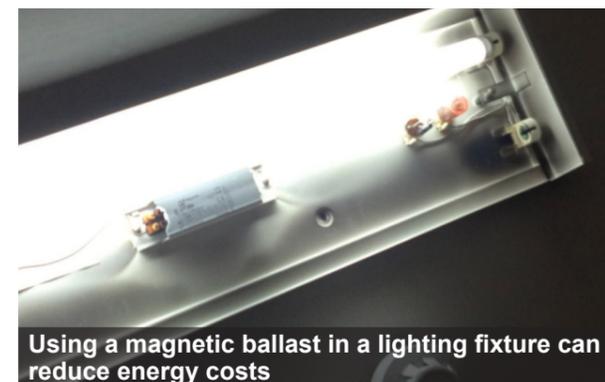
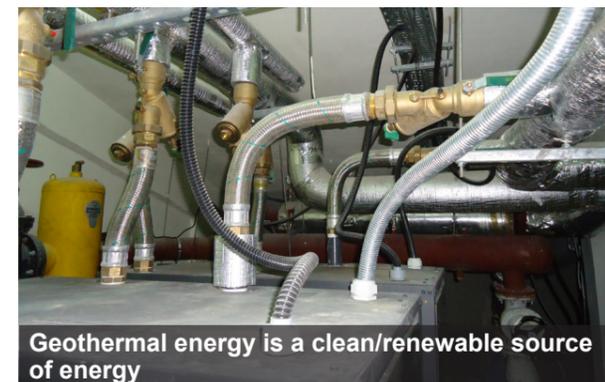
*White Plastic Co. is one of 30 industrial partners working with USAID to reduce industrial pollution and conserve scarce water and energy resources – in ways that benefit the bottom line. The Water Reuse and Environmental Conservation Project examined water and energy use, material and waste flow, production processes, quality control, and other aspects of each facility's operations. The assessments suggested options for minimizing pollution and saving water, energy, and money. Costs and payback periods for various options were also analyzed.*

**ATTACHMENT B**  
**HOW TO OBTAIN FUNDING**  
**FOR GREEN WATER AND ENERGY INVESTMENTS**

2. LOANS	Central Bank of Jordan (CBJ)	Agence Française de Développement (AFD) through Capital Bank & Cairo Amman Bank	Governorates Development Fund (GDF)
<b>Goal</b>	Stimulate lending to industrial facilities Boost lending to MSMEs	Support eco-friendly projects	Stimulate investments and job creation outside the capital. Administered by JEDCO
<b>Programs</b>	<ul style="list-style-type: none"> <li>INDUSTRIAL LOANS: CBJ provides medium- to long-term funding to commercial banks, at low rates and long tenures, for them to lend to qualified industrial facilities at comparable rates, to <b>support renewable energy and energy efficiency improvements</b></li> <li>IBRD LOANS: CBJ administers USD 70 million extended by International Bank for Reconstruction and Development (IBRD) to <b>boost lending to SMEs</b>. Signed agreements with 12 Jordanian commercial banks and has already advanced USD 50 million as of July 2013, with balance expected to be withdrawn by Q1 2014.</li> </ul>	AFD extended lines of credit to lend to qualifying projects on same concessional terms	Equity and quasi equity structures
<b>Supports</b>	<ul style="list-style-type: none"> <li>Industrial loans: Renewable energy and energy efficiency investments</li> <li>IBRD loans: Medium and small businesses</li> </ul>	<ul style="list-style-type: none"> <li>Renewable energy</li> <li>Energy Efficiency</li> <li>Pollution abatement</li> </ul>	<ul style="list-style-type: none"> <li>Project located outside capital city</li> <li>Small, medium and large enterprises</li> <li>Startups or existing entities aiming to expand</li> <li>Sectors open to industrial, agro, services</li> <li>Economically feasible with high social and economical value added</li> <li>High ability to create employment opportunities and replace foreign employment</li> <li>High export potential with clustering opportunity with other sectors</li> </ul>
<b>Currency</b>	JOD	JOD or USD	
<b>Interest rate</b>	Lower by maximum 2% /year if passes in full to borrowers		<ul style="list-style-type: none"> <li>Interest-free, no collateral</li> <li>Partnership agreements specify profit sharing and exit mechanism according to project's cash flows</li> </ul>
<b>Term</b>	<ul style="list-style-type: none"> <li>Industrial: Up to 10 years</li> <li>IBRD: Up to 15 years</li> </ul>	Up to 13 years, with 3 years grace period	<ul style="list-style-type: none"> <li>3 to 8 years</li> <li>Minimum 2-year grace period</li> </ul>
<b>Eligibility</b>	Bank lending policies	Bank lending policies and AFD approval	<ul style="list-style-type: none"> <li>Jordanian employment 60%</li> <li>Project minimum cost JOD 100,000.</li> <li>Promoter contribution 10% or more</li> <li>GDF contribution 26% to 49%</li> <li>GDF contribution minimum JOD 50,000</li> </ul>
<b>Documents to be submitted</b>	Bank lending policies	Bank lending policies	Case by case
<b>Disbursement</b>	Bank lending policies	Bank lending policies	Case by case
<b>Assistance</b>	SME divisions at Jordanian banks	www.cab.jo www.capitalbank.jo Tel: 06-5100200	www.jedco.gov.jo • Tel: 06-5603507 PO Box 7704 Amman 11118

