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ENVIRONMENTAL PRIVATE SECTOR INITIATIVES IN THE NEAR EAST

FINAL REPORT

USAID Contract No.:
PDC-5517-I-00-0104-00
Delivery Order No. 12

International Resources Group, Ltd.
1400 I Street, N.W., Suite 700
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EXECUTIVE SUMMARY

Introduction

The overall goal of the Environmental Private Sector Initiatives in the Near East Project (**EPSINE**) study was to assess the feasibility of the formulation of a private sector partnership in which U.S. industries would supply Near East industries with pollution prevention and waste minimization (**clean**) technology. The term **clean technology** is herein employed because it is a term more familiar to people outside the U.S. and is perfectly consistent with pollution prevention and waste minimization technology. More specifically, the study purpose was to *perform a general assessment of the market potential for U.S. clean technology products in several Near East countries and to select one of these countries to focus on*.

The study team visited Egypt (twice), Jordan, and Tunisia. The team also had discussions with USAID/Morocco officials and undertook economic research related to Morocco.

Findings & Conclusions

- There is a sufficiently large industrial market for clean technology and an abundant number of commercially proven and available U.S. clean technology products to justify this program and make it successful.

- While many U.S. firms are world class manufacturers of clean technology products, most are small businesses without the funds, time, or personnel to invest in developing new business in the Near East region. Therefore, AID or other U.S. Governmental Agency assistance will be critical if this program is to succeed.

- Existing industries in the region lack technological advancement and efficiency in production processes, defining an intrinsic need for modern, clean technology. In addition, industrial sectors in the region are experiencing high growth rates.

- There is a relatively small window of opportunity for the U.S. to act before competing industrial nations such as Japan, Germany, the Netherlands, etc. capture the rapidly emerging industrial Near East market for clean technology products.

- Strong support was voiced by AID Mission staffs, senior host country officials, managers of private and state-owned industries, and leaders of environmental NGOs in Egypt, Jordan and Tunisia, for a fast-track delivery

system for supplying U.S. clean technology products and services to Near East industries.

- A U.S. Government sponsored program will be required if the goal of marketing substantial quantities of U.S. clean technology products to the Near East region is to be met. A program of technical assistance will be required to implement this program. The program should encompass two components:

  - An U.S.-based management entity that will direct and support the Near East-based activity; and

  - a regional technical office staffed by U.S. and host country scientific and technical personnel who will assist local industries to define and install clean technology products in their facilities.

Recommendations

- AID should support a program to export U.S. clean technology products to the Near East region.

- The Program should begin with at least a two-year pilot project to test the validity of the program.

- The Program should establish a regional **Clean Technology Center** in Cairo, and the local executor of the program should be the **American Chamber of Commerce in Egypt.**

- A full scale project design effort should proceed in parallel with the operation of the pilot program.

- The program should investigate locating a satellite center in a Maghreb country, preferably in Morocco.

Report Summary

I. A Requirement for U.S. Government Assistance

Notwithstanding commercially available products and latent market demand, U.S. government assistance is critically needed. Not only do most American companies have problems exploiting foreign markets, the Near East region, in particular, is not especially familiar or attractive to U.S. firms, as compared, for example, to the Pacific Rim and European markets. Moreover, most U.S. firms with superior clean technology products are small businesses which do not have the money, time, or people, to invest in developing new

business in the Near East region. The project team visits found almost no U.S. clean technology products being marketed in the Near East countries at this time. U.S. Government assistance will manage and significantly reduce perceived business risks by supplying resources to overcome initial obstacles to market entry. Once these are overcome, however, and the market is shown to be significant in size and accessible, government financing can be phased out. Self-financing might happen after three to five years of AID support.

However, *there is a relatively small window of opportunity for the U.S. to act before competing industrialized nations capture the rapidly emerging industrial Near East market for clean technology products.* The field visits have confirmed that other countries, such as Japan, Germany, and the Netherlands, have identified what this project has, namely a critical period when developing countries in the region are creating ideal conditions for purchase of clean technology. These conditions are:

- Privatization of industrial sectors;
- reduction of government subsidies of energy, water, and other inputs; and
- expanded environmental regulatory and enforcement programs.

II. Clean Technology Products for Program Success

The recommended AID program would focus on low-cost (under $50,000) to medium-cost (under $500,000) U.S. clean technology products which can be retrofitted into existing Near East industrial facilities without jeopardizing current production outputs and/or quality, or introduced into the design of new industrial plants.

The chief criterion for judging the success of the recommended program will be the *annual sales of U.S. clean technology products in the region in relation to the cost of the program to AID*. Goals should therefore be established in terms of a multiplier defined as the ratio of sales to program costs. It should be noted that other savings will ensue, including raw materials and treatment costs. Furthermore, while traditional end-of-pipe control technology is more costly, the objective is to penetrate the Near East market with U.S. Clean Production Technology.

The primary environmental goal of the recommended program is not to make the largest possible direct impact on current pollution problems. *Instead, use of a large number of small, inexpensive clean technologies will first make a significant direct impact on reducing environmental impacts, and, secondly, will result in a significantly positive effect on the national economy.* The resulting economic impact, in turn, will then lead to a secondary environmental goal of developing new policies and infrastructure to fight pollution. The third environmental goal is the prevention of additional environmental deterioration which would otherwise occur with industrial growth in the absence of aggressive clean technology

implementation. This ripple effect should reduce the quantity of waste material discharge, thereby improving the quantity and quality of products produced, thus saving scarce resources.

All U.S. products included in the program will be required to offer fast payback periods (i.e., no more than three years), because they will improve plant efficiency and productivity, reduce raw material and operating costs, and increase the profitability of Near East companies.

Clean technologies (as opposed to end-of-pipe treatment) made imminent good sense to the over 50 industrialists, government officials, and environmental organizations interviewed by the EPSINE study team. As these individuals uniformly lacked knowledge about the technical and economic aspects of clean technologies, the Center's role will be to convert the latent interest in clean technology into keen awareness and action by informing Near East firms about specific clean technology products which make indisputable economic and technical sense. The proposed program is necessary to give host country companies a sound economic and environmental alternative to pollution control.

III. Key Program Components and Activities

The EPSINE program would incorporate two key components as narrated below. In addition, Figure 1 shows the relationships among the key program components. The solid arrows show the main flows of information for management and operation, and the broken lines show important relationships between the program units and external contributors.

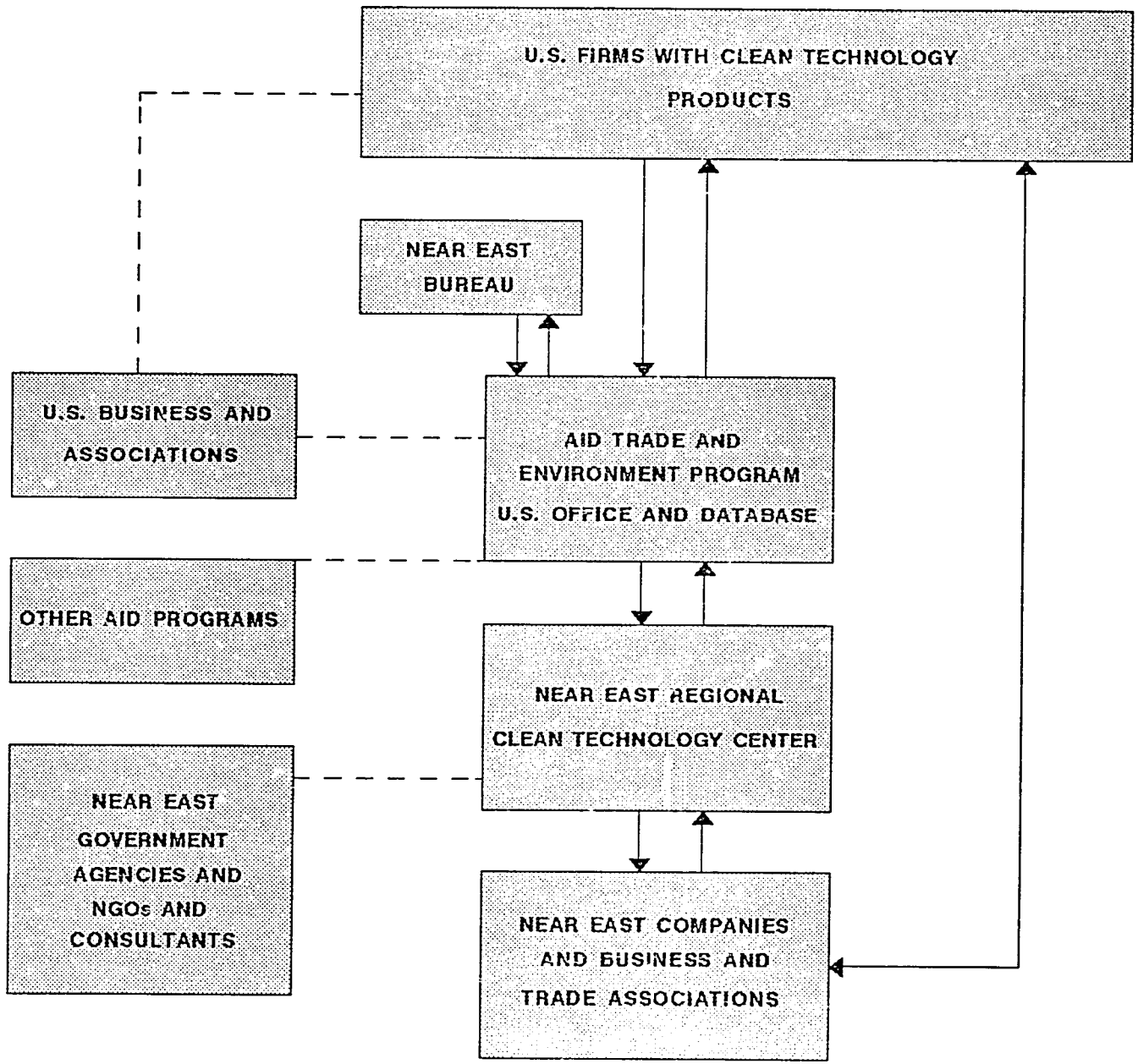
1. Role of the U.S. Office

A program management and support office in the U.S. will provide overall management responsibility for the trade and environment program and also have the mission of identifying commercially available low-cost and medium-cost clean technologies by working with U.S. industries and Trade Associations. A Clean Technology Database (See Section 1.4 and Table 4-2 for details) of commercial sources, which meet the exact technical and economic needs of Near East companies for products, processes and supplies, will be developed to augment existing, available databases on this subject.

Support office staff will also make "best guess" estimates appropriate for Near East countries for specific economic savings, returns on investment, and payback periods under various economic and production cost scenarios. This information will also be in the Database.

FIGURE 1

KEY RELATIONSHIPS AMONG PROGRAM COMPONENTS



The support office staff will coordinate contacts between U.S. firms and trade associations and Near East companies and will coordinate with other AID programs and other U.S. Federal programs, UNEP programs and UNIDO programs, to provide information to the Regional Center to support its activities. For example, many PRIDE activities produce information and reports which can and should be used to support the program's mission and its Center activities.

2. Role of the Near East Center

A Near East Clean Technology Center will serve as the regional program office with a primary mission of facilitating increased sales of U.S. clean technology products to Near East companies. The Center will also identify and stimulate markets which American firms can enter quickly on the basis of product quality, performance and payback.

The study team's reasons for its recommendation that the Center be located in Egypt versus Jordan, Tunisia or Morocco include:

- Egypt has the region's largest industrial economy;
- Egyptian industries tend to be in greater need of technological, modernization, which also means a larger market opportunity; and
- the large AID program in Egypt offers advantages for promoting and financing purchases of U.S. equipment.

The study team also concluded that the location of the Center in Egypt would:

- Maximize near-term program success, without posing insurmountable obstacles to developing opportunities in other countries of the region;
- benefit from the level of Mission, government, and industry support for the program in Egypt;
- profit from positive government policies regarding privatization, subsidy reduction, and environmental regulation;
- benefit from the lack of market penetration by competing industrialized countries (e.g., Germany has penetrated Jordan, Japan, Italy and France have penetrated Tunisia, and France has an advantage in Morocco); and
- permit affiliation with the American Chamber of Commerce in Egypt, making use of its independence and credibility, extensive administrative structure, facilities, and network of Egyptian businessmen.

The Center, with ten or fewer staff, will employ U.S. and Egyptian engineers to identify and assist companies in the region which can benefit from U.S. clean technologies and thereby create demand for additional sales of equipment, processes and supplies.

Firms serving as demonstrators of clean technologies by making their facilities open for inspection, will be provided clean technologies at no cost or under a cost sharing arrangement with the project.

By developing the pollution prevention skills and expertise of consulting engineers in Near East countries, through direct participation in Center activities, the Center will help develop private sector institutional capabilities for pollution prevention implementation.

The Center will include space for: a) showcasing U.S. products for visiting Near East company managers; b) providing sales material including technical brochures on clean technology products; c) special training; and d) providing direct access in Cairo to the Clean Technology Database developed in the U.S. and maintained at the Center in Cairo.

Center staff will establish contacts in other Near East countries to develop markets for U.S. products. Establishment of a satellite office in Morocco, in the French-speaking Maghreb part of the region, will be evaluated while the Cairo Center is up and running. The Center will also maintain close links with other clean technology centers, such as those established by UNIDO, and other clean technology demonstration projects, as well as those anticipated to be implemented under AID's forthcoming EP3 program. Center staff will also monitor government policies and programs in the region which affect interest in U.S. clean technologies.

Center staff will assist Near East firms in using AID Mission programs (e.g., Commodity Import Program), Embassy commercial service programs, and other programs (e.g., the Egyptian Credit Guarantee Corporation) which can assist in financing purchases and overcoming other obstacles to using imported U.S. products.

IV. Near Term Implementation

The study team's recommendation that AID's Near East Bureau initiate, as soon as possible, implementation of the EPSINE Project at a pilot demonstration level for at least two years is based on its belief that doing so will:

- Permit U.S. companies to gain a foothold in the region before otherwise competing countries' firms;
- provide a cost-effective means to test and refine the basic concepts of the program prior to full-scale implementation and funding;

- stimulate interest in clean technology alternatives to "end-of-pipe" or pollution control investments before the later preempt interest in clean technology; and

- place the AID-assisted Near East countries at the forefront of the worldwide "Clean Technologies" movement.

For the pilot program, a minimum of three types of American clean technology products will be used. These should be low-cost products applicable to a crosscutting range of industries. For example, potential inexpensive products include: new nozzles for painting and coating operations which greatly reduce raw material use and waste generation; chemical solvent recovery and recycling units; and water purification units which recover metals and produce reusable water.

1. THE FEASIBLE TRADE AND ENVIRONMENT PROGRAM

1.1 Study Objectives and Methodology

This study has consisted of two primary activities. First, research has been carried out on relevant issues and topics by experts in engineering, environment, pollution prevention, clean technology, and economics. Second, teams of researchers visited Egypt, Jordan, and Tunisia. Details on these visits have been provided previously in the Preliminary Country Profile reports for Egypt, Jordan and Tunisia. See Annex B for tables of industries and government agencies visited.

Originally, the Team planned to visit Morocco, but some scheduling problems precluded the visit; however, some research was conducted on Morocco, and several of the people associated with the project were able to make use of information gained from prior visits to Morocco (e.g. PRIDE reports) and some in-depth conversations with current AID/ Morocco officials.

A second trip was made to Egypt to fill some outstanding informational gaps and to gather more information for the extended market analysis required for the selected country. This additional information is incorporated in this final report. The information obtained supported the selection of Egypt for the Center.

The primary objectives of the country visits were to assess:

- The size and character of industrial sectors;
- the current opportunities for low- and medium- cost interventions using clean technology;
- interest among industrial managers and engineers in clean technology;
- the current state of environmental laws and regulations;
- information about other government policies which affect the economic incentives for using clean technology (e.g., privatization and government subsidies of water and energy);
- interest among environmental NGOs in pollution prevention and clean technology;
- the level of interest in AID Missions in a trade and environment program operated by the Near East Bureau; and

- the extent to which competing industrialized countries have already penetrated industrial sectors with clean technology.

Information obtained from the country visits has been combined with the information obtained from the research activities.

1.2 The Need For A New AID Program

A central question to be resolved early in the project, principally through the field visits, but also through research on current AID and other Federal programs, was: Is a new program needed? Is the original premise for the project valid ? Indeed, all the project activities confirmed the correctness of the original hypothesis.

The first part of the need question is whether other AID programs are doing or will do what this project has addressed. The project's finding is that no current or planned Federal programs focus on what this project has stressed, that is, the near-term export of commercially proven and available low- and medium-cost clean technology products from U.S. private sector firms to private sector firms in Near East countries, nor is such export business occurring by itself because of private sector activities alone.

In other words, this project has focused on examining the feasibility of a very practical, fast-track, expeditious program to deliver clean technology hardware to Near East firms, which would be desired primarily because of the certain, near term economic benefits to purchasers of the U.S. products. While several other AID, Federal, and international programs (e.g., United Nations) address pollution prevention and clean technology to varying degrees, none stresses the three essential components of the program found feasible in this project:

- Single-minded focus on clean technology in comparison to traditional end-of-pipe pollution control technology to address environmental problems;

- limitation to low- and medium-cost clean technologies, which provide unequivocal economic benefits to Near East companies, in comparison to large scale, multimillion dollar projects, often for state owned industries; and

- interest in promoting and facilitating the export of U.S. clean technology products.

Low cost is defined as under $50,000 and medium cost as under $500,000. The topic of how the recommended program would interface with other AID programs by working cooperatively with them and avoiding redundant efforts is discussed in the section on Implementation Issues (see Section 1.6).

The second part of the need question is whether there is current and future market demand for American clean technology products. Project research has found that there is a sufficiently large industrial market for clean technology in Near East countries, and an abundantly large number of commercially proven and available U.S. clean technology products to justify this program and make it successful in a short period of time. Existing industries in the region have a lack of technological advancement and efficiency in production processes, which define an intrinsic need for modern clean technology. In addition, industrial sectors in the region are experiencing high growth rates.

Greater detail on the market potential for U.S. clean technology products in Egypt and other Near East countries is provided in Chapter 4 of this report. The feasibility of effectively supplying U.S. clean technology products is also addressed in Chapter 4, where descriptions of a number of such generic products are provided. *This study has found that many U.S. firms offer world class clean technology products which are more technologically advanced and cost competitive than those from competing companies in other industrialized countries.*

Yet another key issue is: Why is U.S. government assistance needed, especially if the U.S. products and market demand exist? This study finds that U.S. government assistance is critically needed to capitalize on U.S. products and latent Near East markets. Not only do most American companies have problems exploiting foreign markets, the Near East market, in particular, is not especially attractive to U.S. firms, as compared, for example, to the Pacific Rim and European markets. Moreover, although many U.S. firms have superior clean technology products, most of them do not have the resources, including money, time, and people, to invest in developing new business in the Near East region. The project team visits found almost no U.S. clean technology products being marketed in the Near East countries at this time. Government assistance is a way to manage and reduce significantly perceived business risks by supplying resources to overcome initial market obstacles. Once these are overcome and the market is shown to be significant in size and accessible, government financing can be phased out. Self-financing might happen after three to five years of AID support.

It is also important to note a related finding to the need question. *This project has found that there is a relatively small window of opportunity for the U.S. to act before competing industrialized nations capture the rapidly emerging industrial Near East market for clean technology products.* The field visits have confirmed that other countries, such as Japan, Germany, and the Netherlands have identified what this project has, namely a critical period when developing countries in the region are creating exactly the right conditions for purchase of clean technology.

These conditions are:

- Privatization of industrial sectors which provides the profit motive for using clean technologies;

- removal and reduction of government subsidies of energy, water, and other material inputs to industry which provide greater economic incentives for using clean technology; and

- expanded environmental regulatory and enforcement programs which require increased spending on end-of-pipe pollution control equipment or the more economically attractive alternative of clean technology within production operations.

Moreover, the global attention to sustainable economic development and national policies to stimulate industrial growth provide exactly the right context for deploying clean technology.

1.3 Key Goals and Components of Recommended Program

The environmental goal of the recommended program is not to make the largest possible direct impact on current pollution problems. *Instead, the goal is to facilitate the use of a large number of small, inexpensive clean technologies which will firstly make a significant direct impact on reducing environmental impacts, and secondly will result in a significant positive effect on the national economy*. The latter economic impact, in turn, will then provide a secondary environmental improvement, because the stronger a national economy becomes the more effectively it develops the policies and infrastructure to fight pollution. The third environmental goal is to effectively prevent additional environmental deterioration which would otherwise occur with industrial growth in the absence of aggressive clean technology implementation.

It should be emphasized that many of the clean technologies that will be used will also provide remarkable improvements in the working conditions within factories. Enormous amounts of toxic chemical and metal vapors fill the air within many Near East factories. causing worker exposures which must ultimately result in illness and death. The latter imply high avoidable costs and also the opportunity to improve worker and company productivity by providing healthier and safer workplaces.

The trade goal of the recommended program is to assist U.S. firms penetrate Near East country markets with competitively clean technology products. The project has found no significant marketing of clean technology products by U.S. firms in the Near East countries examined. This is not surprising, because U.S. firms in general have not targeted the Near East region for exports. This is unfortunate for several reasons, including the significant size of the region in terms of population and industrial activity, and the likelihood of high rates of industrial growth in coming years.

The potential success of the recommended program rests on the premise that all U.S. products included in the program will be required to offer fast payback periods (i.e., no more than three years), because they will improve plant efficiency and productivity,

reduce raw material and operating costs, and increase the profitability of Near East companies. Additionally, all U.S. products must also help companies address environmental issues, reduce expenditures on end-of-pipe pollution control equipment, and reduce costs associated with current and anticipated regulatory compliance. In achieving these objectives, the program will assist and promote privatization efforts in Near East countries and the growth of their private sector industries in a means which is consistent with sustainable economic development.

It must be stressed that this project, through over 50 visits to industrial plant sites and industrial and government organizations in the Near East, verified that traditional end-of-pipe pollution control methods should be the last resort, because they are not a productive use of capital from a private sector management perspective. (See Annex B.) Clean technologies made sense to industrialists, environmental groups, and government officials, but the principal reservation was that the previous individuals had little specific knowledge about such low- and medium-cost technologies, technically and economically. This is exactly the role envisioned for the Center; that is, to convert the latent interest in clean technology into action by informing Near East firms about specific clean technology products which make indisputable economic and technical sense to Near East companies struggling to reach a higher level of profitability and competitiveness. It is imperative that traditional end-of-pipe pollution control products not be included in the proposed program. They are fundamentally different from clean technology products from an economic and business perspective. They should not be presented as being competitive or viable alternatives to clean technologies.

The dilemma is that most government environmental regulatory programs emphasize pollution control and ignore clean technology. Although it is a worthy objective to inform Near East governments about the preferred pollution prevention strategy by, for example, informing them about the U.S. Federal Pollution Prevention Act of 1990 and about 25 similar state laws, as well as many EPA pollution prevention programs, that objective is not part of the proposed program. However, by working cooperatively with other AID programs, the success in transferring clean technologies into the region can greatly assist AID programs, such as **Project in Environment and Development** (PRIDE), to more successfully promote the public policy aspects of pollution prevention. Such public policy development, in turn, can help ensure the long term success of the proposed program.

The proposed program is necessary to give companies a sound, pragmatic economic and environmental alternative to pollution control. Pollution control currently has a market advantage because sellers of such end-of-pipe equipment are better organized, are better known, and are often pushed by engineering consulting firms. Although clean technologies will never completely eliminate the need for pollution control methods, the competitive playing field is far from level and fair right now. Clean technology needs the special support which the proposed program can provide at a most critical time for Near East countries. Unless the economically and environmentally superior clean technologies are given an opportunity to be selected and implemented successfully, costly investments in

avoidable pollution control will be made. The latter will not help the economies of Near East countries and they will be resisted by many companies in the region, thereby delaying environmental progress.

It has been found feasible at the conceptual level to design a program that has two key implementation components. In keeping with the market and private sector nature of the program, there would be a U.S. activity with a mission to provide a supply of clean technology products and private sector partners. There would also be a Near East regional activity to identify and stimulate market demand for those products and increase interest in working with U.S. partners. The Near East regional activity would be implemented within a Center organization, initially in Egypt, but which would be expanded as soon as practicable to Morocco to effectively develop the markets in the French-speaking Maghreb countries. A proposed near term minimum two-year pilot demonstration of the program is presented below. After a successful demonstration, even a concurrent expansion to Morocco would be a high priority.

1.4 Core Activities of the U.S. Program Office

The primary mission of the U.S. Program Office is to assure a supply of clean technology products and product information, and gather information essential for the operation of the program. The program management and support office in the U.S. will provide overall management responsibility for the trade and environment program and have the mission of identifying commercially available low- and medium-cost clean technologies.

In addition to participating U.S. companies selling clean technology products, alliances and partnerships will be formed with industry trade associations and business organizations to provide long term supplies of clean technology products for diverse Near East industries. **(It should be emphasized that no single U.S. trade association exists which covers clean technology products.)** Virtually any business or trade association may have members which offer clean technology products. However, as many of the U.S. firms which offer clean technology products are small, they are not likely to be members of prominent national business associations.

It would also be worthwhile to consider forming some type of private sector advisory board for the program to obtain the expertise of environmental experts, representatives from U.S. NGOs, trade experts, and others.

A key activity of the U.S. based program will be development and maintenance of a Clean Technology Database, which will identify specific commercial sources which meet the exact technical and economic needs of all kinds of Near East companies. The Database will allow searching for U.S. clean technologies appropriate for specific industries, unit operations, manufactured products, water conservation needs, and raw material inputs. Using CD-ROM technology, users will be able to download highly detailed vendor information on U.S. products. The Database will also be linked to the International

Cleaner Production Information Clearinghouse and the Pollution Prevention Information Clearinghouse operated by the United Nations Environment Programme and the U.S. EPA. This will allow users to supplement vendor information with related case studies and other published information pertinent to specific uses of clean technology.

A preliminary search for clean technologies was undertaken by the study team. Table 4-2 in Chapter 4 lists a representative number of processes, equipment and supplies whose use reduces pollution and/or hazardous waste. A comprehensive **Clean Technology Database** would be developed by the project's U.S. staff utilizing, but not be limited to the following methods:

- Research of published data including: technical literature; conference proceedings; existing databases; state and federal pollution programs; and reports on federally-funded pollution prevention programs;
- queries to industry trade associations;
- requests for information inserted in the Commerce Business Daily; and
- review of professional articles in trade journals.

Office staff will have the responsibility not only to obtain vendor information from as many U.S. companies as possible, but also to make estimates appropriate for Near East countries for specific economic savings, returns on investment, and payback periods under various economic and production cost scenarios. This information will also be in the Database. Additionally, the Office would have the responsibility of obtaining or estimating quantitative environmental improvements for specific commercial products in the Database. Special efforts by the office would ensure that U.S. companies are made aware of the opportunity to list their clean technology products in the Database.

The program office will coordinate contacts between U.S. firms and business organizations and Near East companies and business groups. The office will have responsibility for facilitating the visits of U.S. businessmen to the Near East and for hosting Near East businessmen visiting U.S. companies.

Program office staff will coordinate with other AID programs and other Federal programs to provide information to the Regional Center to support its activities. For example, many PRIDE activities produce information and reports which can and should be used to support the program's mission and its Center activities.

1.5 Location and Core Activities of the Near East Clean Technology Center

The Near East Clean Technology Center will serve as the regional program office. The basic mission of the Center is to identify and develop demand for U.S. clean

technology products. The Center will identify, stimulate, and produce markets which American firms can enter quickly, competitively, and successfully on the basis of product quality, performance, and price. The primary objective is to act as an effective "deal maker" to facilitate increased trade of U.S. clean technology products which offer fast payback periods for Near East companies while also addressing environmental problems of national concern.

This project study recommends that the Center initially be located in Egypt. Table 1.1 which presents summary information on the four countries examined helps explain this decision. The chief reasons for selecting Egypt over Jordan and Tunisia, which were also visited, and Morocco, which was examined, include the following:

- **Egypt has the region's largest industrial economy** which, therefore, offers the largest market opportunity for U.S. clean technologies. The Egyptian economy is about 50 percent larger than Morocco's and 10 times larger than Jordan's. The size of the Egyptian industry sector is 16 percent larger than that in Morocco, but this is mitigated by the fact that a high proportion of Moroccan industry is in large-scale chemicals and textiles, where opportunities for low- and medium-cost clean technologies are minimal. Thus, the market opportunity for clean technologies is significantly greater in Egypt. It is also pertinent to note that Egypt's large population and low per capita GNP support the belief that the rate of industrial growth in Egypt will be very significant in coming years. There is abundant evidence in Egypt of the government's stress on industrial development to spur economic growth.

- **Egyptian industries tend to be in greater need of technological modernization**, which also means a larger market opportunity. While this finding derives mostly from the plant visits made by the teams visiting the countries, it is also supported by certain data. For example, industrial energy use in Egypt is over six times greater than for Morocco, and more than twice that in both Jordan and Tunisia. Similarly, water use in Egyptian industry is much greater than in the other three countries. From an export perspective, the relative lack of technological advancement of much of Egyptian industry, as compared to that seen in Tunisia and Jordan, is a positive market opportunity factor.

- **The presence of the large AID program in Egypt** offers advantages for promoting and financing purchases of U.S. equipment. Indisputably, the AID Mission program in Egypt dwarfs all others. Thus, there is an existing infrastructure that the recommended program can take advantage of.

Table 1.1 - Summary Information on Four Countries

Societal	Egypt	Morocco	Jordan	Tunisia	U.S.	World
population (mil)	52.1	25.1	3.2	8.1	250.0	5,292*
avg annual pop. growth (1989-2000)	1.8%	2.4%	3.8%	1.9%	0.8%	1.6%
Infant mortality rate (per 1000)	66	67	51	44	9	52
Adult illiteracy rate (%)	52	51	20	35	< 5	35
urban population						
% of total	47	48	61	54	75	50
% growth rate 1980-1990	3.1	4.3	4.1	2.9	1.1	4.5
National State of Environment Report	No	IP	IP	No	Yes	-----
Environmental statistical compendium	No	No	No	No	Yes	-----
Economy	**Egypt**	**Morocco**	**Jordan**	**Tunisia**	**U.S.**	**World**
GDP $ mil	33,210	25,220	3,330	11,080	5,392,200	22,298,850*
GNP						
$ mil (1989)	32,501	22,069	5,291	10,089	5,237,707	
$per capita	600	950	1,240	1,440	21,790	4,200
avg annual growth %	4.1	3.9	----	3.6	1.7	1.5
Development Assistance						
$mil	5,604	970	891	316	-11,394	
$ per capita	107.6	38.6	282.5	39.2	-45.58	12.0
Structure of production (%GDP)					1989	
Agriculture	17%	16%	8%	16%	2.2%	14.3%
Industry	29%	33%	26%	32%	24.8%	36.8%
Services	53%	51%	66%	52%	73.0%	49.7%
Structure of production (mil U.S.$)						
Agriculture	5645.7	3531.04	266.4	1772.8	118,628.4	22,509.8
Industry	9630.9	8322.6	865.8	3545.6	1,373,265.6	65,647.8
Services	17,601.3	12,862.2	21[illegible]1.8	5761.6	3,936,306.0	88,660.2
Structure of manufacturing (%; 1990 prices)						
Food, tobacco	31%	20%	22%	17%	12%	
Textiles, cloth	16%	38.2%	4%	21%	5%	
Machinery and transport equipment	9%	NA	2%	5%	32%	-----
Chemicals	8%	20%	11%	9%	11%	
Other	35%	21.8%	61%	49%	40%	
Energy Consumption (kilograms of oil per capita)	598	247	994	520	7,822	1,567
Indust. Energy Use (megajoule/dollar GDP)	38	6	17	14	12	15.6
Avg annual pesticide use (metric tons/hectare 1982-84)	7.6	.36	-----	.28	2.0	-----
Fertilizer use (kilograms/hectare 1987-1989)	384	34	63	22	95	97
Annual water use per capita (cubic meters 1970-87						
domestic	84	30	50	42	259	56.4
agriculture/industry	1,118	471	123	283	1,903	413.3

All numbers are for the year 1990 unless otherwise indicated.
* Denotes world total, all data in the "World" column are averages of countries excluding Cuba, the former U.S.S.R. and the Peoples Democratic Republic of Korea, as well as countries with populations less than 1 million.

Source: World Bank, 1992; World Resources Institute, 1992; The Wall Street Journal, July 10, 1992; Survey of Current Business, U.S. Chamber of Commerce, April, 1991.

For all four countries in the subject study (Egypt, Morocco, Tunisia and Jordan), the Mission Directors have expressed their strong support for the program as it is currently conceived. However, the project concluded that the location of the Center in Egypt would maximize near term program success (i.e., sale of U.S. products), without posing insurmountable obstacles to developing opportunities in other countries in the region. Moreover, the level of Mission, government, and industry support for the program in Egypt is as good as elsewhere. During the second visit to Egypt, the team had extensive meetings with senior government officials who explicitly expressed their unequivocal support for the program. The economic advantages of the proposed program for the Egyptian economy were grasped and embraced. Support, without interference from the Egyptian government, is deemed likely.

Also, government policies regarding privatization, subsidy reduction, and environmental regulation seem as positive in Egypt as elsewhere. Again, this was confirmed during the second visit to Egypt when the team met with senior members of the Egyptian government. Lastly, market penetration by competing industrialized countries was deemed less in Egypt than in the other countries (e.g., Germany has penetrated Jordan; Japan, Italy and France have penetrated Tunisia; and France has an advantage in Morocco). The overall attitudes toward the U.S. and U.S. products in Egypt are very positive.

Although some people believe that there may be stronger communications and transportation infrastructures in the other three countries, which would facilitate Center activities, this possible disadvantage does not outweigh the aforementioned comparative advantages for Egypt.

More specifically, the project recommends that the initial Center be located in Cairo and be affiliated with the American Chamber of Commerce in Egypt, making use of its independence and credibility, extensive administrative structure, and network of Egyptian businessmen. A Cairo location would put the Center close to a very high fraction of Egyptian industry. The General Manager of the Chamber indicated his strong support for this affiliation, during the Team's second visit to Egypt. At that time the Team also had the opportunity to give a well-received presentation on the program's concepts to Chamber members. The objectives of the trade and environment program as currently conceived are perfectly compatible with the interests and programs of the Chamber. The Director of USAID/Egypt supported using the Chamber for operating the Center.

Use of the Chamber will avoid administrative difficulties normally associated with programs having direct involvement of the Egyptian government. Start-up costs and difficulties for the Center will also be reduced. Financing for the Center would be through the Chamber, and the Center would be operated as a unit of the Chamber. The financing of the Center might be administered by means of a grant directly from AID or through a grant or subcontract from the party selected to manage and operate the parent trade and environment program for AID (i.e., the entity administering the U.S. office).

It appears feasible for the Center to be successful and cost-effective with a professional and support staff of under 10 people, mostly Egyptian (e.g., engineers, economists) with one or two senior U.S. engineers; however, initial staffing would be lower and staff size would be increased as the workload justified it. The long term goal would be for the Center to become self-financing through various fees charged to sellers and purchasers of clean technology products. Sellers (exporters) are used to paying fees for assistance in marketing and post-purchase support, and purchasers would be paying for appropriate technical assistance and engineering support services. Center staff will obtain detailed data on sales of U.S. clean technology products which have been directly or indirectly facilitated because of Center activities.

On the issue of measuring success, the chief criterion for judging the success of the recommended program will be the annual sales of U.S. clean technology products in the region. The amount of sales will be related to the amount of money spent on the entire program, both for the U.S. program office and the Near East Center. Goals should be established in terms of a multiplier defined as the ratio of sales to program costs. In order to be become self-financing, which is the second measure of program success, the multiplier will have to exceed one and probably reach a level of 2 to 4. The third measure of program success will be increasing market share for U.S. clean technology products as measured against the total amount of such goods and services purchased in the Near East region.

As for principal activities, the Center will employ U.S. and Egyptian engineers to work in three areas: market development to establish opportunities, technical assistance to assist in making specific sales, and operation and maintenance support to ensure customer satisfaction and future sales.

- **Market Development.** Identify specific companies in the region (not limited to membership in the Chamber), which can make use of U.S. clean technologies. Identify and assess specific opportunities within those companies for using certain kinds of U.S. products. Form industry consortia with similar technology needs to promote rapid diffusion of clean technology products. Arrange for demonstrations of specific U.S. products not yet used in the region. Operate a technology exhibition hall.

- **Technical Assistance.** Provide technical assistance to ensure effective selection and installation of U.S. products for facility retrofits. Center staff will also provide assistance to plant personnel in carrying out no cost pollution prevention actions and in performing economic analyses which support the purchase and financing of clean technology equipment.

- **Operation and Maintenance Support.** Supply education and training for company workers and managers to ensure optimal operation and maintenance of purchased U.S. equipment, and to build demand for more U.S. clean technology products.

Although Center engineers, working directly for the Chamber, will assist companies to understand, evaluate and select specific U.S. technologies, all U.S. vendors supplying information to the program on their products will be given information on companies in the region which are potential customers. Participating U.S. companies can choose to contact Near East companies directly, hire agents in host countries, or use the services of the Center.

Another critically important Center activity is for staff to arrange for pilot demonstrations of U.S. products new to the region. It is important for Near East companies to see the actual use of U.S. products in local companies. These demonstrations will be used to show industry executives in other companies, which may be members of industry consortia, how the products are functioning successfully in actual Near East industrial operating conditions. In return for making their facilities open for inspection and for supplying certain operating information, companies participating in pilot demonstrations will receive the U.S. technology at no cost (i.e., the equipment will either be purchased by the Center or donated by U.S. vendors or under a cost-sharing arrangement with the project). Center staff will also publish case studies in English, Arabic, and French based on pilot demonstrations to promote awareness of Center activities and markets for U.S. products in Near East countries.

The Center will include an exhibition hall to showcase U.S. products for visiting Near East company managers, for special training programs, and for periodic trade shows. The Center will be a repository and distribution source for brochures on U.S. clean technology products, and for direct computer access to the Clean Technology Database maintained in the U.S.

Technical assistance activities should make primary use of local consultants. By developing the pollution prevention skills and expertise of consultants in Near East countries, through direct participation in Center activities, the Center will help develop private sector institutional capabilities for broad pollution prevention implementation, which, in turn, will lead to sustainable development.

During visits to the countries, the EPSINE team spent significant time examining this issue of operation and maintenance of imported equipment, which is considered critical. There is a general widespread belief among people with experience in transferring technology to developing countries that all too often imports do not function efficiently and sometimes not at all. This condition was confirmed by the country visits. There were two specific cases where imported U.S. technology was not functioning. Therefore, the third activity given above, which would provide education and training for Near East company workers and managers is critically essential for the success of the program. The Center must provide technical assistance and training to ensure effective operation and maintenance capabilities in the companies which purchase U.S. products. Center staff, themselves, may require training by U.S. vendors and they will have to have engineering credentials and experience which allow them to know the operating details of many

different technologies. This need is particularly critical for Egypt, where workers often lack the requisite skills to properly maintain the equipment.

Center staff will establish contacts and, as appropriate, assist in establishing satellite offices in other Near East countries to develop markets in them for U.S. products. A satellite office in the French-speaking Maghreb part of the region will probably be the first expansion priority. Morocco and Tunisia offer excellent opportunities; both AID Mission Directors have expressed interest in having the program operate in their countries. The advantage of Morocco is a larger industrial economy, about twice as large as Tunisia.

Personnel for satellite offices will be trained by the Center. The Center will also maintain close links with other clean technology centers, such as those established by UNIDO, and other clean technology demonstration projects, such as those contemplated under AID's forthcoming Environmental Pollution Prevention Project (EP3). Center staff will also monitor government policies and programs in the region which affect interest in U.S. clean technologies.

Center staff will assist Near East firms in using AID Mission programs (e.g., Commodity Import Program), Embassy commercial service programs, and other programs (e.g., Egyptian Credit Guarantee Corporation) which can assist in financing purchases and overcoming other obstacles to using imported U.S. products.

1.6 Implementation Issues

1.6.1 Presentation of Information and Analysis of Other AID/Federal Programs

There are several other AID and federal programs that may have bearing on EPSINE; either by complementing EPSINE activities in a particular region or by collaborating with EPSINE on specific issues. These programs and agencies and their related activities are discussed below.

A. A.I.D. Programs

The **Project in Development and the Environment (PRIDE)** is a five-year effort to provide A.I.D.'s Europe and Near East Bureau and Missions with technical, analytical, and informational support to promote sound environmental and natural resource use for long-term sustainable economic growth in host countries. The key components of this project that directly complement EPSINE, providing public sector awareness and assisting in private sector development, will help promote information dissemination crucial to Near East manufacturers who will directly benefit from U.S. cost-saving clean technology. An important aspect of PRIDE that is key in a complementary aspect is the mandate to establish information systems that identify financing sources for environmental technology as well as promoting trade of U.S. environmental and clean technology goods. While the emphasis on promoting trade of U.S. products is the same, PRIDE has the additional scope

of identifying potential funding sources for Near East buyers, which is essential to ensure the sale of U.S. clean technology products to developing industries in this region.

In addition, the **U.S. Asia Environmental Partnership** (US-AEP) is a serious effort by A.I.D. to advance economic development in conjunction with environmental protection endeavors throughout the region. Although this project does not emphasize specifically the promotion of U.S. clean technology products, it is similar in that its Technology Cooperation component seeks to foster trade activities between Asian and U.S. businesses. This component targets solidifying trade relations and improving the linkages between U.S. and Asian businesses in the area of environmental technology. EPSINE can use the information gathered and analyze the success of this component to apply this knowledge towards implementation of this project. EPSINE can also examine the effect of US-AEP's trade shows, a part of the Technology Cooperation component, in evaluating what its needs will be for the demonstration center in the Near East.

Another component of US-AEP that bears consideration is the Environmental and Energy Infrastructure component. Under this program, demonstrations of U.S. environmental technologies available to Asian countries will play an important role in promoting US-AEP's agenda. US-AEP attempts to ameliorate environmental problems resulting from development by emphasizing export of U.S. environmental products and services appropriate to industry needs in Asia. Evaluation of this component's success can aid EPSINE in the implementation of trade links between U.S. clean technology suppliers and developing private sector industries in the Near East.

The **Environmental Pollution Prevention Project** (EP3) is a world-wide project aimed at reducing environmental pollution resulting from urbanization and industrialization. This project focuses on providing pollution prevention technologies, control techniques, and the financial assistance needed to implement process changes and install cleaner production equipment. EP3 will concentrate on supplying information on pollution prevention through centers as well as services in technical assistance and training.

Though similar in design, EPSINE is primarily devoted to linking U.S. private sector manufacturers of clean technology with Near East industries. However, EPSINE can benefit from EP3's proposed information center on pollution prevention technologies, as well as the funding sources the project has identified.

GREENCOM, an environmental education and communications project, is designed to disseminate information on environmental issues throughout the developing world. GREENCOM's focus will be on the priorities of individual host countries, not on specific technology. In respect to EPSINE, GREENCOM could reinforce environmental awareness in Egypt, for example, through its proposed Center for Information Exchange which will be a conduit for environmental technological innovations.

Other similar AID projects include the **Environmental Policy and Training Project** (EPAT), which also provides environmental information and dissemination that can be used by EPSINE in identifying industries and markets.

Regarding the need for funding sales of American environmental technology between the U.S. and other world markets, **A.I.D.'s Private Sector Revolving Funds** (AID/PSRF) provides loans or guarantees for projects in developing countries. The projects that meet PSRF requirements will have developmental impacts and promote environmental development, earn foreign exchange, produce employment, develop local skills and transfer technology. EPSINE's project goals fit the requirement of the PSRF and could be used as a potential funding mechanism or assist by guaranteeing loans.

B. U.S. Government Agencies

The **Environmental Protection Agency** (EPA) recently developed the **Pollution Prevention Information Clearinghouse** (PPIC), a program that is dedicated to reducing industrial pollutants through technology transfer, education and public awareness. PPIC is designed to be a source of environmental information on pollution programs, provision of documents, and information concerning upcoming events and funding opportunities. This information can be accessed by personal computers to reach databases, by telephone, in the hard-copy reference library or information packages. EPSINE can tap into the databases and use information on pollution prevention technology to identify appropriate technologies.