3. LOAN GUARANTEES	Jordan Loan Guarantee Corp (JLGC)	Jordan Loan Guarantee Facility (JLGF)
<b>Goal</b>	Support lending to SMEs	Support lending to SMEs (under 300 employees)
<b>Programs</b>	Guarantees loans by 70%	<ul style="list-style-type: none"> <li>Guarantees 60% to 65% in Amman</li> <li>Guarantees 70% outside Amman &amp; for women-owned SMEs</li> </ul>
<b>Supports</b>	<ul style="list-style-type: none"> <li>SMEs</li> <li>Industrial facilities</li> </ul>	SMEs
<b>Amount</b>	<ul style="list-style-type: none"> <li>Up to JOD 100,000 for SMEs</li> <li>Up to 550,000 JOD for industrial facilities</li> </ul>	USD 25,000 to 1,000,000
<b>Interest rate</b>		Determined by market but not to exceed 5% above average market rates
<b>Term</b>	<ul style="list-style-type: none"> <li>72 months SMEs in general</li> <li>Up to 96 months industrial facilities</li> </ul>	Maximum 10 years
<b>Assistance</b>	Participating Jordanian banks	Arab Bank, Housing Bank, Cairo Amman Bank, Ettihad Bank and Ahli Bank
<b>Notes</b>		In 2011 OPIC extended a USD 250 million in loan guarantees to support lending to SMEs. Program is implemented by Global Communities. USAID is providing USD 9.7 million to cover operating expenses of Global Communities.

## How to Obtain Funding for Green Water and Energy Investments



Thirty-two industrial facilities in Jordan, all of them small and medium-sized enterprises (SMEs), have completed rigorous self-assessments, identifying specific ways they can reduce their water and energy costs and at the same time improve their environmental performance. Working in partnership with the USAID Water Reuse and Environmental Conservation Project, these facilities have prepared detailed plans and timelines to implement pollution prevention and environmental management systems. The next step is for them to present those plans to the agencies and banks that offer affordable financing for those investments.

### Three types of assistance are now available to SMEs in Jordan:

#### Grants

- Jordan Enterprise Development Corporation (JEDCO)
- Amman Chamber of Industry (ACI)
- Jordan Environment Protection Fund (JEF)

#### Loans

- Central Bank of Jordan (CBJ)
- L'Agence Française de Développement (AFD) thru Capital Bank & Cairo Amman Bank
- Governorates Development Fund (GDF)

#### Loan Guarantees

- Jordan Loan Guarantee Corp. (JLGC)
- OPIC through Global Communities

For more information on green finance, join The Network for Jordanian Industrial Sustainability ([www.jordannetwork.net](http://www.jordannetwork.net)) and look at the section on finance.