In addition to using this data link, EPSINE can also access the **International Cleaner Production Information Clearinghouse** (ICPIC) through PPIC. This program is the United Nation's computerized information exchange system of the United Nations Environmental Program's Industry and Environmental Office (UNEP/IEO). The ICPIC also provides pollution prevention data on specific industries, descriptions of cleaner production processes, and summaries of research in environmental technologies. Again, these databanks should provide EPSINE with valuable information regarding new technologies and application in the pollution prevention field.

The **Export-Import Bank (EXIMBANK)** of the U.S., an independent government agency, has reason to be considered in this analysis of federal programs given its key mandate. The Bank's mission is to assist foreign buyers in the purchase of U.S. goods through financial support. The Bank facilitates support by providing direct loans to those foreign entities interested in purchasing U.S. materials, and also through encouragement of funding and risk protection by U.S. banks of the suppliers. The **Department of Commerce (DOC)** has a mandate to facilitate trade between U.S. manufactures and suppliers and potential buyers. The department's aim to foster global U.S. trade relations complements the EPSINE goal of linking U.S. suppliers of clean technology with Near East industries. Additional funding sources such as the **Overseas Private Insurance Corporation (OPIC)** also advance the goal of EPSINE by providing U.S. producers insurance on their

investment into new markets and trade relations and arranging direct loans for foreign entities interested in purchase of U.S. goods.

The **U.S. Trade Representative (USTR)** is responsible for trade negotiations and trade policy. The USTR deals with GATT (General Agreement on Trade and Tariffs) issues, trade and commodity issues relating to Organization for Economic Cooperation and Development (OECD) activities, East-West trade negotiations and the UN Conference on Trade and Development. Other primary concerns are investment incentives and disincentives, as well as bilateral investment barriers. Although the USTR does not focus specifically on issues related to the environment, it is involved in the environmentally-related trade negotiations. With its mission to ensure fair trade practices for all U.S. business activities world-wide, EPSINE can benefit from USTR's knowledge and practices relating to trade.

The following table identifies the key A.I.D. projects and other government agency programs that are related to EPSINE.

Table 1.2

Complementary A.I.D. Programs and Agencies

	Funding/ Loan Guarantees	Database/ Tech Transfer	Trade Links	Demonstrations Tech Centers	Private Sector Development
EP3	■	■		■	
EPAT		■		■	
PRIDE			■		■
US-AEP			■	■	■
GREENCOM		■			
PSRF	■				
EXIMBANK	■				
DoC		■	■		■
OPIC	■				
USTR			■		

1.6.2 Near Term Implementation

This project finds it feasible and appropriate for the AID Near East Bureau attempt to initiate implementation at a pilot demonstration level of funding as soon as possible and for a duration of two years. There are three main reasons for recommending this strategy:

- First, it is imperative that U.S. companies get a foothold in the region, as soon as possible. If they fail to do so, other competing countries are likely to gain a competitive advantage in the region which will be difficult to overcome.

- Second, a two-year pilot program will provide a cost-effective means to test the basic concepts and operating principles of the program and to refine and optimize the program prior to full-scale implementation and funding.

- Third, because of the rapidly emerging environmental programs in the region, it is important to stimulate interest in clean technology alternatives to pollution control investments before the latter preempts interest in clean technology.

For such a two-year program, it is recommended that no more than three types of American clean technology products be used in the program. These should be low cost products applicable to a broad range of industries. For example, potential inexpensive products could include:

- New nozzles for painting and coating operations which greatly reduce raw material use and waste generation;

- filter systems to extend the life of oils used in machinery;

- chemical solvent recovery and recycling units; and

- water purification units which recover heavy metals and produce reusable water.

It is deemed feasible to establish the basic organizational structure and affiliation with the Chamber at about 25 percent of the full implementation level. In other words, if full implementation during the first several years of operation was estimated to require approximately $2 million a year, for example, which seems reasonable, then the two-year pilot demonstration program would be funded at no less than $1,000,000. Naturally, the reduced level of funding means that some activities discussed above would not be implemented (e.g., exhibition hall) or would be implemented at a significantly reduced level (e.g., database).

2. ECONOMIC PROFILE AND MARKET POTENTIAL IN THE NEAR EAST

2.1 Introduction

In order to determine the most appropriate country for the location of the EPSINE Center, there are various factors that need to be examined. These include the current economic conditions in the country, existence of relevant programs, size of the industrial base, level of interest in the Center expressed by AID Mission officials, and relative ease of entry by U.S. firms into the Near East markets. The purpose of this section is to provide an economic/industrial profile of Egypt, Jordan, Tunisia and Morocco. The section will also approximate the potential size of the pollution prevention equipment market.

2.2 Egypt: Economic Profile

2.2.1 Background

Egypt, a country of 56 million people, occupies about 386,000 square miles. Its population growth rate ranges from 2.7 to 3 percent.(U.S. Department of Commerce, Foreign Economic Trends, Egypt, 1991). Egypt is a service-oriented economy, with services accounting for about 53 percent of Gross Domestic Product (GDP). Agriculture and industry account for 17 percent and 29 percent of GDP respectively. (See Table 1.1 in Section 1.5)

The Egyptian economy has traditionally been controlled by the public sector. In the 1950s, major industries such as banking, insurance, transport, major trading, mining, and agriculture were nationalized by President Nasser. Over the next 20 years, valuable national assets were built up, particularly the iron, steel, and other heavy industries. However, economic growth was sluggish, and wars with Israel depleted currency reserves. There was also little domestic demand to stimulate the economy.

In 1974 President Anwar Sadat tried to reverse the centralized economic policies of Nasser, and instituted the *Infitah* or the open door policy, encouraging both domestic and foreign private investment. In the latter part of the 1970s, GDP grew in the magnitude of nine percent per year. (The Economist Intelligence Unit, Country Profile, Egypt 1991-1992). A closer look revealed, however, that much of the growth was fuelled by oil sales, Suez Canal tolls, tourism receipts, and workers' remittances rather than by increased growth in the agricultural and industrial sectors.

In the 1980s, President Mubarak debated the merits of public versus private investment, but he ended up following the same "mixed economy" policies as Anwar Sadat i.e., keeping the heavy and basic industries under state control while allowing the light industries to privatize. In 1982, he introduced a new investment law which gave Egyptian private investors most of the privileges of foreign investors. The dominance of the public sector was reflected in the 1982/83-1986/87 plan which allocated 76.5 percent of planned

investment to the public sector. Although this sector continues to dominate the economy, in the next five-year 1987/88-1991/92 plan, its allocation dropped to 62 percent.

2.2.2 Current Economic Situation

In 1991 and 1992, the Egyptian economy suffered from sluggish growth, inflation, unemployment, and foreign debt. The Gulf War exacerbated these problems. The economic problems experienced by Egypt were largely caused by the public sector-oriented policies described above that have impeded productivity and efficiency. Extensive state ownership in the industrial sector burdened the economy with a wide variety of inefficient and over-staffed enterprises. Further, large subsidies and economic controls, originally designed to protect the public sector from competition, have encouraged waste, distorted resource flows, and stifled productive incentives. The following economic indicators delineate the economic problems Egypt has had recently.

In terms of output, official data indicate that GDP in constant prices rose in 1988 and 1989 moving from £E 58.7 (approximately $17.7 billion) billion in FY1987/88 to £E 84 billion (approximately $25.3 billion)[1] in FY1989/90. The Department of Commerce, however, believes that based on market soundings and sectoral information, total output rose very little in those years. The economy slowed in fiscal year 1990 with the impact of the Gulf crises and fell further in the first part of fiscal year 1991.

Inflation seems to have gone down. The index of Egypt's statistical agency (CAPMAS) which gives an indication of inflationary conditions, increased 7.2 percent in 1990 as compared with 28.5 percent in 1989. (U.S. Department of Commerce, Foreign Economic Trends, Egypt, 1991). However, it should be noted that the slowdown in prices did not stem from fundamental causes, but from changes in the extent in the way inflation has been suppressed by price controls, more subsidies, and restraint of the exchange rate.

Egypt's balance of payments improved in 1990 after its current account deficit narrowed after a considerable deterioration in FY 1989. This improvement was due partly to the 52 percent increase in government transfers (aid) and an amelioration in Egypt's trade balance. Both of these factors helped offset the negative impact of a 50 percent increase in interest payments. Finally, tourism and Suez Canal receipts rose strongly, but growth in workers remittances remained modest.

The Gulf War created many economic problems. One of the main after shocks of the Gulf War was the reduction of foreign exchange earnings. This was attributed to a variety of factors. Firstly, transfers of about $550 million annually from 500,000 Egyptian workers in Iraq and $400-$600 million from the 185,000 Egyptians working in Kuwait immediately ceased. (The Economist Intelligence Unit, Country Profile, Egypt, 1991-1992).

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[1] Based on £E3.31/dollar

In addition, due to concerns over security, tourism earnings fell sharply. Earnings from this sector, the second largest source of foreign exchange, went down by $1.25 billion through the end of 1991. This was a substantial loss considering that tourism is one of the largest sources of foreign exchange earnings, drawing an estimated $2.5 billion in 1990. (U.S. Department of Commerce, Foreign Economic Trends, Egypt, 1991) Income from Suez Canal operations, a chief source of government revenue, dropped somewhat due to reduced international trade and higher shipping insurance premiums.

By the end of 1991, foreign exchange losses reached approximately $2.5 billion. The income losses have sent a ripple effect throughout the economy, depressing consumer demand, output, and government revenues. It is expected that many Egyptians will be able to return to their old jobs in Kuwait, but remittances from that source will likely remain depressed.

Finally, the mounting national debt has probably been one of the major economic problems Egypt has had to face this decade. Its rise has been attributed to many factors. The direct and indirect effects of rapidly falling oil prices, resulting in a substantial loss of foreign exchange, coupled with the need to maintain adequate levels of investment in wealth generating activities so as to avoid cuts in living standards liable to cause social unrest and political instability, made it necessary for the Government to resort to foreign loans and credits to finance even the most essential requirements. As a result, the total foreign debt, excluding IMF credit, increased from an estimated $21.2 billion in 1981 to nearly $40 billion in 1985 and over $55 billion in 1990. Thus by 1990, the debt/GNP ratio stood roughly at 163 percent, and the debt/export ratio was about 678 percent. (Annual Report on Economic Conditions in Egypt, 1992).

The Government has recognized the burden of the debt problem, and in late 1984, they began deliberations on the underlying causes of this problem and initiated a number of minor austerity measures. Finally, in 1986, following a further decline in the price of oil, severe macroeconomic imbalances and an increase in debt service arrears, the Government opened discussions with the IMF for a stand-by agreement and with the Paris Club for debt rescheduling.

Egypt negotiated an 18-month stand-by agreement with the IMF, which covered the period April 1987 to October 1988. By early 1987, Egypt rescheduled $7 billion in arrears and maturities due to Paris Club creditors in 1987-1988. The stand-by agreement called for a number of economic reforms including initial actions to devalue the currency, minor increases in interest rates and budget deficit reduction, primarily through partial price corrections to reduce subsidies. By the end of 1987, the inadequacy of the Egyptian reforms became clear as the country missed IMF performance targets and key macroeconomic indicators continued to show signs of deterioration. Negotiations began in early 1988 for a new stand-by arrangement. After the first review in December 1991, the IMF Board finally approved continuation of the stand-by agreement and modified targets for the remainder of the program.

In 1990 and 1991, the government took important measures to correct macroeconomic imbalances and re-orient the economy towards market mechanisms and the private sector.

2.2.3 Economic Outlook

Clearly, Egypt's economic performance in the last two years has been weak. But its economic outlook hinges on its success in implementing essential reform measures, and the international community is poised to give it the support it needs. In addition to the stabilization program reached by the IMF, the World Bank approved a $300 million policy-conditioned Structural Adjustment Loan (SAL) in June 1991. The U.S. government, through its AID program in Egypt, will soon release $115 which the U.S. Congress has designated to be used in support of economic reform. (Annual Report on Economic Conditions in Egypt, 1992). International creditors are sympathetic to Egypt's plight, and have agreed that upon conclusion of the IMF agreement, they would meet in the Paris Club to engage in a comprehensive restructuring of Egypt's debt to help ensure medium-term balance-of-payments viability.

Meanwhile, the government has tried to address the underlying causes of inflation and foreign exchange shortage, while unwinding the measures that have attempted to suppress the symptoms of these problems in the past. The accelerated depreciation of the Egyptian pound will raise import prices, and the government will need to undertake new tax measures and additional subsidy cuts to reduce its budget deficit.

Egypt's experience suggests that a higher standard of living cannot be sustained through high government spending, guaranteed employment, subsidies, and price controls. Only a more efficient, productive, and growing economy can generate better paying jobs, and a higher standard of living on a sustainable basis.

Thus, Egypt has a long way to go in its path of economic reform. However, the accomplishments of the past year suggest that <u>fundamental re-orientation can be achieved and the corner may be turned toward prosperity</u>.

2.2.4 Sector Profiles

Due to its urbanized population, well-educated by regional standards, Egypt turned at an early date to industrialization. In the 1970s and 1980s, industrial production grew at an annual rate of 10 percent and more, but slowed down after 1983, growing by some seven percent a year between 1981/82 to 8.2 percent in 1986/87. During the current five-year plan, industry is expected to grow by 7.2 percent. (The Economist Intelligence Unit, Country Profile, Egypt, 1991-1992)

Rise of Islamic Fundamentalism

One of the more disturbing developments that bears mentioning has been the rise of Islamic fundamentalism. On May 4 of this year, 13 Christians were massacred by Islamic extremists. Despite the tighter security, renewed violence has continued, and the government's worst nightmare was realized when a tourist bus was recently bombed at Karnak temple. Although the bombing attempt failed and no one was hurt, these attacks highlighted the vulnerability of one of the country's major foreign exchange earners. Tourism in Egypt is dependent on the perceptions of the country's civil stability.

The government has taken serious steps to combat the rise of fundamentalism. A series of amendments have been taken, including the Penal Code, criminal procedures, secret accounts, and the law of arms and ammunition. The new legislation introduces the death penalty for membership in terrorist organizations and empowers the security authorities to detain a suspect for three days.

It is clear that the rise of Islamic fundamentalism violence has had discernable impact on tourism. On an optimistic note, it can be hoped that with the stern response from the government will contain the advent of fundamentalism in Egypt.

In Egypt, industry has traditionally been broken down into public and private sector enterprises. Public sector enterprises include heavy and basic industries including textiles, food, electrical appliances, metals manufacturing, pharmaceuticals, and mining. Private sector enterprises focus on light industries such as food processing, beverages and confectionery, hotel management, and other small-and-medium industries.

The textile sector has been Egypt's major industry, employing about 50 percent of the industrial workforce. Within this sector, high-growth areas are spinning and weaving which grew by 62 percent between 1981 and 1987, and ready-made items such as blankets and knitwear which rose by around 100 percent between 1982 and 1987. The new cities in Egypt are home to a number of thriving enterprises producing and exporting garments, leather goods, and cosmetics.

The arms industry, technologically one of the most developed industries in the region, is also the fastest growing and liveliest industry in Egypt. As a leading partner in the Arab Organization for Industrialization (AOI), set up in 1975, Egypt has four out of the nine factories of the AOI, in addition to a highly trained workforce. The second branch of the Egyptian arms industry, National Organization for Military Production, has 17 major plants which turn their spare capacity to the production of a range of items from water pumps to sewing machines, TV sets, and videos.

Finally another growing sector of Egyptian industry has been vehicles. Over the past decade, Egypt has been assembling cars and trucks through joint venture companies such as General Motors Egypt and Suzuki Egypt. These joint ventures companies have also

been producing tractors and buses to meet the growing needs of the domestic market. The production of both rose by almost 25 percent between 1981 and 1987.

Table 2.1. indicates production trends in major industries from 1985-1990

Table 2.1: Industrial Production in Egypt

Industrial production ('000 tons unless otherwise indicated)					
	1985/86	1986/87	1987/88	1988/89	1989/90
Cotton yard	225	251	249	289	297
Silk & artificial fibres	28	36	34	33	38
Cars (units)	19,243	17,939	19,358	11,092	15,684
Buses (units)	763	968	1,136	1,406	2,250
Trucks (units)	3,345	2,580	1,745	1,475	1,510
Washing machines ('000)	194	178	248	297	349
Refrigerators ('000)	536	601	693	662	704
Aluminium	179	179	179	181	181
Cement	7,612	8,762	9,794	13,635	15,300
Phosphates	...	...	...	780	947
Phosphatic fertilizers	934	957	986	1,372	1,509
Nitrogenous fertilizers	4,482	4,282	4,387	4,525	4,977
Soap	275	302	292	373	410
Source: Central Bank of Egypt, Annual Reports					

Agriculture deserves an important place in the Egyptian economy because it accounts for about 17 percent of GDP. Furthermore, this sector has been on the forefront of President Mubarak's drive for economic reform. Over the past five years, controls and constraints over this sector have been dramatically reduced, and their effects are beginning to be felt. In 1990, for example, agricultural output rose by eight percent as farmers took advantage of new incentives with wheat and rice production totalling 3.1 million tons each. (Annual Report on Economic Conditions in Egypt, 1992). Agriculture is a growing sector of the economy, and the government is committed to improving productivity by increasing the land available for production, instituting agrarian reform laws, and creating incentives for farmers to improve and increase productivity.

2.2.5 Estimates of Industrial Base

The sector profiles described above give a general background of the agro-industrial base in Egypt. For the purposes of the report, the task at hand is to determine both the type of industries most relevant to EPSINE activities as well as estimates of the number of industries which will be receptive to the purchases of pollution prevention equipment. Research has indicated that one of the major threats to Egypt's environment is the pollution of its waters resulting from industrial discharges. The EPSINE team field visit indicated that the biggest polluting industries were the petrochemical and mining and extracting industries.

In order to determine the approximate industrial base, i.e., the number of firms within the most relevant industries for EPSINE activities, we can use a variety of estimates. The Egyptian Ministry of Industry maintains a listing of all public and private firms registered to do business in Egypt. This listing currently contains about 18,000 firms, of which approximately 85 percent have ten or fewer employees. When one applies the dual criteria of firms with 20 or more employees and a listed capitalization of £E 1,000,000 ($302,114.8)[2] or more, one derives a list of approximately 830 firms.

USAID has developed its own listing of sizable firms in the magnitude of 727, including 383 state-owned, 250 public joint-venture, and 94 under establishment. This listing does not include private firms. If one were to add the privately-held firms with the same criteria (20+ employees and a minimum of £E 1,000,000 ($302,114.8)[3] in capital), the AID list would approximate the Ministry of Industry listing of the 830 firms.

Finally, Fiani & Partners of Cairo, Egypt publishes a directory of companies and institutions registered to do business in Egypt. The directory is broken into a wide range of industrial and service sectors. The sectors most relevant to EPSINE including the ones mentioned above are: agriculture, mining & quarrying, oil, food, paper, carton & packaging, chemicals and plastics, metallurgical, leather, wood, textiles, pharmaceuticals & cosmetics, building materials and refractories, and electric and electrical industries.

A review of the Fiani & Partners directory covering the above mentioned industrial sectors and using the criteria of firms with a listed capitalization of £E 1,000,000 or more, resulted in an approximate total of 685 firms being derived from a listing of 1897 firms in the aforementioned sectors. These figures do not reflect the oil sector, wherein the 200 listed firms are mainly service companies which do not manufacture any product. The Fiani data is good, but some of the firms listed which appear to meet the capitalization level selected for the purpose of this analysis do not list their capitalization and were therefore

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[2] Based on £E3.31/dollar

[3] See Footnote 2

not counted among the 685 firms. It appears that at least 50 firms could be added to the list, giving a base of 745 firms.

Whichever data is used, it is apparent that there are between **700 to 900** Egyptian firms which could benefit from clean technology products and services available under the EPSINE project.

2.2.6 Policy and Institutional Factors

There are several policy and institutional factors which the Government has also been committed to in order to accompany its program of economic reform. Some of these changes have direct bearing on the activities of the EPSINE center.

The most important reform has been an increased commitment to privatization. As explained previously, the heart of many of Egypt's economic problems has been the domination of the industrial economy by public sector enterprises. The public sector has placed heavy burdens on the budget, and consequently, through its failure to service much of its debt, on the banking system. The benefits of a heavy public sector orientation such as low prices on consumer goods or guaranteed employment have been purchased at a huge cost to overall productivity and living standards. The World Bank and the Egyptian government have agreed on a reform program. The government has drafted a new public sector company law to give firms more autonomy and make managers accountable for efficient and profitable operations.

Of particular importance is the government's efforts in pricing reform which involves a staged de-control of public sector prices and removal of subsidies over an agreed time period. Thus, in the energy sector, electricity and petroleum prices are to be increased on a steady path to reach economic prices by June 1995; and in the agricultural sector, prices to cotton farmers will be increased to provide incentives for cotton production. Subsidies are also to be reduced on pesticides, fertilizer, and livestock feeds. Transportation tariffs are going to be increased to cover operating costs by the mid-1990s.

Another policy reform the government has been involved in is liberalization of trade regulations. Trade liberalization was one of the main features of the open door policy or *Infitah* instituted in 1974. However, this resulted in a cumbersome customs regime which determined the priority of the goods to be imported. In 1986, this was streamlined and imports were divided into four categories: prohibited, luxury, regular, and necessary, and the number of tariffs was reduced from 43 to 10. In January, 1990, the protected product list was cut from 300 to 200 items. A 100 per cent duty rate imposed on these items was removed. Currently, further cuts are promised along with tariff rationalization as constraints on imports and exports are gradually phased out.

There has also been an easing of investment regulations. In 1989, a new law aimed at boosting foreign investment came into effect. Under the law, the General Authority for

Investment and Free Zones (GAIFZ) is given sole responsibility for approval and oversight of projects and must announce its decision on any new application within 20 days. This law removes discrimination between Egyptian and foreign investors, improves tax exemptions, grants all investors the right to buy land and property necessary for their projects, and forbids the nationalization or confiscation of investment projects without judicial procedures. It also clears the way for debt-equity swaps by enabling foreign creditors to settle their debts in the form of a local denominated currency.

These trends are all positive developments as privatization, removal of subsidies, and trade liberalization provide the **profit motive** for local industries to use clean technologies.

Another important institutional reform has been the establishment of environmental action plans, institutions, and legislation. In May, 1992, Egypt presented its **Environmental Action Plan** to a conference of donors assembled by the World Bank who had assisted in the production of the report. Aiming to strengthen the management of the country's environmental affairs, the report focuses on actions necessary for a more efficient use of natural resources, particularly land and water, and to halt the degradation of Egypt's heritage and urban environment. The main thrust of the report is to improve incentives for the proper management of the environment through appropriate pricing of inputs to encourage conservation and recycling. Often this means that enterprises need to operate on a more efficient and profit-oriented basis so that sufficient revenues are generated to finance environmentally-sound practices. The plan envisages required investments of $300-$500 million in the initial five-year phase, in addition to investments in drainage, water, and sewage programmes by the World Bank and USAID. In addition, the plan calls for greater emphasis on education and training for the strengthening of Egypt's environmental institutions.

One of the recommendations of the report is to give greater power for regulation and enforcement to the central **Egyptian Environmental Affairs Agency (EEAA).** The Environmental Protection Law, a draft of which is currently before the Parliament, would give the EEAA increased powers and duties. Some of the powers and duties include:

- Inspection and enforcement of the law; and
- responsibility for Environmental Impact Assessments required for future investment projects ensuring that requirements are laid down and respected.

This represents a significant strengthening for the EEAA, and it reflects the government's determination to give environmental protection more serious attention than in the past. This has been re-enforced by the recruitment of significant numbers of additional staff for the EEAA.

2.2.7 Current Activities in Egypt Relevant to EPSINE

USAID has been actively involved in Egypt since 1975. The AID assistance has supported both the broad economic goals of the Egyptian Government and specific development programs to build a stronger economy.

> One of the most prominent pieces of environmental legislation in Egypt has been Law 48. This law, which addresses the protection of the Nile River and related waterways from pollution, was enacted in 1982. However, it is yet to be enforced, because of unrealistic phasing of discharge reductions in meeting the standards. To enable enforcement in the near future, temporary permits incorporating realistic phasing of reductions and penalties for discharge of pollutants need to be considered.

During the field trip to Egypt, both A.I.D. representatives and EPSINE team members discussed relevant programs in Egypt which may be able to cooperate with EPSINE. Although specific areas of collaboration were not outlined, these projects are mentioned because they will be able to help various EPSINE activities once the project is implemented.

The most important program is the Commodity Import Program (CIP). This program, worth about $200 million per year, provides credit and foreign exchange to the Egyptian public and private sectors to finance imports from the U.S.

The Small & Micro Enterprise Project (SMEP) was designed in 1988. The project design called for the establishment of two non-profit groups which operate under the Ministry of Social Affairs. The purpose of the project is to provide credit, technical assistance, and training to small (6 to 15 employees and up to £E 7000 [$2114.8, based on £E 3.31/US$] capitalization) and micro (1 to 5 employees and up to £E 3,000 [$906.34 based on £E 3.31/US$] in capitalization) in the Cairo and Alexandria areas.

The third program the EPSINE team looked at was the Credit Guarantee Corporation. This was founded by nine local banks and one insurance company. Since its inception, another four local banks have joined the consortium. The CGC will guarantee up to 50 percent of a loan when it determines the borrower has a reasonable business plan and potential for repaying the loan. Loans range from £E 20,000 ($6042.3 based on £E 3.31/dollars) to a maximum of £E 1.5 million (approx. US$ .45 million based on £E 3.31/dollar), with the average loan running to about £E 50,000 (US$ 15,105 based on £E 3.31/dollar). To date, there have been 500 guarantees with no defaults. Loan funds are made over a broad spectrum of industries in the private sector. No loan guarantees are made to public sector or trading companies.

Any of the above three programs can be used to finance the importation of U.S. clean pollution prevention technologies and equipment.

Although it is not an activity, the role of Egypt's universities should not be understated. Egypt has several large universities in both Cairo and Alexandria. These universities serve as reservoirs of talent in sciences and engineering. The EPSINE center would be well served to harness the local expertise from these universities in order to address the issues in pollution prevention as they come up. Some of the key universities include **The University of Ain Shams, The American University of Cairo, The University of Helwan, and The University of Alexandria.** The first three are located in Cairo and the last one is located in Alexandria.

2.3 Jordan: Economic Profile

Jordan is a small country with a population of 3.2 million (Table 1.1). It has a limited natural resource base, and only 10 percent of the total land area, about 9.7 million hectares, is arable. (Economist Intelligence Unit, Country Profile, Jordan, 1991-1992). The effective use of this area is severely restricted by water shortages. Rainfall is low and highly variable, and much of Jordan's available groundwater is non-renewable. Jordan's principal economic resource base has traditionally centered on **rock phosphate, potash,** and their **fertilizer derivatives.** These are the principal sources of hard currency earnings.

2.3.1 Background

Given its limited resources, Jordan has historically been heavily dependent on external inputs. It imports energy supplies (crude oil) from Iraq; manufactured goods and consumer durables from Europe, Japan, and the United States; and cereal grains from the United States. The country has also relied on external sources of income. Fuelled by substantial flows of worker remittances and official grants from the Gulf states during the oil boom years, the economy grew at an unprecedented rate. During 1974-1982, the average real economic growth exceeded 10 percent, real investment more than quadrupled, and real per capital income almost doubled. (Economist Intelligence Unit, Country Profile, Jordan, 1991-1992).

This period enabled Jordan to: Embark on an extensive infrastructural development program; establish capital intensive extractive industries in phosphates, potash, and cement; expand irrigated agriculture in the Jordan Valley; and rapidly expand government services. The high level of external receipts from the 300,000 Jordanians who migrated to the Gulf allowed Jordan to achieve economic growth with a manageable inflation rate and a stable currency.

However, after the mid-1980s, Jordan's economy was adversely affected by the contracting oil economy in the Gulf. With the regional decline in economic activity, demand for Jordan's most valuable export--its skilled workers--fell off dramatically. For example, worker remittances, a main source of foreign exchange for the Jordanian economy, dropped from $1.1 billion in 1982 to about $623 million in 1989. (Economist Intelligence Unit, Country Profile, Jordan, 1991-1992). Furthermore, Arab grant assistance fell off, reaching an estimated $350-$400 million in 1989 compared to $1.2 billion in 1981. The government failed to adjust to the drop in external revenues, and government expenditures continued to rise as the country opted to move forward with costly infrastructural development projects. The government also increased its military spending while the country's trade balance deteriorated as the country failed to reduce demand for its imports. In order to finance the deficits in its balance of payments and budget, the government was forced to borrow both domestically and abroad.

The results of this economic downturn were disastrous. As the government started to look abroad to finance its balance of payments deficits, its foreign debt burgeoned to $8.3 billion at the end of 1988. (The Economist Intelligence Unit, Country Profile, Jordan, 1991-1992). In addition, the country's foreign exchange reserves dwindled, causing the Central Bank of Jordan (CBJ) to impose foreign exchange controls by putting a one-year ban on the importation of automobiles, electronic goods and appliances, and other luxury consumer items. This caused a severe disruption in the business community as importers encountered difficulties in opening letters of credit.

By this time, the overvalued Jordanian dinar came under increasing pressure. The government floated the currency in October 1988, causing a sharp depreciation in its value. From an exchange rate of $2.66 to the dinar in 1988, the dinar plummeted to an average of $1.74 in 1989, and by 1990, it had sunk to $1.5. (Economist Intelligence Unit, Country Profile, Jordan, 1991-1992).

The final casualty of the economic downturn was Jordan's budget. In 1989, the budget deficit stood at 15 percent of GDP, excluding grants. The deficit put pressure on the government to cut subsidies and de-control prices on basic commodities. In April, 1989, the government increased prices on fuels, beverages, cigarettes, telephone, electricity and vehicle registration fees. It should be noted that the price hikes triggered rioting in the economically depressed southern regions in the country.

The economic discontent experienced by Jordan helped stage the first moves toward democratization. On November 8, 1989, the Kingdom held its first general parliamentary election in 22 years, and by December, the government implemented sweeping political reforms, including removing regulations against the press, lifting martial law, and reducing the power of domestic security forces. The government's experiment in political liberalization, however, has done little to alleviate Jordan's serious debt problem--the greatest single threat to Jordan's economic stability--in addition to its mounting water resource and population problems.

2.3.2 Current Economic Situation

Jordan is faced with three severe economic problems. These are: A massive foreign debt and accompanying macroeconomic problems, a severe water shortage, and an excessively high population growth rate. Jordan's future economic growth hinges on its ability to effectively combat these problems.

Jordan has taken positive steps to confront its debt burden. In 1989, it opened negotiations with the IMF to reschedule its foreign debt of $8.3 billion. Terms of repayment on official debt were finalized in a Paris Club accord which provided for rescheduling of $573 million in debt payments between July 1, 1989 and December 31, 1990. Payments were scheduled over a 10-year period, with a five-year grace period. (Economist Intelligence Unit, Country Profile, Jordan, 1991-1992).

The balance of payments situation has improved as imports have been contracting in such product categories as vehicles and spare parts, cereals, machinery, and electricals. However, many of these products are supplied by U.S. firms who have been seeing their exports to Jordan decreasing. The dinar has been stabilizing at around $1.50/dinar due to the intervention of the CBJ. Finally, the government has moved to control spending and enhance its revenue base by increasing personal income taxes, corporate income taxes, and consumption taxes.

The second problem facing Jordan is the scarcity and mis-allocation of water which has created the country's most severe environmental problem. There are several causes to this. Primarily, there is an inadequate supply of water to meet the country's demand. Presently, this deficit is being met by over pumping aquifers. It is estimated that major aquifers will prove to be inadequate in the next 5 to 10 years. When water is available, it is viewed as a semi-free good by many users which leads to its overuse.[4] Again, unless water is economically rationalized, there will not be enough to go around in the next few years. Finally, a good deal of Jordan's water is shared with Israel and Syria. Thus, the country needs to approach the rationalization of use and pricing policies in coordination with the practices of neighboring countries.

The third challenge confronting Jordan is its population problem. Currently, Jordan faces the tremendous burden of having one of the highest population growth rates in the world. Jordan's population grew at an annual rate of 4.3 percent during the 1960s, 1970s, and early 1980s. Although 1990 showed a declining trend in fertility from 7.7 children per woman in 1976 to 5.6 in 1990, population continues to grow at an annual rate of 3.4 percent. At this rate, the population will increase to 6,000,000 by the year 2000 and will double in 20 years. (U.S. Agency for International Development, USAID in Jordan, 1992). Like the water problem discussed above, Jordan's population explosion is a potential economic time bomb. The country cannot afford to keep its current level of social services nor expand its infrastructure in keeping with the current rate of population growth.

2.3.3 Economic Outlook

Given Jordan's economic performance in the last few years, the economic outlook for the country is mixed. On one hand, the economy is expected to grow at 2.5 percent in 1992. There are many signs to be optimistic about this modest growth. The 300,000 returnees from Kuwait will be expected to repatriate their savings back into Jordan. If IMF structural adjustment measures are successful, a real GDP growth rate of 3.5 percent is projected for 1993, and the trade deficit is expected to subside from its massive level in 1991 of JD 1.4 billion (approximately $2.07 billion based on US$1.482/JD) to a projected JD 812 million (approximately $1.2 billion based on US$1.482/JD). Finally, a realistic

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[4] Ideally water should be treated like a market commodity by those demanding the right quality and quantity of water to be delivered at the right time by the suppliers.

exchange rate combined with economic incentives should encourage exports. (Economist Intelligence Unit, Country Profile, Jordan, 1991-1992).

Impact of the Gulf Crises

The effects of the Gulf Crises inflicted severe harm on the Jordanian economy that it was ill-equipped to cope. The international economic embargo against Iraq meant that Jordan lost a lucrative export and re-export market. This inflicted damage on the Kingdom's manufacturing sector, which had grown heavily dependent on the Iraqi market. The loss of the re-export trade and the reluctance of shipping lines to use the port at Aqaba meant that the economic activity of the port was greatly curtailed. The direct impact of the loss of the Iraqi market in turn damaged the Jordanian transport sector and those services, such as insurance, closely associated with it. The loss of Iraq as the main source of the Kingdom's oil supplies, together with Saudi Arabia's decision to close the Tapline, resulted in Jordan having to pay the market price for oil imports from Syria and Yemen and higher bills for transportation. Saudi Arabia also greatly restricted economic relations with Jordan. Jordanian farmers were deprived of both the Saudi market and effective access to Gulf markets beyond. The political difficulties between Jordan and the states comprising the Gulf Cooperation Council (GCC) had a major impact on regional tourism to the kingdom. The balance of aid transfers, amounting to some $200 million, promised by the Arab oil states at the Baghdad summit in May 1990 and due to arrive in Jordan in the second half of 1990 failed to materialize. The influx of 300,000 Jordanian nationals from Kuwait, resulting from the Iraqi invasion, imposed a tremendous strain on government services, as well as adding to the pool of unemployment. The crises in the Gulf has had a major effect upon remittances; the high number of permanent returnees means that remittances will be depressed indefinitely.

However, the three major problems of massive foreign debt, water shortage, and population growth will continue to plague the Jordanian economy in the next few years and erode any positive growth unless serious policy changes are made to address these issues.

Table 2.2 gives a forecast summary of major economic indicators for the upcoming year.

2.3.4 Industrial Profile of Jordan

Jordan has a varied industrial base consisting of both heavy and light industries. The heavy industries, based on natural resources, include mining and quarrying. The light industries, consist of industrial products such as textiles, pharmaceuticals, perfumes, and cosmetics. The following paragraphs give a more detailed profile of these sectors.

The mining and quarrying sector comprises approximately seven percent of Jordan's GDP. Its main components include phosphate and potash, and their fertilizer derivatives, cement, and petroleum products. Phosphate mining is a good example of how Jordan has made the most of its limited resources. In the world market, after a number of years of

depressed or falling prices, the rise of phosphate prices led to a peak in total production of 6.8 million tons in 1987. Potash mining is another lucrative industry for Jordan. Table 2.3 delineates phosphate & potash production trends in Jordan for the period 1985-1990.

Table 2.2
Summary of Economic Indicators in Jordan
($ million, unless otherwise noted)

Forecast Summary	1990	1991	1992	1993
Real GDP growth (%)	-5.6	1.0	2.5	3.5
Consumer price inflation (%)	16.1	8.2	7.0	8.0
Exports, Fob	1,064	1,132	1,350	1,550
Imports, Cif	2,599	2,512	2,600	2,700
Phosphate production (mn tons)	5.7	4.5	5.5	5.7
Current account	-754	-712	-600	-550

Source: Economic Intelligence Unit, Jordan Country Report No. 3, 1992.

Table 2.3

Phosphate and Potash Production in Jordan ('000 tons)						
	1985	**1986**	**1987**	**1988**	**1989**	**1990**
Phosphate	6067.1	6249.2	6845.4	5628.4	6635.6	5748.1
Potash	908.2	1102	1203.2	1298.9	1350.7	1415.1
Source: Central Bank of Jordan, Monthly Statistical Bulletin						

The agriculture, fishing, and forestry sectors are no longer the cornerstone of the economy. The agriculture sector, in particular, is poorly managed by a multitude of corporations with overlapping areas of activity and lack of coordination between the agencies. Crops account for two-thirds of agricultural production, and the main crops are cereals, vegetables, citrus, and olives. Sheep and goats provide a small part of the country's livestock needs, but substantial investments in poultry and egg production will enable the country to achieve self-sufficiency.

The manufacturing sector of Jordan (excluding agriculture and food processing) accounts for about 12.5 percent of Jordan's GDP. (Economist Intelligence Unit, Country Profile, Jordan, 1991-1992). The heartland of the country's manufacturing base is a small belt stretching from Amman to Zarqa primarily along the Zarqa river. Currently, most of the manufacturing sector is comprised of public companies, whose equity is sold on the local stock exchange, and some private limited companies. The government has been very active in trying to improve the general climate for the private sector, with substantial investment in infrastructure over the years. The manufacturing sector consists of light industrial products such as: Leather products; pharmaceuticals; rubber and plastic products; chemicals; cosmetics and perfumes; furniture; paper products; clothing and textiles; printing; and office supplies.

2.3.5 Policy and Institutional Changes

For any economic reform program to be successful, it must be accompanied by complementary policy and institutional reform. Following political liberalization in 1989, the Government of Jordan has made policy and institutional reform a priority.

As in Egypt, the Government has made the privatization of public companies high on the reform agenda. Currently, the Government is preparing to sell its stake in a number of public companies including Royal Jordanian Airlines to private investors. In some companies, private ownership already exceeds 50 percent of a given company like the Arab Pharmaceutical Manufacturing Company which is now 98.5 percent privately-owned.

Another policy reform has been the increasing role of market forces in determining prices. This was already reflected in 1989 when the government increased prices on basic commodities such as fuels, beverages, cigarettes, etc. These measures are going to be unpopular in the short run, but they are necessary if the government is serious about market-based economic reform.

Jordan also is eager to attract foreign investment capital into the country, and the incentives offered to non-Jordanians are very strong. For non-Arab foreign investment, the government has emphasized that foreign firms can establish manufacturing enterprises in the kingdom and retain total ownership. A generous investment law favors this arrangement, and the act was amended for the second time in three years. Currently, incentives are being directed away from the greater Amman area to the "New South".

Finally, foreign companies are being allowed to transfer capital and profits without restriction.

Tariff reform is also being considered, and capital goods, raw materials, and agricultural foodstuffs are now either totally exempt or subject to low rates of duty.

It bears mentioning that one of the most important institutional changes being considered is the development of Jordan's National Environmental Strategy (NES). Jordan had considered developing the NES since 1980 as it joined a group of 30 countries in support of the declaration of the World Conservation Strategy (WCS). The outcome of this declaration was that each country was asked to prepare a national conservation strategy for environmental protection to address the country's specific problems. Consequently, when the Department of Environment was established later in 1980, one of its first goals was to formulate a NES. In June 1988, a steering committee was formed under the chairmanship of the Minister of Municipal, Rural Affairs & the Environment to initiate the strategy process. The committee was charged with the task of drawing up environmental policies, facilitating and reviewing the progress of work, and consulting with the various sectors involved in environmental affairs. By September 1988, an agreement for producing the strategy was signed between the Government of Jordan, represented by the Ministry of Municipal and Rural Affairs and the Environment and the International Union for the Conservation of Nature and Natural Resources (IUCN). The strategy was finally approved on May 2, 1991.

The Jordan NES is more than a set of guidelines and principles. It also contains information on the country's natural and socio-economic environment. The practical objective of the NES is to ensure that the future generations of Jordanians are not burdened with the environmental debt of today's actions in terms of depleted resources, environmental problems, and decline in living standards.

The Jordan NES contains over 400 specific recommendations and suggested actions in the field of environmental protection and conservation. It has been formulated by 180 Jordanian specialists with substantial hands-on experience. Thus it is practical, realistic, comprehensive, and forward looking. Specifically, it contains four major strategic initiatives to be undertaken:

- Constructing a legal framework for environmental management;
- strengthening institutions;
- expanding the role of Jordan's protected areas; and
- bringing environment to the people.

The outcome of this strategy is an increased commitment from the government to the nation's most pressing environmental problems.

Concurrent with the approval of the NES, has been the strengthening of existing institutions that are working for environmental protection and conservation. The key institutions are:

- **The Department of the Environment.** Its role is to regulate and enforce environmental protection measures. It is anticipated that it can be strengthened by enacting enabling legislation, and by obtaining additional financing within Jordan and from foreign assistance grants to enhance its technical capabilities.

- **The Royal Society for the Conservation of Nature.** The efforts of this institution focus on nature reserves and wildlife protection. It can be strengthened by enhancing its capabilities in planning and management, teacher training, environmental impact assessments, technical libraries, and in-house workshop resources, computerized data bases, and aerial photo interpretation.

2.3.6 Estimates of Industrial Base

The Industrial Guide of Jordan (Industrial Guide of Jordan, 1988) lists over 1,500 firms in sectors such as leather, pharmaceuticals, rubber and plastics, chemicals, cosmetics and perfumes, furniture, paper, textiles and clothing, and packaging and printing. However, among these firms only 90 to 100 are considered to be firms of any significant size as to the number of employees, production, and sales. The other approximate 1,400 firms have fewer than 10 employees and limited sales volumes. This estimate suggests that Jordan has a limited industrial base to support the sale of pollution prevention equipment.

2.4 Tunisia: Economic Profile

Tunisia is the smallest of the countries in Northern Africa. As a part of the Arab Maghreb, it is located between Algeria in the west and Libya in the southeast. Tunisia has a well-watered and fertile northern area which is a source of most of the country's agricultural production, a central coastal plain, and a semi-arid central steppe gradually blending into the Saharas. This latter region accounts for more than one-third of Tunisia, but lacks sufficient rainfall to support more than sparse grazing and semi-nomadic people. Despite its size, Tunisia is a populous country. In mid-1992, it had an estimated population of 8.2 million. (Economist Intelligence Unit, Country Profile, Tunisia, 1992). It is concentrated mainly along the Mediterranean coast from Tunis to Sfax.

Tunisia's modern identity is a mix of Islamic and European cultures. Due to its strategic position along the Mediterranean, the country has been influenced by Romans, Arabs, Ottomans, and the French. Independent Tunisia is outward-looking with a reputation for moderation and tolerance in international relations. Although its economic links are mainly with Europe; culturally, its Maghrebian and Islamic ties remain very strong.

2.4.1 Background

In the 1970s Tunisia experienced a relatively prosperous period due to prudent economic policies, high prices for phosphates and oil, and growing revenues from tourism. The economic growth was based on agriculture, manufacturing, tourism, petroleum, and mining.

The prosperity continued until the mid-1980s. During 1983 to 1985, the average annual growth of GDP was 5.4 percent. However, a sharp decline in agricultural output and tourist arrivals, combined with the collapse of oil prices, led to a contraction in GDP. Since 1985, GDP has grown at an uneven rate. For example, in 1987, GDP grew by 6.7 percent due to good harvests and a boom in tourism. In contrast, the severe drought of 1988 led GDP to grow only by 0.1 percent. The economy picked up in 1989 and 1990, growing at 3.7 percent and 7.6 percent, respectively. However, the ramifications of the Gulf War slowed down the GDP growth to 3.5 percent in 1991. (U.S. Department of Commerce, Key Economic Indicators, Tunisia, 1992).