**Grants, soft loans, and loan guarantees can support your P2 and EMS investments.**

**Use these tables to find the one that's right for you.**

**Tables:**

- 1. Grants**
- 2. Loans**
- 3. Loan Guarantees**

<b>1. GRANTS</b>	<b>Jordan Enterprise Development Corporation (JEDCO)</b>	<b>Amman Chamber of Industry (ACI)</b>	<b>Jordan Environment Protection Fund (JEF)</b>
<b>Mission</b>	Raise export capacity of industrial and service sectors	Promote deployment of renewable energy technologies	Support environmental projects
<b>Program</b>	JUMP II Scheme 5, SME reinforcement	Industries Support Program to Procure Renewable Energy Systems, Energy & Water Efficiency Systems	
<b>Supports</b>	<ul style="list-style-type: none"> <li>Introduce environmentally friendly technology (energy and water improvements)</li> <li>Increase productivity, value added and/or cost reduction (Materials conservation)</li> </ul>	<ul style="list-style-type: none"> <li>Solar water heating</li> <li>Photovoltaic systems</li> <li>Energy and water conservation</li> </ul>	<ul style="list-style-type: none"> <li>Industrial wastewater treatment</li> <li>Solid waste recycling</li> <li>Renewable energy and energy conservation</li> <li>Environmentally positive small and medium projects</li> </ul>
<b>Timing</b>	March and September		February and July; <b>NOTE: not operational since 2011</b>
<b>Amount</b>	<ul style="list-style-type: none"> <li>10,00 to 100,00 Euros</li> <li>90% of eligible costs outside Amman or woman-owned</li> <li>80% otherwise</li> <li>Equipment up to 60% financed</li> </ul>	<p>Solar: Up to:</p> <ul style="list-style-type: none"> <li>50% if locally manufactured</li> <li>25% if imported</li> <li>5,000 JOD</li> </ul> <p>PV: Up to</p> <ul style="list-style-type: none"> <li>50% if locally manufactured</li> <li>30% if imported</li> <li>7,5000 JOD</li> </ul> <p>Energy/water: Up to: 50% to 7,500 JOD</p>	Up to 75% of total project cost Maximum JOD 15,000.
<b>Evaluation Criteria</b>	<ul style="list-style-type: none"> <li>Operational and financial capacity</li> <li>Relevance to Sch. 5 priorities Jordan, region and EU</li> <li>Feasibility</li> <li>Sustainability</li> </ul>		Project implementation 3 to 9 months
<b>Eligibility</b>	<p>Applicant:</p> <ul style="list-style-type: none"> <li>Legal entity in manufacturing sector</li> <li>&gt; 2 years of operations</li> <li>Fully owned by private sector</li> <li>10 -250 employees.</li> <li>Paid-up capital JOD &gt; 10,000</li> </ul> <p>Action</p> <ul style="list-style-type: none"> <li>Implementation period 1 to 18 months</li> <li>Manufacturing sector</li> <li>Examples <ul style="list-style-type: none"> <li>Enhancement of productivity</li> <li>Equipment acquisition</li> <li>Acquisition of new technologies</li> <li>Quality control, testing and research equipment</li> <li>Maintenance and safety equipment.</li> <li>CAM / CAD systems, automation, and robots</li> <li>Other actions to be financed may encompass capacity building activities in areas of marketing, production, organizational, HR</li> </ul> </li> <li>Costs must be incurred during implementation, must be reasonable, verifiable, justifiable</li> </ul>	<p>Applicant</p> <ul style="list-style-type: none"> <li>Current member in ACI</li> <li>Registered with SSC</li> <li>&lt; 249 employees</li> <li>Paid-in capital &lt; JOD 1,000,000</li> <li>May qualify only once</li> </ul> <p>Solar</p> <ul style="list-style-type: none"> <li>System must be used in industrial applications.</li> <li>Evacuated tubes do not qualify for grant</li> </ul> <p>PV</p> <ul style="list-style-type: none"> <li>System must be used for electricity generation in industrial facilities</li> </ul> <p>Water and energy conservation:</p> <ul style="list-style-type: none"> <li>Facility must undergo audit supervised by ACI under "Mobile Energy and Environment Clinic" program</li> <li>Grant to be used to implement specific actions recommended by ACI during the energy audit</li> </ul>	<ul style="list-style-type: none"> <li>Objectives and relevance to objectives of Fund and Ministry</li> <li>Feasibility - socially, economically and environmentally</li> <li>Direct and indirect beneficiaries</li> <li>Environmental impact</li> <li>Operational aspects</li> <li>Sustainability</li> </ul> <p>For private sector and NGOs:</p> <ul style="list-style-type: none"> <li>Applicant duly registered Jordanian entity</li> <li>10 or more employees</li> <li>Operational for at least 2 years</li> <li>Must prove operational capacity</li> <li>Must prove financial capacity of at least 25% of full cost</li> <li>Grant disbursed following project completion</li> <li>Only one project with specific objective can receive a grant in any given round</li> </ul> <p>Other conditions apply to public sector entity or an individual, but not particularly relevant to P2 industrial facilities.</p>
<b>Documents to be submitted</b>	<p>Certified copies of</p> <ul style="list-style-type: none"> <li>Commercial registration certificate</li> <li>Financial statements for past 2 years</li> <li>Social security corp. registration certificate</li> <li>Bank reference certificate</li> <li>Application package which includes: <ul style="list-style-type: none"> <li>Concept note in format specified by JEDCO</li> <li>Detailed application in format specified by JEDCO</li> </ul> </li> </ul> <p><b>NOTE: Award decision depends largely on quality of application submitted.</b></p>	Application on ACI form	<ul style="list-style-type: none"> <li>Signed application form, with all annexes completed</li> <li>Project forecasts</li> <li>Project economic and social feasibility and environmental impact assessment</li> <li>copy of commercial registration certificate</li> <li>Bank statement for preceding six months</li> <li>Social security letter confirming number of employees enrolled in program</li> </ul>
<b>Disbursement</b>	<ul style="list-style-type: none"> <li>Advance payment of 80% of grant within 45 days of contract signature. Advanced payment bank guarantee may be required</li> <li>Balance within 45 days of submission of final expenses verification report</li> </ul>	<ul style="list-style-type: none"> <li>Grantee solicits at least two offers (estimates).</li> <li>After analyzing offers submitted, grantee forwards all submitted offers along with analysis and recommendation to ACI</li> <li>ACI reviews and formally endorses recommendation of grantee.</li> <li>Following system acquisition and settlement of purchase price to vendor, grantee forwards all documents including purchase order, invoices and proof of payment to ACI</li> <li>ACI inspects the system installed and accordingly reimburses the grantee for costs incurred</li> </ul>	<ul style="list-style-type: none"> <li>Upon contract signature - 25%.</li> <li>According to progress - 50%</li> <li>Upon project completion - 25%</li> </ul>
<b>Assistance</b>	www.jedco.gov.jo • Tel: 06-5603507 • PO Box 7704 Amman 11118	www.aci.org.jo • Tel: 06-4643001 • PO Box 1800 Amman 11118	www.moenv.gov.jo • Tel: 06-5560113 • PO Box 1408 Amman 11941