Due to the world-wide depression following the Gulf War, it was generally agreed that the growth rate in Tunisia depicted the resiliency of the economy. The Department of Commerce estimates that the strong economic performance was propelled mainly by the agricultural sector which grew by 5.3 percent in real terms in 1991 due in large part to record rainfalls. The manufacturing sector, which consists of textiles and electronic assembly operations, contributed 0.7 percentage points to overall GDP growth. Hydrocarbons and phosphate mining are the principal components of the mining sector, which grew by 3.8 percent in 1991. The only sector that suffered during this period was the services sector which contracted by two percent. This was mainly attributed to problems

in the tourist industry as tourist revenues fell by 18 percent as a by-product of the Gulf War. (Economist Intelligence Unit, Country Profile, Tunisia, 1992).

2.4.2 Future Economic Prospects

Tunisia has many reasons to look at the future with optimism. The Economist Intelligence Unit estimates real GDP to grow between 5.5 percent and 6.5 percent in 1992. (Economist Intelligence Unit, Country Profile, Tunisia, 1992) The growth will be propelled by the service and the manufacturing sectors. The service sector has already shown signs of recovery as tourist bookings have returned to pre-Gulf levels. Industrial manufacturing is expected to respond to a strong recovery in domestic demand and projected growth in exports. Growth in the agricultural sector has been strong over the past two years due to record rains following two years of drought. Assuming a return to normal harvests in 1992, this sector is expected to contract slightly.

Other factors which favor Tunisia's economy and growth in the next few years are:

- **Excellent International Credit:**
  The Government of Tunisia has remained high on the list of international creditors and has obtained substantial loans. The World Bank recently approved a $250 million loan over a 17-year period to finance the next phase of its structural adjustment program.[5] In the meantime, the Government is committed to economic reform for the next few years with particular focus on the removal of import controls, privatization of state-owned enterprises, and strengthening of local financial markets.

- **Price Reform Undertaken:**
  In February 1992, the National Economy Minister, Sadok Rabah, announced a new program for price reform. The reform package would see the removal of price controls on 75 percent of all products by the end of 1994. (So far price liberalization has only concentrated on imported goods). Tariff protection is also being scaled down with the long-term objectives of reducing tariffs to an average of 25 percent.

- **Reduction of Current Account Deficit:**
  The picture for the current account deficit looks brighter, and the government hopes for further improvement in 1992. Early forecasts estimate the deficit at $430 million for 1992. (Economist Intelligence Unit, Country Profile, Tunisia, 1992). This assumes a good harvest which would limit large quantities of foreign wheat imports and continue the growth in exports.

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[5] In 1986, the Government of Tunisia initiated a comprehensive reform package. This included a structural adjustment program focussed on increased efficiency of the economy through progressive liberalization of investments, prices, and interest rates as well as promoting the private sector.

Full member in the GATT:

- The Tunisian government has recently become a full member of the General Agreement of Trade and Tariffs (GATT) after 30 years as a provisional member. The Tunisians have also signed a bilateral investment treaty and a double taxation treaty with the U.S. Government. Both these treaties are awaiting ratification. When they are ratified, the latter treaty will protect businesses and individuals that operate in both Tunisia and the U.S. from being taxed doubly. The former treaty will furnish provisions for the arbitration of disputes and guarantees for the repatriation of profits, national treatment, and protection against expropriation.

2.4.3 Sector Profiles

Tunisia has a growing and diverse economic base consisting of agricultural, energy, mining, manufacturing, and service sectors. Although pollution prevention efforts are best suited for the manufacturing sector, it is worthwhile to explore the agricultural and mining sectors as they may offer opportunities for the use of pollution prevention equipment.

The agricultural sector comprises a significant amount of the economy. In 1991, it accounted for 18.1 percent of GDP. (Economist Intelligence Unit, Country Profile, Tunisia, 1992). The importance of the sector, however, comes from the fact that the Government has made it a top priority in the upcoming decade. The current five-year plan from 1992 to 1996 envisages the sector to grow at 1.8 percent annually and encourages the reduction of imports and the expansion of exports. Tunisia's major products are wheat, barley, olive oil, fruits, fish, and meat.

Although mining constitutes a smaller portion of Tunisia's GDP (In 1991, it only accounted for one percent), it is an important sector due to its substantial foreign exchange earnings. Phosphates are one of the most important products, and Tunisia is one of the world's largest producers. A proportion of phosphates is processed locally into superphosphates, phosphoric acid, and phosphate fertilizers. The other main minerals are iron, lead, and zinc. Table 2.4 delineates mineral production from 1986-1991.

Table 2.4
Mineral Production ('000)

	1986	1987	1988	1989	1990	1991*
Phosphates	5,734	6,216	6,026	6,610	6,259	4,500
Iron ore	310	291	326	280	291	225
Lead	3.1	3.4	3.6	2.7	3.6	1.0
Zinc	8.1	10.7	16.3	17.4	13.5	7.2

* January-September.
Source: Banque Centrale de Tunisie, *Statistiques Financières*.

Source: Economist Intelligence Unit, Tunisia, 1992

The manufacturing sector has been growing in importance. In 1991, it contributed 17.3 percent of the GDP at factor cost and generated 69 percent of export earnings. (Economist Intelligence Unit, Country Profile, Tunisia, 1992). It is also one of the high growth sectors, showing a growth rate of 9.3 percent in 1990. Textiles and leather goods are the most promising, valued at $1.34 billion in 1990. A fast growing population has created a strong demand for food and food-based products which has consequently led to an increase in food-based industries. Flour, cheese, and cooking oil have expanded rapidly. The government has made a strong effort to attract investment from the private sector, and this has been reflected by an increased optimism in the business community.

2.4.4 Trade Potential

As a part of its economic liberalization program, the Tunisian government is committed to easing restriction of imports, a process which is now well-advanced. Tunisia's exports often depend on the needs of the manufacturing sector. Hence, textiles as an intermediate input, and machinery satisfying the demand for capital goods are Tunisia's major imports in value terms. In 1992, the Economic Intelligence Unit revealed that Tunisia's major imports consisted of textiles, machinery, petroleum, electrical equipment, vehicles, cereals, plastics, pharmaceutical goods, wood, and scientific equipment. In addition, the Department of Commerce identifies consumer goods and household appliances, spare parts for construction, mining, and transportation equipment, airport equipment, telecommunications, medical equipment, packaging machinery and equipment as the best prospects for American exports. One of the main impediments to trade with Tunisia is the wide preference for the country to trade with its traditional partners like France and Italy. Indeed, the EPSINE team field visit to Tunisia revealed that the most serious obstacle to exporting U.S. clean technologies was the preference for French pollution control equipment and technology. Further, the fact that the U.S. is not a major donor in the country limits its ability to influence this trend.

2.4.5 Policy and Institutional Factors

There are several policy and institutional factors that make Tunisia a promising country in which to locate the EPSINE regional center. The Tunisian government has shown a commitment towards policy reform that will lead to future economic growth. This includes economic restructuring, a commitment towards privatization, a serious look at environmental laws and regulations, and finally, trade policy reform.

As mentioned before, Tunisia has taken economic restructuring very seriously. The government has enjoyed a high regard in the international community. The current World Bank loan of $250 million, mentioned earlier, will further reforms and assist in the removal of fiscal distortions and finance ministry borrowing practices.

With regard to the environment, for the first time environmental regulations are being addressed. The EPSINE team found that there are a significant set of environmental laws and regulations. However, there was also a general acknowledgement that some areas of the environment are not being presently addressed and that regulations often lack specific standards for effective implementation. Air pollution, for example, is not currently addressed. Despite the slow progress, the recent establishment of the Ministry of Environment is a positive development. An environment non-government association called the **Association for the Protection of Nature and Environment** is playing a key role in advancing environmental regulations and in improving government programs and policies.

Finally, although Tunisia has always been trading with its former colonizers, it has been trying to extend its trading network. For example, it recently became a full-fledged member of GATT after 30 years as a provisional member. The government has also made full convertibility of the dinar and the scaling down of tariffs into important goals in the next few years.

2.4.6 Presence of Local Programs and Activities

One of the programs the Team found in Tunisia was the (Regional Institute of Scientific Information and Telecommunications) IRSIT program. Originally funded by the AID Mission, this program has succeeded in transferring U.S. computer and software products to Tunisian industry. This program offers a promising role model for EPSINE and suggests that language and European ties can be overcome when specific measures are used.[6]

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[6] One of the measures undertaken by IRSIT included using U.S.-educated Tunisians to implement the program.

Another program that may be of use to EPSINE is the new privatization project. USAID has agreed to lend $3 million for a pilot project aimed at encouraging private investors to buy small shareholdings in privatized companies. The loan will guarantee 50 percent of all local banks' loans to small shareholders who want to borrow in order to buy shares. Even if this project does not specifically collaborate with EPSINE, its mere presence will encourage privatization of industries and thus indirectly benefit EPSINE.

2.5 Morocco Economic Profile

Morocco is a small country in the Northwestern corner of Africa. It had a GDP of 231.3 billion dirhams (approximately $26.9 billion in 1991, based on 8.6 dirhams/dollar) and registered a population of 25.8 million in 1991. The country has a large agrarian sector, and depending on cereal harvest, agriculture can account for 15 percent to 20 percent of GDP. There is also a large service sector which employs about 35 percent of the workforce and is dominated by commerce. The other main industries include a fairly diversified manufacturing sector which accounted for about 17 percent of GDP in 1990, and a mining and refining industry in which phosphates are a principle product. (U.S. Department of Commerce, Foreign Economic Trends, Morocco, 1992)

The production of phosphates and phosphate derivatives continue to be crucial for the economy, but diversification of the export base has reduced their dominant share of total exports while the share of agricultural products, textiles, and clothing has advanced. Meanwhile, the country is still dependent on imports for food and energy which makes for a deficit in the merchandise trade account. This, however, is partially offset by substantial earnings from tourism and workers' remittances.

2.5.1 Background

Since the early years of its independence from France, Morocco has emphasized centralized planning as an approach to economic development. Thus, vital sectors of the economy like phosphates, tea, and tobacco had been placed under state control. However, one of the major problems the country faced was how to attract investment. For example, immediately after independence, investment levels dropped sharply. It only peaked during 1967 and 1977 in wake of the government's decision to increase phosphate prices unilaterally. Since then, one of the continuing problems has been how to attract sufficient investment into development. In both the 1978/1980 and the 1981/1985 development plans, private investment was expected to play a significant part, but these expectations were met with disappointment. A part of this plan was to encourage foreign investment through tax concessions and special investment codes.

In 1982, regulations covering foreign investment were liberalized in that the insistence on a majority Moroccan shareholding in all foreign capitalized companies was abandoned and foreigners were provided with better terms for repatriation of profits and tax concessions. In 1984, a series of measures were taken to liberalize foreign trade, including the removal of state controls on exports through the Office de Commercialization et d'Exportation and the reduction of tariffs and duties on imports of all kinds. Finally, in 1985, the government embarked on a privatization program and announced plans to privatize large sectors of the economy. However, strategic industries such as phosphates continued to be under state control. In 1986-1989, with the assistance of the World Bank, increased privatization continued through the form of sectoral adjustment loans for

industry, trade, and agriculture. In March of this year, the World Bank approved another $275 million structural adjustment loan.

In its most current Five Year Plan (1988/1992), a reform of the public sector was included which involved the privatization of many state companies, and the systematic encouragement of the private sector through various liberalization measures. In fact, the King publicly endorsed the strategy of liberalization and privatization allowing the appropriate legislation to be developed. In 1989, a law was passed by the Chamber of Representatives permitting the privatization of 112 companies with a book value of $1.2 billion. Among the 112 enterprises scheduled for privatization before the end of 1995, three are in agriculture, 14 in the food sector, 12 in textiles and leather, 18 in other areas of industrial production, nine in banking and financial services, 38 in tourism, and 18 in other services.

With regard to other aspects of economic planning, Morocco has been working in close conjunction with the International Monetary Fund (IMF). In 1983, following a series of payment imbalances and an unsustainable accumulation of foreign debt, Morocco approached the IMF for assistance. The Fund granted a Special Drawing Right (SDR) 300 million (approximately $214.28 million based on an exchange sale of 1.4 SDR/$) stand-by credit, recommending the government undertake policies designed to reduce public expenditure and liberalize foreign trade. The IMF has been continuing to provide Morocco with additional financing over the years, contingent on the success of the policies mentioned above as well as improved macroeconomic performance. In 1992, the Fund approved a stand-by credit of SDR 91.8 (approximately $65.57 million based on an exchange sale of 1.4 SDR/$) in support of very specific macroeconomic goals. The government hopes that the end of 1992 will mark the end of the period of structural adjustment, and hopes to reduce the country's dependence on IMF resources.

2.5.2 Current Economic Situation

The year 1991 was a difficult year for Morocco, but it got through it with an impressive five percent growth in output and record foreign exchange holdings. Although the growth was propelled by an exceptional harvest, output in other sectors expanded as well. Tourism receipts, however, declined by 17.5 percent, primarily due to the Gulf War. However, this was partially compensated by a four percent increase in workers remittances. Morocco also received more than $800 million in 1991 in foreign aid, and its foreign exchange reserves stood at a record $2.8 billion. (U.S. Department of Commerce, Foreign Economic Trends, Morocco, 1992)

The year 1992 started off with a serious setback when a severe winter drought hit the main cereal crop. As a result of this, the harvest for this year will be between 2-3 million metric tons. The sharp drop in agricultural production is expected to ripple through other sectors of the economy. The Commerce Department expects that this may result in a negative GDP growth in 1992.

The effect of the 1992 drought will be mitigated by the increasing diversification, resilience and adaptability of the Moroccan economy after a decade of impressive economic reforms. Tourism is expected to improve, and revenues from light industry and mineral exports will continue. Morocco is also meeting the approval of international creditors. In January, it signed what is hopefully its last stand-by agreement with the IMF. In February, the Paris Club rescheduled debt service due in 1992 plus arrears from 1991. This is Morocco's last Paris Club rescheduling as the IMF projects that Morocco should be able to meet scheduled debt service in future years. The World Bank is also providing Morocco with a $275 million structural adjustment loan which will encourage further trade liberalization and financial reform. As an indication of confidence in its currency, Morocco has announced that it plans to eliminate the remaining restrictions on current account (specifically trade, services, remittances, and tourism) transactions.

2.5.3 Sector Profiles

The major sectors in Morocco include agriculture, forestry, fishing, mining, manufacturing, chemicals and fertilizers.

Agriculture is one of the major sectors of the economy. As noted previously, depending on cereal harvest, it comprises anywhere from 15 to 20 percent of GDP. It employs about 40 percent of the workforce, and in 1991, food products accounted for over 27 percent of exports. The major crops are wheat, barley, beans, citrus, and sugar beet. (The Economist Intelligence Unit, Country Profile, Morocco, 1992).

Livestock production is a component of the agriculture sector. Many Moroccan farmers raise sheep, goats, and cattle. However, the pasture is often thin, and the quality of herds is poor. There have been recent attempts to introduce ranch style stock rearing into the country. Morocco produces nearly all its national meat requirements and dairy production has been steadily rising over the last few years.

Next to agriculture, manufacturing is one of the largest sectors in Morocco. The most important industries are food processing, textiles, chemical manufacturing, and light industries. The food processing industry produces products including canned fruit and fish for export and flour and vegetable oils for domestic consumption. Textiles have traditionally been at the forefront of export-led industrial growth. In 1992, the Moroccan clothing industry was comprised of 1,500 enterprises and constituted 25 percent of all manufacturing. The engineering sector consists of four plants assembling cars and small utility vehicles. Also included is the production of lorries, trucks, and motor vehicle components. With regard to the chemical and fertilizer sector, Morocco has several plants producing phosphoric acid and triple superphosphate. Finally, the remaining industries which have expanded recently include cement, building materials, ceramics, paper, and basic metal industries.

Although mining constitutes a relatively small portion of GDP, amounting to only 3.2 percent in 1990, (U.S. Department of Commerce, Foreign Economic Trends, Morocco, 1992) it is nevertheless one of the dominant sectors of the economy. This sector is dominated by the phosphate industry, although iron ore, lead, and barytes have started to play a significant role.

2.5.4 Foreign Trade and Market Potential

Morocco's trade is dominated by Western Europe. About 60 percent of foreign trade is conducted with the European Community, a percentage that is rising. France is the dominant partner, providing 26 percent of imports and taking 32 percent of exports in 1990. It is anticipated that Western Europe will continue to dominate Moroccan trade. However, the Commonwealth of Independent States and Eastern Europe have been looking towards the Middle East as potential areas of diversification.

Trade Relations with the European Community-A Brief Capsule

Morocco's trade relations with the European Community began in 1969 when a five-year agreement conferring "partial association" was concluded. In this agreement, Moroccan exports of most categories of industrial and artisanal products were accorded duty and quota-free entry into the then six EC countries. Exports of citrus fruits were allowed an 80 percent reduction in the common external tariff applied to this commodity category. Other concessions agreed by the Community for Moroccan exports included olive oil, vegetable conserves, and canned fish. In return, Morocco reduced some customs duties and quotas but these concessions were of a limited nature. The thrust of the agreement was in the direction of one way rather than two way free trade.

In 1976, as part of the EC's "global Mediterranean policy", a trade and cooperation agreement with Morocco replaced the "partial association" agreement of 1969. Although in principle it was more ambitious than the earlier agreement, in practice it proved to be disappointing. Moroccan exports like textiles have been severely restricted. Further, since the increasingly protectionist stance of the EC towards exports of Mediterranean agricultural produce has curtailed the export of agricultural goods.

Morocco made a full application to the EC in 1987 and was rejected. In January 1992, the EC Parliament blocked Morocco due to poor human rights records. The EC is currently taking steps towards a Euro-Maghreb partnership including a free trade area. However, it is too early to tell whether this will have any bearing on Morocco.

Although the U.S. is not a major trading partner of Morocco, the Department of Commerce estimates that in the next year, potential markets for U.S. goods may open up. These include:

- A $100 million market for agricultural equipment;
- a $100 million market for medicines and medicinal equipment; and
- a $1.5 billion market for telecommunications equipment

Other categories which the Department of Commerce believes have significant export potential for U.S. manufacturers include: Computers; industrial chemicals for textile, plastic, food processing, and pharmaceutical industries; franchising; refrigeration equipment; and pollution control equipment as Morocco looks to improve its environment; and electrical power generation and transmission equipment

2.5.5 Institutional and Policy Factors

In the past few years, the Moroccan government has made successful efforts to foster market-oriented growth. In this regard, it has liberalized trade, continued privatization efforts, and made considerable progress in structural adjustment efforts.

Ever since Morocco joined GATT in 1987, it has continued to liberalize its import policies. In 1991, a new Foreign Trade Act was passed which reversed a legal presumption of import protection. Currently less than nine percent of product categories require import licenses, and the Ministry of Foreign Trade has announced plans to remove most of the remaining items by the end of 1993. The Government is also moving ahead with tariff rate reform and has lowered the maximum from 45 to 40 percent.

Morocco has also been moving deliberately toward the privatization of the 112 government-owned enterprises mentioned above. In the second half of 1991, the King appointed a Privatization Transfer Commission and a Valuation Authority, and the Parliament approved implementing regulations permitting the sale of state-owned enterprises through financial markets, tenders, and direct purchase. These actions have permitted the privatization process to begin by the audit and evaluation of companies, and several public enterprises are likely to be privatized in 1992.

Finally, the Government has continued its course of economic reform under the structural adjustment measures imposed by the IMF. In January 1992, Morocco signed a 15-month agreement which calls for a budget deficit of less than one percent of GDP in 1992.

2.6. Estimates of Market Potential for Pollution Prevention Equipment

The OECD has estimated the global market for environmental technologies and services as **$200 billion annually in 1990 and $300 billion for 2000**. (OECD, 1992). The issue for this kind of analysis continues to be how to distinguish market opportunities for clean technology products from more easily defined traditional markets for end-of-pipe pollution control products and services. Like other market estimates, the OECD estimates do not appear to explicitly take into account clean technology alternatives to pollution control expenditures by industry.

Part of the analytical dilemma is that there is no certain one-to-one correspondence between pollution control spending and spending on alternative clean technologies. For example, not all pollution control needs can be substituted with pollution prevention options, although some can be. When use of clean technology is technically feasible, the level of spending may be very different than a traditional use of pollution control equipment. Also, many types of spending on clean technology may occur on the basis of economic payback because of improved industrial efficiency, without replacing any spending on required pollution control. Moreover, the situation for developing countries is much more complex than for industrialized ones. It is not all clear, for example, how public policies will help divert spending from pollution control to clean technology.

How then can the OECD estimates for four categories of equipment (water, waste, air, and other) and services be converted to clean technology estimates? Based on professional experience with alternative clean technologies, a conversion of 20 percent is believed to be a valid conservative estimate for using low-to-medium cost clean technology alternatives during the period before the turn of the century.

In other words, $40 billion for 1990 and $60 billion for 2000 for the global market for low-and medium-cost clean technologies. Based on the size of industrial sectors (Table 1.1) for the four Near East countries examined in this report, these global figures translate into annual markets of $120 million and $180 million (on the basis of using a 0.3 percent share of the global industrial GDP), respectively for 1990 and 2000 for the four countries. These approximate market estimates for low/medium cost clean technology products are consistent with the multiples discussed in this report relative to AID support of a trade and environment program as recommended in this report. If higher cost clean technology alternatives are considered, including construction of new plants, then the conversion rate would be higher, perhaps as high as 50 percent of the global OECD figures, raising proportionately the Near East market ultimately possible.

3. ANALYSIS OF THE FOUR COUNTRIES

The previous chapter delineated, in general terms, the economic, institutional, and industrial profiles of four Near Eastern countries: Egypt, Jordan, Tunisia, and Morocco. In this section, we analyze the previous sections in order to develop a criteria for the selection of the Center in one of the above-mentioned countries. Based on desk research in Washington D.C. as well as field trips to Egypt, Tunisia, and Jordan, the EPSINE Team has identified six factors in choosing the Center. These are: **Country economic performance and future economic growth, size and diversity of industrial base, institutional and policy reform, presence of local programs** to complement EPSINE activities, **Mission support for EPSINE**, and **U.S. accessibility to local markets.**

3.1 Economic Performance

A country's economic performance and future growth is the first factor in determining the location for the EPSINE center because healthy growth, especially in the industrial sector, indicates a strong demand for industrial products like pollution prevention equipment.

The economic performance in the Near East countries is difficult to gauge. All four countries in our study were hurt by the Gulf War. The Egyptian economy suffered from sluggish growth, inflation, unemployment, and underemployment. However, in both 1990 and 1991, the government took important measures to correct macroeconomic imbalances and re-orient the economy towards market-based reform and private sector growth. Future economic growth in Egypt depends on its ability to implement successful reform measures as indicated in the World Bank Structural Adjustment loans and the IMF Stabilization Program. The past year's accomplishments suggest that, with an average annual growth rate of 4.1 in GDP, Egypt is well on its way to economic recovery (Table 1.1).

Tunisia and Morocco have also fared well, considering both countries were hit hard by the Gulf War. In Tunisia, GDP was estimated to grow between 5.5 percent and 6.5 percent in 1992. (see Section 2.4.2) Furthermore, the Tunisian Government has been high on the list of international creditors and has obtained substantial loans from the World Bank to continue its commitment to economic reform. Morocco, despite the fact that it started off with a serious setback in the form of a winter drought, has an impressive growth rate of five percent and is expected to continue to grow as the tourism industry recovers and revenues from light industry and mineral exports improve.

The only country where the economic outlook is mixed is Jordan. The GDP is expected to grow at a rate of 2.5 percent in 1992, which is low compared to the other three countries. Further, Jordan is plagued by heavy debt, water problems, and high population growth rates all of which are long-term problems.

The economic conditions suggest that **Egypt, Morocco, and Tunisia** have the requisite growth patterns that would be conductive to the location of the EPSINE center.

3.2 Industrial Base

The next factor to examine is the industrial base and the size of the market that would be receptive to the purchase of U.S. pollution prevention equipment. Egypt has one of the largest industrial bases in the Near East region. The Team found that compared to industries in other countries, Egyptian industries have the greatest need for technological modernization. The Team estimates suggested that there are about **700 to 900 firms** which could benefit from EPSINE activities. These firms were in sectors such as: Agriculture; mining and quarrying; oil; food; paper carton and packaging; chemicals and plastics; metallurgical products; leather goods; furniture; textiles; pharmaceuticals and cosmetics; building materials and refractories; and the electric and chemical industry.

A substantial industrial base was also found in Tunisia, specifically in leather tanning, paper manufacturing, food processing, household chemicals, detergents, and soaps, and phosphate processing. It was found that these industries were very receptive to technical opportunities for economically rewarding use of low- and medium-cost U.S. technologies.

Jordan also has a varied industrial base including textiles and garments, pharmaceuticals, paper and cardboard, soaps, bleaches and detergents, spirits and alcohol, stoves and refrigerators. As explained in section 2.3.6, only 90 to 100 firms were considered large enough to support the activities of the EPSINE center. The Team believes that this is not a large enough industrial base to justify placing the Center in Jordan.

Finally, Morocco has a fairly large industrial base accounting for about 17.5 percent of its GDP. The most important industries relevant to EPSINE would be food processing, textiles, chemical manufacturing, engineering, and other light industries. However, due to the fact that the Team did not get a chance to visit Morocco in this study, exact estimates of industries as well as industry interest in pollution prevention equipment are difficult to gauge.

The above criterion suggest that Egypt and Tunisia each have an industrial base which is both large and receptive to receiving pollution prevention equipment.

3.3 Institutional and Policy Factors

The third factor used for selecting the EPSINE country location was the institutional and policy reform measures undertaken and/or in process. This is based on the assumption that institutional changes like privatization, market-based price reform, and trade liberalization will give the industries the profit motive to use clean technologies as well as encourage them to open up their markets for trade in pollution prevention equipment.

The economic and markets profiles revealed that each of the Near East countries have made privatization, market-based economic reform, and liberalization of domestic markets a top priority.

In Egypt, the government, together with the World Bank, has made privatization and price reform an important component of its economic restructuring program. Private sector reforms are intended to foster private sector development through the dismantling of government monopolies, the elimination of investment and production controls, and the creation of a level-playing field for private firms vs public enterprises in the purchase of inputs.

Another aspect of economic reform in Egypt has been the removal of subsidies and the liberalization of prices so that they are increasingly determined by market forces. In this regard, transport, energy, power, and water prices are gradually rising to international levels. This is extremely important for countries interested in exporting to Egypt as they will not have to compete with local products which are artificially priced lower due to government subsidies.

Finally, Egypt is well on its way towards foreign trade liberalization, including phasing out most non-tariff barriers, lowering high tariff rates, replacing the multiple exchange rate system with a single exchange rate, and generally eliminating the anti-export bias that has previously characterized its trade policy.

Both Tunisia and Morocco have also taken market-based reform as a part of their economic restructuring very seriously. In Tunisia, there has been a commitment to sell off public assets. Price reform is also being implemented, as the start of a new program that would see the removal of price controls on 75 percent of all products by the end of 1994. Tariff protection is being scaled down to a range between 17 percent and 43 percent on all goods with the long-term objective of reducing tariffs to an average of 25 percent.

In Morocco, the current 1988/1992 Five Year Plan included reform of the public sector, involving privatization of state-owned companies and the systematic encouragement of the private sector through various liberalization measures. In December 1989, a law was passed which permitted the privatization of 112 companies with a book value of $1.2 billion.

In Jordan, the political liberalization of 1989 has made privatization and price reform an important goal. The government is planning to sell its stake in a number of public sector companies and price reform in basic commodities has already started. Market reform and privatization have a long way to go in Jordan, but it is off to a good start.

Institutional and policy factors suggest that all four countries have embarked on policies which would be conductive to the Center's activities.

3.4 Local Programs and Activities

The presence of local programs and activities is an important factor in the selection of the EPSINE Center with the idea that these programs would complement EPSINE activities.

Team field research has identified the existence of local programs and activities complementary to EPSINE in Egypt and Tunisia. To the Team, Egypt demonstrated the greatest potential for local activities which would complement EPSINE goals. Egypt currently receives about $200 million per year under the Commodity Import Program (CIP) which provides credit and foreign exchange to the Egyptian private sector to finance imports from the U.S. The CIP, along with the Small and Micro Enterprise Project and the Credit Guarantee Program, could provide funding for the importation of equipment under EPSINE.

Tunisia has some programs which could complement EPSINE. The most important one is the IRSIT (Regional Institute of Scientific Information and Telecommunications) program. Originally funded by USAID, this program has been a tremendous success in transferring U.S. computer and software technology to Tunisian industry. IRSIT offers a role model to EPSINE, illustrating successful technology transfer and the use of U.S. educated Tunisians to implement a program. Another program which may be of use to EPSINE is the USAID-funded pilot privatization project which will encourage private investors to buy small shareholdings in companies the state plans to sell.

3.5 Mission Interest in EPSINE

The extent of interest indicated by the USAID Missions was one of the most crucial considerations for the location of the Center. The EPSINE Team went to three countries: Egypt, Jordan, and Tunisia, and met with Mission officials. The Team found that EPSINE was met with a great deal of interest from the Egyptian Mission. The Mission Director, explicitly expressed his interest and support. He affirmed his commitment to "facilitate" the program, which was characterized as a "win-win" opportunity for U.S. business and Egyptian industry. He also indicated that should the program be successful, the Mission would consider providing funding for it. The Associate Mission Director, also supported the program and could see the anticipated trade and environmental benefits to EPSINE. Additionally, the EPSINE team also met with members of the Egyptian government. The Team met with the minister-level head of the Egyptian Environmental Affairs Agency (EEAA) as well as the Minister of Cabinet Affairs, who is also in charge of the EEAA. Both ministers had a clear grasp of the clean technology concept and a complete appreciation of how the EPSINE program would benefit Egyptian private sector industry and how it would fit with the Egyptian government's growing environmental programs and privatization of industry.

The Tunisian Mission, from the very beginning, strongly supported EPSINE. The Mission officials affirmed that it would support EPSINE's activities in Tunisia regardless of where the Center was located.

The Mission in Jordan was enthusiastic about the EPSINE project and the location of the Center in Amman. The Team, however, feels that the relatively small size of the Jordanian industrial sector, coupled with the substantial involvement of the World Environment Center and other bilateral donors, does not favor the location of the Center in Jordan.

3.6 U.S. Accessibility to Local Markets

The final factor to be taken into account by the EPSINE Team was the relative ease with which the U.S. could penetrate the local market. In this regard, market penetration opportunities were deemed greater in Egypt than in any of the above three countries evaluated. The team found that Germany has an edge over the U.S. in Jordan, while Japan, Italy, and France have penetrated Tunisia, and France has an advantage in Morocco. Egypt remains the only country where the U.S. has a competitive edge in the industrial equipment trade.

In Table 3-1, a grid is used to summarize the factors used in the selection of the Center. Clearly, Egypt emerges as the top choice for the EPSINE Center location. The analysis shows that Egypt has the nation's largest economy and industrial base which offers the biggest market opportunity for U.S. clean technologies. The government policies in Egypt, including privatization, subsidy reduction, and environmental regulation are positive factors. The USAID Mission has endorsed this project, and compared to other countries, the U.S. has the greatest competitive edge in penetrating Egyptian markets.

Table 3-1
Summary of Factors Relevant to Selection of Center

	Egypt	Jordan	Morocco	Tunisia
Future Economic Growth	Anticipated growth rate of 5.8 percent under the current 1991/92 plan. Other estimates include 4% growth (Table 1.1) which is also optimistic.	Real GDP is expected to grow 2.5 percent in 1992 and 3.5 percent in 1993.	The high growth rate of 5.5 percent in 1991 is expected to be overshadowed by the drought in 1992.	GDP is expected to grow between 5.5 percent and 6.5 percent in 1992
Industrial Base	Varied base with the potential market of 700 to 900 firms.	Small industrial base with only 90-100 firms as potential market	Large industrial base. Number of firms is difficult to estimate.	Large industrial base. Number of firms is difficult to estimate
Policy Reform	Privatization and market-based reform underway	Some privatization and market based reform underway.	Commitment to privatization and market reform. To date, 112 are scheduled to be privatized.	Strong commitment to privatization and market reform.
Presence of local activities and programs	Three programs which could provide funding for equipment under EPSINE	Commodity Import Program		One program which could serve as a role model for EPSINE
Mission Support for EPSINE	Very Strong	Strong	Very Strong	Strong
U.S. Presence in Local Market	U.S. goods have competitive edge	U.S. goods face competition from Germany	U.S. goods face competition from Italy, Japan, and France	U.S. goods face competition from France, Japan, and Italy

4. U.S. CLEAN TECHNOLOGY PRODUCTS

This section describes, in general terms, U.S. clean technology products that can be marketed in the Near East. Ideal technologies for early implementation are those which cost under $50,000 and produce quick and easy to gauge results. Examples would be a high-tech, seal-less pump which retards fugitive emissions, or a small solvent recycling machine which provides reusable solvents at very low cost. As Near East nations see the benefits of simple pollution prevention, they will consider investing in equipment which requires more capital cost. When investment increases to between $50,000 and $500,000, payback becomes more significant and in many cases payback can be fast. Table 4-1 lists some U.S. technologies and their respective payback periods which are discussed below.

In developing countries which do not have the same regulatory costs associated with generating hazardous wastes, the payback period may be longer than in the United States, unless other factors prevail. There needs to be other economic motivations for purchasing higher cost pollution prevention equipment.

Exportable clean technologies consist of systems, equipment, materials, and manufacturing methods which reduce raw material usage, hazardous and non-hazardous waste generation, or water consumption. Below, they are broken into two major categories: broadly applicable products, and industry specific technologies. Broadly applicable products which can be applied to several different industries include:

- solvent use
- water conservation
- sludge management
- organic waste recycling
- painting, coating, and dyeing
- miscellaneous

Examples of broadly applicable technologies which U.S. companies sell are listed in Table 4-2.

The second major category consists of technologies that are specific to industries which are prevalent in the four countries evaluated for this study. Pollution prevention can be applied to:

- petroleum and chemical industries
- food processing
- printing and film developing
- cement production
- electroplating and metalwork
- textiles
- tanning

Table 4-1 Payback Periods for U.S. Pollution Prevention Technologies

Technology	Payback period
Install floating roofs and solvent conservation units	6-12 months
Install cryogenic vapor recovery systems	6 months
Install a hydrochloric acid and caustic soda recovery system for the textile industry	2.5 years
Install a chrome recovery system in tanning mills	6 months
Install a wastewater recycling system in fertilizer manufacturing plants	3 years
Use high volume, low pressure paint spray guns	6 months
Use electrostatic painting technologies	1 year

Table 4-2 Examples of Competing Pollution Prevention Technologies Sold by American Companies

Solvent Use

Company 1	Offers a system which removes solvents from the waste air stream by using cryogenic CO_2. Condensed solvents are then distilled for separation and purification. These systems cost between $10,000 and $75,000 to install.
Company 2	Uses liquid nitrogen as the medium through which solvents are removed from the air stream. This company says that nitrogen is more versatile than CO_2. These systems cost between $10,000 and $100,000 to install.

Oil Recovery

Company 1	An oil-water separator which utilizes a series of coalescing plates can be purchased and installed for between $5,000 and $20,000 depending on the capacity.
Company 2	Sells an oil recycling unit for under $50,000.

Water

Company 1	Offers a full line of water purification equipment which can be designed specifically to satisfy numerous applications. These systems which can range from basic filtration to advanced electrolytic recovery generally consist of a combination of several technoiogies and cost over $50,000.
Company 2	Relies primarily on the sale of off the shelf equipment. However, this large, corporation employs engineers who specially design large systems for a wide variety of industries. This company also contracts people out to help run the systems they design. Installation of equipment costs over $50,000.

Raw Material Recovery

Company 1	Sells an activated carbon adsorption system with an electrolytic recovery system which removes and recovers chromium, cadmium, and copper from industrial wastewater. These units cost between $75,000 and $250,000 to purchase and install depending on the desired capacity.
Company 2	For between $25,000 and $100,000 a chemical precipitation system can be used to recycle zinc and/or other valuable metals.

Sludge Management

Company 1	Sells sludge systems which enable industries to recover useful materials for reuse, and then reduce volume of sludge with filter presses. Complete sludge management systems cost over $200,000.
Company 2	Offers a wide variety of filter presses. These presses cost between $5,000 and $100,000 and can be used with raw material recovery equipment to reduce volumes and toxicity of wastes while ensuring the recovery of valuable materials for reuse.

Pumps

Company 1	Sells seal less pumps which significantly reduce fugitive emissions. These pumps which vary in size and can be used with several different waste streams cost less than $10,000. Many large industries would need to purchase several pumps.
Company 2	Sells seal less pumps as well as several other components such as flow reducers, gauges, and gaskets. This equipment varies in price, but individual components rarely cost more than $10,000.

Painting, Coating and Dyeing

Company 1	Sells a high volume, low pressure spray gun which uses less paint, reduces overspray, and cuts back on VOC emissions. Systems for application can be installed for around $1,000 per gun.
Company 2	Sells electrostatic spray guns which relies on an electric charge for efficient paint application. These systems cost approximately $1,500 per gun.

- paper and packaging
- phosphate industry

4.1 Broadly Applicable Technologies

4.1.1 Solvent Use

Industrial solvents and solvent-based products present a variety of environmental problems and the solutions can vary based on cost, application, size of operation, and amount of solvent required. Typical problems associated with solvent use include volatile organic compounds (VOCs) emissions, disposal of hazardous waste, and depletion of ozone by halogenated solvents. Other problems in using solvents are created when solvents are disposed after one cycle, thus wasting potential opportunities for recovery and reuse.

One of the cheapest alternatives to traditional solvents is to use aqueous, biodegradable, non-toxic solvents such as citrus solvents which do not contain petrochemicals. While these solvents still cost slightly more than traditional petroleum naphtha, their primary advantages are that they will not harm the environment when released into the water and air, and because they do not vaporize as quickly as many petrochemical based solvents, they last longer. Other measures which can cut the consumption of solvents include the installation of floating roofs with primary and secondary seals (prevented the loss of 1.5 million pounds of solvents in one year for a large American chemical company), and conservation vents which can cut organic air emissions from solvent tanks by 30 percent or more. Installation of equipment for the above two pollution prevention measures would cost between $5,000 and $13,000 and, in one case-study, resulted in an annual savings of $150,000. (Huisingh and Bailey, 1982)

Water-based, biodegradable, non-toxic products are also useful as substitutes for solvent based products. These products would include water-based cleaners, soybean-based inks, starch-based surfactants, and natural cleaners and degreasers, to name a few. Mechanical cleaning and stripping techniques can also be considered as replacements to solvents. The one major drawback to mechanical cleaning is that even when no solvents are used, the material which has been mechanically removed can be hazardous, thereby presenting a waste disposal problem. Therefore mechanical measures have to be carefully chosen and applied. Implementation costs for mechanical cleaning vary greatly. However, even in countries where there are no regulations or waste disposal costs, mechanical methods as opposed to solvents or solvent based products offer payback from elimination or significant reduction of the cost of purchasing solvents. Mechanical methods include plastic bead blasting, or a dry ice (pelletized CO_2 [carbon dioxide]) cleaning system to clean or strip coatings.

While coatings and painting systems have traditionally been heavily dependent on solvents, there are several pollution prevention measures which eliminate the need for such harmful materials. Water-based electrostatic painting systems have been found to reduce

hazardous waste and discharge of liquids into surface waters. By giving the paint a negative charge and applying it to an object with a positive charge, the paint is electrically drawn to the surface without generating much waste. A manufacturer can coat metal, plastic, and wood materials with a 75 percent to 90 percent efficiency. Electrostatic spray guns might cost ten times as much as standard spray guns, but operate at twelve times the efficiency. Pay back for this technology is often within one year. Likewise, radiation cured or powder coatings dry much faster and decrease the amount of coating required, while drastically cutting the amount of waste generated. Supercritical CO_2 as a replacement for organic solvents in the formulation of spray coatings enables manufacturers to recover CO_2 for reuse. This technology is said to reduce the emission of VOCs by 30 percent to 70 percent.

In cases where there is no replacement for solvents or when a change to an alternative method or material is unfeasible, solvent recovery systems may be considered. Recovery of solvents results in lower VOC emissions, less hazardous waste disposal and lower costs associated with purchasing the solvent raw material. Spent solvents can be recovered from process and/or vent through steam stripping, distillation, gravity separation with decanter system, vaporization (pot stills, thin-film or wipe-film evaporators), activated carbon adsorption/absorption system, and various membrane techniques. Entrained solvents, which are solvents that are trapped or carried along through a dissimilar waste stream (i.e., sludge) can be recovered through filtration, flotation, and centrifugal separation methods.

Different physical characteristics of solvents can lend themselves to different recovery methods. For instance, to separate some components from liquid mixtures it is more efficient to use distillation which employs differences in boiling points to make a separation. However, in other cases, where boiling points or volatilization levels are too similar, extraction, which relies on differences in chemical structure, is a preferable alternative. Many of the above technologies can be implemented for between $5,000 and $200,000 depending on the size of the operation. Vapor recovery systems which are generally more expensive and more efficient are sold by many American companies. One such system is a cryogenic system which employs liquid nitrogen as a refrigerant to condense VOC's. These systems can cost between $10,000 and $100,000 to install depending on the moisture content of vapors. One system which recovered 36,800 lbs of methylene chloride per month costs $80,500 to purchase and install, and $8,300 per month to operate. This should result in a payback period of less than six months. (Liquid Carbonic, 1992)

4.1.2 Oil Recovery

There are many similarities in oil recovery and solvent recovery techniques. However, since oil has different chemical and physical properties and is often found in different types of waste streams, some modifications need to be made. Potentially reusable oil is wasted when it is disposed with aqueous waste streams. Alternatives include: oil recovery systems, such as ultrafiltration, which employs low pressure to separate different

components of liquid mixtures for reuse; centrifuges, which can separate water to better than 99 percent purity, and oil to better than 95 percent purity, but which, because of their high speed of operation, require regular maintenance; oil skimmers which can be purchased for under $2000; and pH adjustment followed by quiescent, or inactive separation, to recover oil from aqueous solutions for recycling.

Oil recovery can be performed with an oil-water separator where feed is reduced to a laminar (non-turbulent) flow in the oil/water mixture. The liquid is divided into thin sheets in the coalescing plates and buoyancy forces oil droplets to rise. These droplets coalesce into large globules. Oil, water, and other substances can go through separate gravity discharge ports for collection. Individual units with a relatively low capacity can be purchased and integrated into a manufacturing system for under $50,000. These systems are sold with no disposable filter elements or moving parts. A once-a-year cleaning is the only maintenance required.

4.1.3 Water

In some parts of the world, inefficient consumption of water is causing permanent damage to surface waters, and is seriously depleting what once were large rivers. The condition of the world's rivers can be improved if industries use water more efficiently. There are several measures that can be taken which require less water and result in reduced pollution to waterways. One cheap and effective method for conserving water and decreasing chemical consumption is using spray nozzles and fog nozzles for rinsing instead of dip rinses.

Generation and disposal of hazardous wastewater can be decreased by installing automated systems which employ flow reducers, flow meters, metered pumps, sensors and probes (to measure pH, temperature, metal concentrations) to help conserve water and raw materials. While comprehensive systems in large manufacturing facilities can be extremely expensive, selectively purchasing components which meet a facility's needs can result in a measurable drop in waste generated.

Likewise, although completely changing an existing factory's manufacturing process to incorporate a closed loop water recycling system may be prohibitively expensive, business owners may find that when building a new factory, a "state-of-the-art" recycling system which includes, for example, an electric chiller, an outdoor condenser, and a storage tank can be installed at little, if any, additional cost.

Instead of disposing process waters (i.e., cooling water, rinsewater, washwater), there are several techniques that can be undertaken to recover would-be contaminants and reuse water either in its original capacity, or for some other purpose depending on its purity. Filtration techniques are a commonly used method for purifying water. All membrane based purification systems require initial filtration to remove particles larger than five to 10 microns. Different purity requirements involve different filtration equipment and

techniques. If complete purity of water is not necessary or if the water is not contaminated by toxic materials, filtration systems can be implemented and operated at just a few dollars per thousand gallons. For more thorough filtration needs, membrane technologies such as microfiltration, ultrafiltration, nanofiltration, and reverse osmosis can be employed. Figure 4-1 provides an example of microfiltration in electroplating wastewater treatment and recovery. Membrane and deionizing systems generally yield water with higher purity, but also cost more. Deionizing systems include reverse osmosis, ion exchange, continuous deionization, and electrodialysis. Below are basic explanations of deionizing methods:

Reverse Osmosis - produces high purity water for several industries, notably, the electronics, pharmaceutical, power, and chemical. It is effective in removing colloids, organics, microorganisms, and pyrogenic materials. Reverse osmosis utilizes pressure energy to separate water from its contaminants. A pump applies a pressure great enough to drive solvents through a filter away from the pure water and back to the "solvent side" of the membrane.

Ion exchange - special resins remove ions from water. Basically, resins trap particles and other materials. Ions are then backwashed and chemically regenerated. The regenerates are then rinsed from the beds using a slow rinse cycle; finally a fast rinse returns the beds to the service cycle.

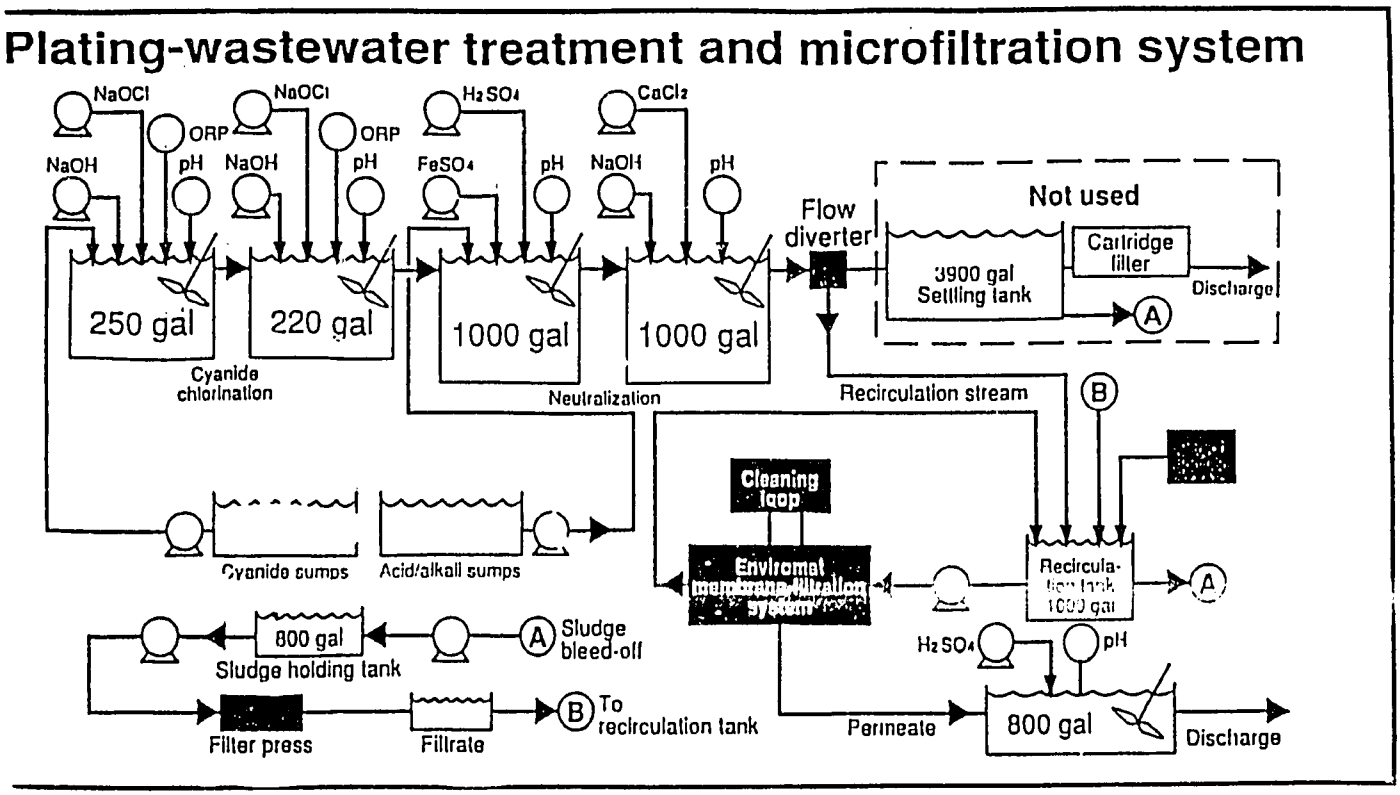
Continuous deionization - is a combination of ion exchange resins and membranes with an electrical charge which deionizes water.

Electrodialysis - consists of a direct current electrical field to remove ions by passing them through an ion permeable membrane that is impervious to water. Electrodialysis is most economical for sources with moderate total dissolved solids (up to 12,000) such as brackish waters. It has also been combined with ultrafiltration and reverse osmosis for high purity water production in the electronics industry.

A rule of thumb in determining costs of water purification systems is that for water only the cost would be $20,000 plus $1000 for every gallon per minute of required capacity. For systems with multiple waste streams which need to be recovered such as metal salts and solvents the cost would be $30,000 plus $2000 for every additional gallon per minute of capacity. (Olson, 1992)

One other option in trying to recoup process water is to install a batch brine concentrator recycling unit. These units range in capacity from five to 600 gallons per minute, are energy efficient, and can allow for a 95 to 99 percent recovery rate. The remaining waste is then condensed to one percent of the original flow.

Figure 4.1
Plating-wastewater Treatment and Microfiltration System



Source: Ionics Inc., 1992

One non-industrial application of pollution prevention which would save considerable amounts of water would be to replace current commodes that use about 3.5 gallon of water with new low-flush commodes that use about 1.6 gallons per flush. This would lessen the amount of wastewater, and sludge generation especially in populated areas. Numerous American companies sell a wide variety of water conservation devices.

Table 4.3 summarizes some of the many industry-specific water conservation and pollution prevention technologies.

4.1.4 Raw Material Recovery

Disposing of water creates a wasted opportunity for recovery and reuse. In the same manner, severe pollution problems can result from disposal of raw materials when they could be recovered instead. In addition to pollution prevention in the factory, recovery of raw materials results in less environmental damage. One example of potential damage is the disposal of metal contaminated rinsewater, coolant, (metalworking fluids) or sludge which cause groundwater, surface water, and land contamination.

There are numerous rinsewater recycling systems which recover metals and reuse the rinsewater and coolant. Electrochemical methods offer closer control of each reaction step, lower processing temperatures and costs, and result in less waste-byproducts than chemical methods. Electrochemical methods are effective because they utilize electron reagents which unlike standard chemical reagents can be readily removed or added without the by-products of the reagents to contend with. An electrode can oxidize various chemical species to convert them into profitably saleable products without undesirable by-products. An electrolytic cell is the basis for a variety of electrochemical processes including electrodialysis, ion flotation, and ion exchange.

Various filtration methods and combinations thereof are also effective in metal recovery. Driven by rising purity and safety standards, filtration has been developed to the point where it is highly convenient and sophisticated. As with water conservation, standard filtration techniques such as ultrafiltration and microfiltration have been combined with other proven technologies such as distillation. These advanced methods are extremely selective and extend the potential to recover a variety of materials, and improve the quality of products recovered. One example is crossflow or tangential flow filtration which works by sweeping fluid systems across the surface of a microporous or ultrafiltration membrane preventing larger retained cells or molecules from plugging the filter. This self-cleaning ability enables faster flowrates, improves throughputs, and maximumizes metal recovery. These filtration devices vary in price depending on the size of the operation, and the amount of filtration desired, but generally cost more than $50,000. They are now being integrated into specific stages of production rather than just at the end of pipe. This results in a purer recovery product, and source reduction.

Table 4-3 Industrial Pollution Prevention: Successes in Reducing Water Demand and Water Pollution

Process	Description	Capitol cost	Payback
Electroplating	Replaced single-pass, water treatment system with closed-loop, batch system for rinsewater. Water usage decreased from 12,000 gallons per day to 500 gallons per day (90% reduction). 20% reduction in sludge production for savings of $58,460 per year in waste disposal costs. Savings in pollution control cost of $29,400 per year and personnel/maintenance of $10,200 per year.	$210,000	3 years (I), >10 years (D)
Film Developing	Installation of decanter system provided gravity separation of organic solvent from water (1,1,1-trichloroethane). Savings: $12,000 in first year by reducing amount of new solvent and makeup water required for film developing unit.	$4,000	3 months (D)
Metal Parts Remanufacturing and Restoration	Metal parts cleaning system bakes metal parts to remove volatile oils and grease, and sprays parts with a high-velocity stream of aluminum shot to remove grime and rust and provide a rust-resistant coating. Replaced system involving wet application of caustic soda, scrubbing and water rinse. Resulted in annual savings of 48,000 gallons of rinsewater (100% reduction), $5,400 for caustic soda, and $25,000 in labor costs (three employees to two employees), and $12,000 to $18,000 in caustic sludge waste management by recycling the aluminum dust by-product. Aluminum shot costs $1500 per year.	$75,000	<2 years (I); <2.5 years (D)
Food Canning	Steam-jet vacuum compressor added to atmospheric cookers to prevent escape of steam (wasted food-processing energy) through can in-feed and discharge ports. 100% reduction in water usage (3,600 gallons per cooker per year), and $45,000 reduction in energy per 1,000-hour season.	$1,300 to $2,500 per cooker	4 months
Manufacture and Metal Finishing of Stationary Power Tools	Ultrafiltration system and oil skimmer allowed recovery from process water of $8,000 worth of oil per year and $3,000 worth of alkaline cleaning solutions per year. Water costs reduced by $1,100 per year and process water treatment costs by $10,000 per year. Saved firm from having to expand wastewater treatment capacity.	$65,000	2 years (I); 5 years (D)
Metal Working	Disposal of water-mineral oil emulsion machining coolant replaced by portable waste coolant recycling system. Metal chips removed in paper filter, with reuse possible, and oil recovered. Reduction of 80-90% in waste coolant. Annual reduction in virgin materials costs of $21,000 and disposal costs of $12,300.	$17,500	<0.5 year (I), <1 year (D)

Nickel Plating	Used advanced reverse osmosis to separate rinse tank waste stream into two streams to recycle into plating line. Concentrate of 50% nickel in rinsewater waste stream recycled to plating tank. Permeate of deionized water recycled to clean rinse tank. Low temperature evaporative recovery system utilizes vacuum evaporation to concentrate rinsewater waste streams which then pass through carbon filter for organic contaminant removal prior to reuse as make-up rinsewater. Reduces water use and chemical purchases.	$75,000 $9,000	4.4 years (I) approx. 1 year (I).
Printed Circuit Board Manufacturing	Decreased withdrawal rate of plating bath. Intermediate withdrawal rate of plating bath combined with longer drain time. Each modification resulted in 55% reduction in drag out for electroless bath and 40% reduction for etchant bath. Annual savings for each modification: $3,300 ($2,600 saved from extended resin life in ion exchange treatment system). $700 per year saved in water and sewer charges if rinsewater flow rates are reduced proportional to reduction in drag out.	none	immediate
Stainless Steel Processing	Oil skimmers installed on all machine coolant reservoirs to remove free oil resulting in increased life of coolant by biological activity reduction (26% reduction in coolant generation). Segregated waste streams into waste oil and coolant (water) resulting in recovery of 30,000 gallons of high-BTU oil for fuel blending and disposal cost savings of $0.24 per gallon. Achieved 90% reduction in waste coolant.	$140,000	6 months (I)
Citrus Packing	Discharge of washwater to wastewater treatment plant replaced by water pretreatment and reuse system which reclaimed and reused water 20 to 40 times. Daily water savings: 19,000 gallons (95% reduction).	pretreatment system - $5,000, Reuse $5,000	2-3 growing seasons (I)

Acrylic Yarn Manufacturing	Reused non-contact cooling water and contact production water in dying process. Placed three 5,000-gallon, salvaged, stainless steel tanks adjacent to dye vessels. Piped circulated water from cooling coils to three tanks through temperature activated diverter valve for reuse. Used hot water from tanks for dying process steam needs during generation of heat. Water used in dye house. Contact water reused by transferring water from process tanks back into preparation tanks. Expended chemicals replenished for batch reuse. Savings in water usage and disposal costs: $13,000 per month. Process water usage reduced from 320,000 gallons per day for 12 dye batches to 102,000 gallons per day for 20 dye batches. Resulted in water use and waste generation reduction of 60%, with increase in batches produced. Water reuse system resulted in chemical savings of $45 per batch; reduced fuel usage by 140 gallons per day by reducing heat-up time by 8-10 minutes per cycle; and reduced water usage by 3,000 gallons per batch recycled. Payback: <30 days (I). Minimized chemical usage by automating dyebath flow and temperature. Resulted in clean final dyebath exhaust. Eliminated need for rinsing after dying. Replaced vertical configuration dying machine with machine that has packages in horizontal configuration. Resulted in 50% reduction in both water and chemicals utilization.	reuse system: $5,600	<30 days (I)

(I) Payback period dependent on regulatory structure in U.S. which provides avoidable costs.
(D) Payback period applicable to developing countries without costly regulatory compliance impacting economics

There are several methods for metal recovery through chemical treatment such as acid purification, chemical precipitation which involves adding chemicals such as sodium hydroxide or sodium carbonate to plating rinses, and solvent extraction. Other basic measures for metal recovery include cyclone separation, magnetic separation, and evaporation. These methods are best implemented by small-scale generators of waste, constrained by limited budgets. They result in less environmental benefit, but in the short run, are probably cheaper.

Metals can also be recovered from rinsewater through installation of air or ultrasonic agitation. Agitation is similar to using a centrifuge, however with agitation devices, the rotating or reciprocating elements create and maintain dispersions of different materials over a wide range of operating conditions. Agitation systems are generally more selective in removing a variety of different materials and can be used in combination with filtration or deionizing methods to recover valuable raw materials.

4.1.5 Sludge Management

Sludge is a common waste product from several industries. Often, the sludge contains metals, oils, and solvents which can be recovered, thus helping to purify the sludge for non-hazardous disposal. Sludge generally contains water or other liquid wastes. One important way to cut the volume of sludge is to dewater it through mechanical liquid-solid phase separation techniques such as vacuum technologies and plate and frame filters/filter presses. Filter presses can be purchased for between $5,000 and $100,000.

Once sludge is dewatered it can be handled for reuse by one or several of the following pieces of equipment: Vibratory screens generally serve as a first stage to remove coarse materials down to forty microns; two stage separators remove medium or fine particles down to 10 microns; solid bowl decanting centrifuges can separate materials down to three microns; and a recessed chamber filter press can separate materials down to a sub-micron level. Each of these machines require a capital investment of under $50,000 and can allow for recovery of several different materials. One valuable application for dewatered sludge is to use it as a fertilizer, preferably after it has been composted. This can be accomplished for under $200 per dry ton. (Logsdon, 1991)

4.1.6 Miscellaneous

One problem that has simple solutions, and is important to correct is that of fugitive emissions and leaks. Fugitive emissions are often caused by poorly maintained valves and seals, and by poor monitoring practices. There are a variety of leak detection and prevention systems including valves, seal-less pumps, double-barrel seal pumps, new pipes and fittings, and alarm systems for leaks.

Pumps are probably the most widely used pieces of equipment throughout a large variety of industries. As such, performance demands range from deionized water to

corrosive chemicals. Seal-less pumps are highly preferable because they reduce fugitive emissions, thus preserving valuable materials and improving environmental conditions both inside and outside the plant. Pump styles range from corrosion resistant metering pumps to intermittent service pumps to cantilever pumps which resist damage from heavy slurries. Here again, the needs of different manufacturing facilities must dictate the level of investment and types of pumps which are chosen. Prices vary enormously based on the size of the pump needed, the viscosity, and corrosivity of the pump, and any other component which might be required with the pump (i.e., monitors, flow controllers, leak detectors).

One other miscellaneous pollution prevention practice which is cheap and effective is using clean-in-place filters as opposed to disposable liquid filters. Among the many advantages gained from these filters are that they decrease the volume of waste sent to landfills and incinerators, are cheaper in the long run, and provide the potential to recover reusable materials from filters.

4.1.7 Recycling of Organic Waste

Much like sludge, organic waste can serve as an environmentally preferred fertilizer particularly after it has been composted. Disposal of organic waste by landfilling or incineration results in water and air contamination and is expensive. Recycling through the composting of food and other organic waste not only eases the burden on landfills, but also is an important step in practicing sustainable agriculture.

Compost consisting of non-toxic biodegradable materials produces a valuable soil amendment. Several potentially significant benefits can be derived from the development of composting as a waste management tool. According to a report by several environmental groups for the state of New York, composting of yard and kitchen wastes could drop the solid waste stream by up to 20 percent. When non-recyclable food contaminated and other paper discards are accounted, the total fraction of compostable Municpal Solid Waste (MSW) is at least 50 percent.

Traditional toilet facilities produce sewage and sludge that must be treated and disposed and require a lot of water. Composting toilets are useful in that they limit treatment and disposal problems and they provide a waste source which could help to establish the material balance between nitrogen and carbon which is essential to successful compost. In addition composting toilets conserve water.

4.1.8 Painting, Coating, and Dyeing

Painting, coating, and dyeing have numerous applications in industry. In addition to consumer products, coatings are useful as corrosion and degradation resistant materials for manufacturing facilities and equipment. Pollution prevention can make a measurable difference in manufacturing facilities which unnecessarily generate large amounts of hazardous wastes, paint sludge, and air and water emissions.

Often, inorganic pigments must be used for their greater longevity in many applications. However, inorganic coatings are much more persistent in both air and water. For this reason, organic pigments such as titanium dioxide, which is inert, or water based paints are preferable for applications where little physical or mechanical contact takes place. Because material substitution is not always practical especially if the estimated service life of an organic paint is shorter, source reduction alternatives are often sought.

High solids coatings are becoming more popular as an environmentally preferable product. By increasing the proportion of resins and pigments in each can of paint, the proportion of solvent required to maintain the consistency of the solution is decreased. Conventional paints have a solids content of 30 to 50 percent. High solids products typically have a solids content of 65 percent or more. High solids also have a higher build per coat, thereby reducing both the number of coats needed, and waste generated. These factors result in cost as well as environmental advantages.

One of the most proven options in paint application is to use low pressure compressed air spray guns which eliminates the blasting generally associated with most paint spray guns. This reduces turbulence and provides an extremely high quality finish while cutting coating costs and solvent use by 30 percent to 50 percent. At a cost of just a few thousand dollars, these spray guns provide money savings by applying a light spray which adheres evenly to the surface with minimal overspray. Payback for this equipment in paint costs alone is easily within six months if a facility uses over 200 gallons of paint a month. Additional benefits are realized through reductions in VOC emissions, hazardous and solid waste, paint clean-up, equipment maintenance - and most importantly results in a more healthful work environment, in the absence of personal breathing apparatus and related occupational safeguards.

4.2 Industry Specific Technologies

4.2.1 Petroleum and Chemical Industries

A large number of wastes are generated from several different stages of petroleum production. Aqueous wastes constitute about two-thirds of the total waste generated by the petroleum industry in the United States. The remaining wastes are oily sludges, chemicals, contaminated soil, "other," and spent catalysts. While these practices can minimize waste inside a refinery, there are also other pollution prevention methods that can be employed by the petroleum industry.

For example, traditional mineral-oil based drilling fluids result in the smothering of marine life and elevated hydrocarbon levels in the sediments around well sites and possible contamination of fish. However, biodegradable vegetable oil-derived drilling fluid has a much lower toxicity, and does not cause significant harm to the environment.

Light chemicals production is the major form of chemical production in Near East countries. Soaps and detergents are especially important products of the Near East. Water effluent from detergent manufacturers is known to contain harmful pollutants such as fluoride and phosphate-related waste. By recycling wash effluents from both the liquid and powder detergent sections of a factory and using the water in the pastemaking process, suspended materials and oxidizable materials are decreased by 540 percent and 850 percent respectively. (Overcash, 1986)

4.2.2 Food Processing

The food processing industry can take advantage of numerous pollution prevention activities many of which involve low cost operational changes or equipment. Solid waste in the wastewater stream can be limited by installing grates in the floor where material is being washed. Furthermore, solids can be separated from liquids by installing modern centrifuges. Spoilage can be controlled through better storage and distribution techniques, and waste can be reduced by modernizing bottling and canning equipment.

Another pollution prevention opportunity in the food processing industry is to conserve energy in conventional food drying methods. Pulse-combustion (sound waves generated by a pulse combustor) to dry temperature-sensitive food ingredients requires 30 to 40 percent less energy than standard drying methods. Many technologies mentioned in the water conservation section of this report are applicable to this industry. For example, food washing can take place using intermittent spray washing, or reverse flow cleaning which allows for the reuse of rinsewater.

Wasted steam in canning retorts can be recovered using a steam jet vacuum compressor which pulls vapors from the can discharge hood and re-injects the compressed vapors into the retort. Seals can be installed at both can ports to retain steam in the retort.

Steam jet vacuum compressors save energy, conserve considerable amounts of water, cut down-time, and eliminate the need to treat cooking water.

4.2.3 Cement

Cement production is a large industry in the Near East. Often in areas near cement plants, dust from air emissions are piled several feet high by the sides of roads. This dust, while providing fertilizer for the soil, causes significant respiratory problems for nearby residents. Conventional scrubbers in a cement kiln result in the disposal of hazardous cement kiln residues.

There are several technologies which can be applied to cement kiln dust. One simple alternative is to convert kiln dust into kiln feed (clean limestone) and fertilizer (potassium sulfate) with the use of a recovery scrubber.

Another significant problem in cement manufacturing is limestone scrubbers which clean sulfur dioxide (SO_2) and nitrous oxide (NOx) from flue gas. These scrubbers contribute to higher levels of CO_2 generation which leads to acid rain and tropospheric ozone, and it simply converts one form of pollution (SO_2) to another (sludge). Using aqueous liquid membranes, sulfur dioxide and nitrogen oxides can be withdrawn through the liquid membrane as a concentrated permeate stream while the flue gas is cleaned. The permeate stream may then be processed to recover liquefied sulfur dioxide, elemental sulfur, or sulfuric acid as a by-product. Aqueous liquid membranes affect a net reduction in CO_2 emissions. (Alsop, 1992) Sulfur dioxide emissions can also be lowered using regenerative fluegas desulfurization which is based on oxidizing SO_2 with Br_2 (bromine gas) and regenerating the Br_2 via electrolysis. Byproducts are sulphuric acid (H_2SO_4) and hydrogen gas (H_2) which can be recovered and sold.

In general, installing these, or any of several other pollution prevention systems in the cement industry involves immense capital costs (over $10 million) and do not result in large payback. Lower efficiency systems cost considerably less. In the cement industry, it appears that there must be environmental incentives, because there are no long-term economic payoffs to using new methods given the regulatory conditions in many developing nations.

4.2.4 Electroplating and Metalwork

Electroplating in developing countries has traditionally been performed by a large number of small facilities. For this reason they are rarely in a position to purchase large-scale costly pollution prevention products. Furthermore, technologies which carry any additional cost are hard to sell to industries with less advanced economic infrastructures, regardless of long-term payback. Despite this fact, the electroplating industry could improve drastically by investing in simple pollution prevention products which curtail the large amount of pollutants going out in the wastewater stream. For instance, electroplating

with cadmium in cyanide baths results in hazardous wastes, occupational exposure, and the release of cadmium into the environment. These effects can be offset by using non-cyanide substitutes such as zinc chloride, alkaline zinc and cadmium alloys. Ion Vapor Deposition (IVD) of aluminum in lieu of cadmium plating is also an alternative which substantially decreases the amount of hazardous wastes generated.

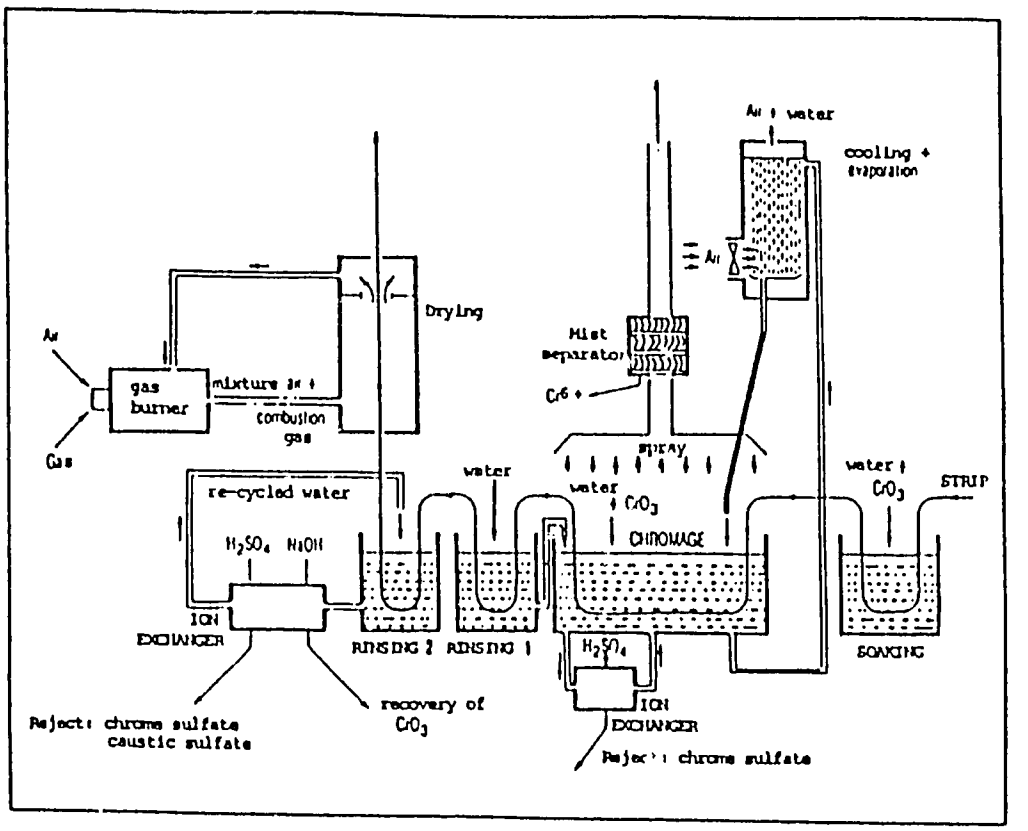
Hazardous water emissions occur during electrolytic plating which applies an electrical current to plating in chemically mixed baths. In this method, acids, etchants, and solvents are used unnecessarily. Operating savings can be realized with electroless aqueous plating which employs the electrons supplied by a chemical reducing agent. This method eliminates the need to use high levels of chemical treatments, and thus simplifies the waste streams for recycling. Complete or near complete recovery of bath and rinses through a computerized-sensor, reverse osmosis technology can be applied to the following rinsewaters: electrolytic or electroless nickel, copper (electroless and cyanides), zinc, trivalent and hexavelent chrome, cadmium, tin stripping, etching, pickling, electrocleaning acid copper, tin, or lead-solder palladium and other precious metals, and numerous other wastes. Installation of the equipment costs about $30,000 per unit and saves thousands of dollars per month in raw material costs while reducing water consumption by over 90 percent.

Other methods exist to recover acid from spent baths and spent pickle liquor. Thermal decomposition can be utilized in recovery of sulfuric acid from spent acid sludges to recover ferric chloride from acidic titanium dioxide waste and in recovery of hydrochloric acid from spent liquor or halogenated organic residues (with a spray roaster, a fluid bed, or a sliding bed to separate hydrochloric acid from iron oxide in spent pickle liquor). Using atmospheric and vacuum evaporators is a common, affordable method. However, although this method is effective in preserving bath solutions, it results in water loss through evaporation. Crystallization, activated carbon filtration (removes and recovers built up organic bath contaminants), and ion exchange which separates acids and bases from salts to recover the salt/acid/base components can also be cost-effective pollution prevention methods in electroplating. An ion exchange system for a clean chrome plating process is illustrated in Figure 4-2.

Product substitution can be successfully implemented by substituting chrome-free anodize (boric-sulfuric acid anodize) for chromic acid anodize as a pretreatment coating for aluminum. Implementation of chrome-free anodizing could involve significant capital costs. The benefit is that chrome-free anodize is less energy intensive, is much faster acting, and eliminates the generation of hazardous chrome waste. Copper sulfate can be substituted for heavy copper cyanide in baths. This eliminates carbonate build up in tanks. Other methods which control chemical transport between baths, and improve water conservation include installing multiple stage countercurrent rinsing equipment

Figure 4.2
Clean Chrome Plating Process

Clean Process



Economics $MM

	Old Process	Clean Process
Investment	0.36	0.56
Running Costs	0.26	0.016

Diagram of clean chrome plating process. Chrome losses are reduced and running costs are substantially reduced.

Source: Donald Huisingh and Vicki Bailey, Making Pollution Prevention Pay: Ecology with Economy as Policy, Pergammon Press, 1982.

and flow reducers, and practicing various dragout elimination measures (i.e., decreased dip times, longer drainage times and diluting bath solutions).

There are also alternatives to standard flux which is used to solder metal joints. Standard flux creates the need for large amounts of cleaning solvents and flux thinners (VOCs), and creates solid and hazardous waste disposal problems. A water soluble high speed flux which is compatible with aqueous cleaners typically causes significantly less damage to the environment.

4.2.5 Textiles

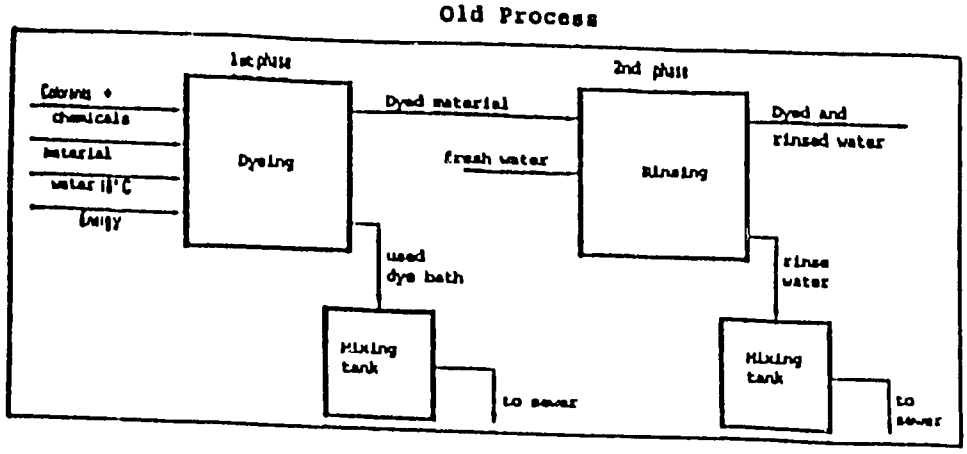
Textiles is an industry that has been practiced in the Near East for hundreds of years. The methods for textile manufacture have been ingrained over a long period of time and changing people's habits is a formidable challenge. However, there are marketable pollution prevention products for this industry. Activities which commonly take place in the textile industry include cleaning, scouring, dyeing, and finishing.

Traditional dye application has numerous drawbacks which could reasonably be eradicated. Inefficient use of dye, loss of dye to wastewater, excessive solvents waste caused by large amounts of adhesive overspray, and high water consumption are primary reasons to consider alternative practices. Also, when water is sent out of the mill it contains high levels of heavy metals. In the 1960s in the United States, 50 percent of all dyes contained heavy metals. Now that figure is down to five percent. Alternative dyes for Near East countries would be economically competitive, and would improve environmental conditions in and around textile mills. Hazardous waste and water output can be reduced by installing low-liquid jet dyeing systems which reduce the amount of dye required in textile manufacture. With this system, more dye gets onto the material and less goes out with wastewater. Recycling of dyeing vat materials can be implemented to further reduce wastewater effluents. This system is diagramed in Figure 4-3.

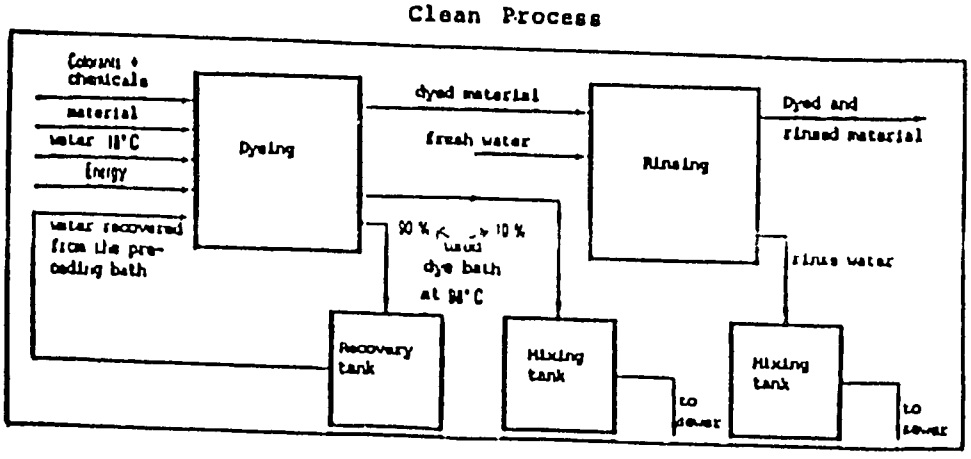
Along with over consumption of water, discharge of highly alkaline and soap laden effluent from cotton scouring and desizing is another problem commonly found in the textile industry. This clearly contributes to further destruction of surface waters. Non-aqueous systems in the textile industry result in less wastewater and allow for the collection of soluble natural impurities in an oily semi-solid form from which raw materials can be recovered and reformulated. One other practice which leads to less water consumption is substituting supercritical CO_2 for water as a dye solvent. Supercritical CO_2 can eliminate water pollution and save energy by speeding up the dyeing of synthetic fibers and eliminating the need for secondary drying.

Figure 4.3
Textile Dyeing

Old Process



Clean Process



Economics $MM

	Old Process	Clean Process
Investment	-	0.09
Running Costs	0.10	0.002

Diagrams illustrate old polluting and new clean processes of textile dyeing. Recycling of dye vat materials reduces pollution and reduces running costs.

Source: Huisingh, Bailey, 1982.

Baths in textile mills can be recovered and reused by changing processes slightly. Instead of rinsing in three different stages, and disposing of waste rinsewater all at one time, rinses can go through a full rotation where the first rinse bath goes through an evaporater whereby strong soda and other useful substances (i.e., polyvinyl alcohol) are recovered for reuse while other rinses are rotated backward. This reduces consumption of strong soda and hydrochloric acid and cuts back significantly on wastewater volumes. Figure 4-4 provides an example of this clean technology. Consequently, operating cost is lowered by $190,000 annually while new capital costs are $435,000 as opposed to $330,000 for the old system. This results in a payback period of less than 2.5 years. (Overcash, 1986)

4.2.6 Leather Tanning

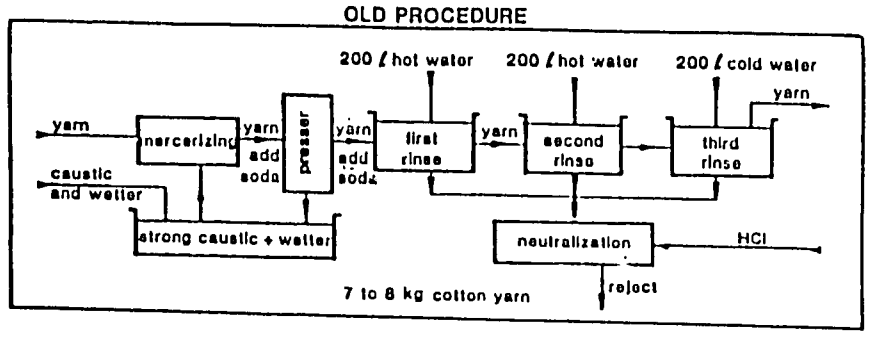
Leather tanning is another large industry in the Near East. Wastes from the tanning industry are generally very difficult to deal with. Waste streams are generally very high in chemical oxygen demand (COD), biochemical oxygen demand (BOD) and suspended solids. Specifically, hair, dirt, and oil and grease from animal hides make it extremely difficult to separate desired materials for recovery. Chrome waste is the greatest concern to pollution prevention experts. Chromium sulfate solutions are 60 to 70 percent absorbed in the leather leaving a 30 to 40 percent residual that results in effluent contaminated by metal. Using an improved equipment design and standard chemical treatment, chromium sulfate can be recycled from the effluent into the process. This change can decrease chromium wastes by 99 percent without change in product quality, productivity or down time. The system would cost around $1.2 million to install including cost of equipment and could save upwards of $300,000 annually in raw material purchase, for a payback period of about four years. In addition, there would be substantial savings from reduced water usage and savings from reduced wastewater treatment costs.

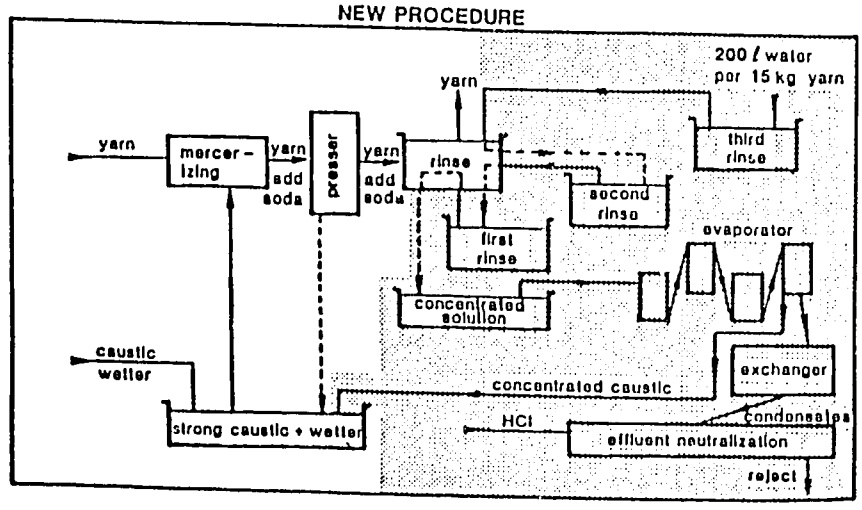
Chemical treatment and precipitation reduces the amount of chromium contained in the effluent by 60 percent. This results in a reduction of filter wastes while regenerating chromium in the sludge. Figure 4-5 provides an illustration of traditional methods, and a recommended technology change. It involves an investment of approximately $75,000 and net annual operating costs of $53,000 after deducting economic benefits from recycled chromium. Old systems require lower investment costs, but cost over $200,000 annually to operate. Adoption of this technology would pay for itself in six months. (Overcash, 1986)

4.2.7 Paper and Packaging

The paper industry presents several major challenges to pollution prevention. Utilizing chlorine as a bleaching agent has long been an issue of interest to pollution prevention specialists. Chlorine and chlorine derivatives cause the formation of dioxins and furans, chloroform and other suspected harmful materials. These substances are some of the most toxic known to man and have been responsible for the widespread destruction of living organisms in water bodies in areas where papermaking is prevalent. Several companies have

Figure 4.4
Rinsewater Recovery





Source: Micheal Overcash, Techniques for Industrial Pollution Prevention, Lewis Publishers, 1986.

developed substitution materials which are environmentally preferable. One company sells a generator which produces a substitute made from a hypochlorous acid and a proprietary additive which results in significantly reduced chloroform and dioxins. Others have substituted oxygen, ozone, chlorine dioxide, and hydrogen peroxide. Substitution of chemicals can carry a capital cost of 10 to 25 million dollars and can almost completely eliminate absorbable organic halogens (AOX), dioxins, and pentachloro phenol (PCP) while saving several dollars per ton of pulp in operating costs. (Mccubin, 1992)

There have been other innovative papermaking techniques which decrease waste generation. A closed-loop process refines wood into separate components much like petroleum fractioning. This conserves water, and allows for simpler, less chemical intensive treatment methods for wastes that are generated. One company has developed a waste reduction method using nascent chlorine and ozone which bleaches inside a cell, and then oxidizes to carbon dioxide and water, before being emitted.

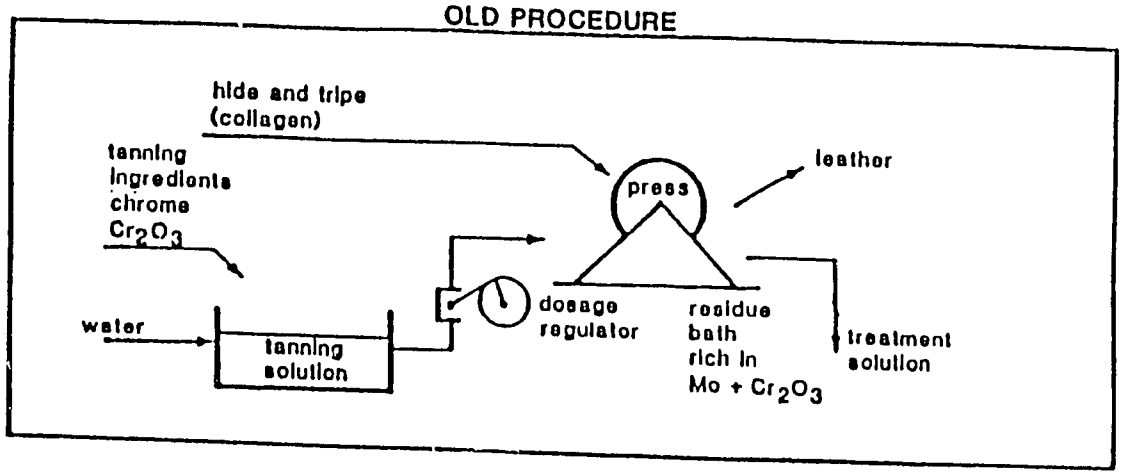
Another primary problem in the paper industry is the unnecessary destruction of natural forests and corresponding generation of large quantities of waste paper which is being disposed of in landfills. A company in Michigan has developed a steam explosion technology which involves subjecting newsprint, corrugated boxes and paper waste to high temperature and pressure which turns these waste products into pulp.

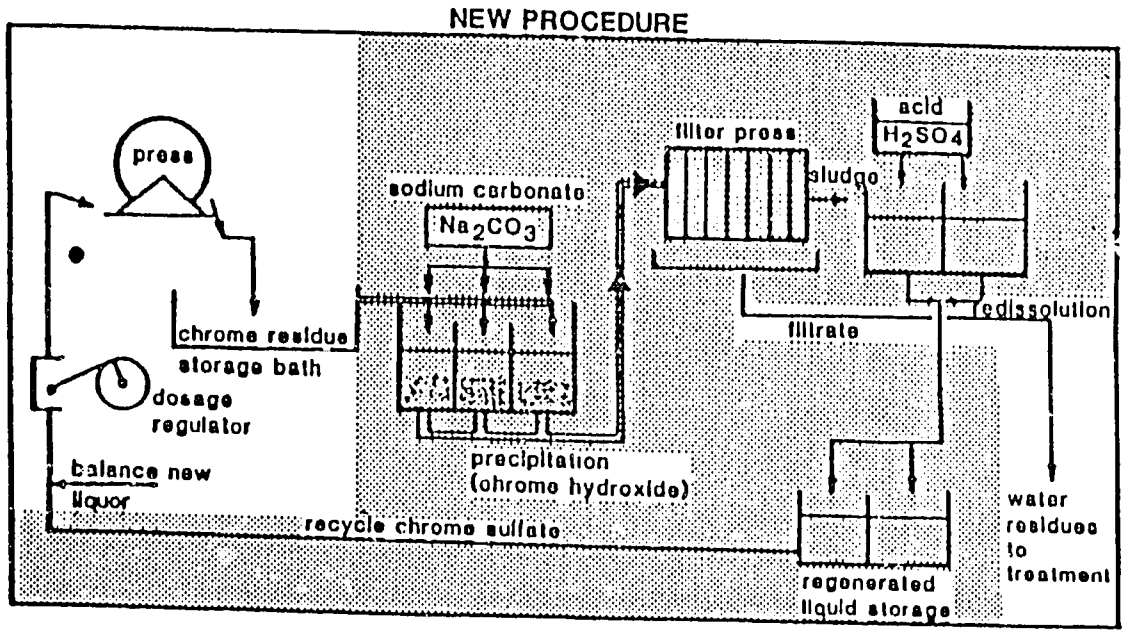
There are many new technologies for recycling paper. Flotation, for instance, combines the pulping and cleaning action of water washing with air bubbles which carry off ink particles. In this method, 85 percent of the small ink particles that standard washing techniques cannot get to are removed and one-half the water is consumed which results in a much smaller volume of sludge. Surfactants induce the proper level of bubbling and ensure proper pulp.

Other methods in paper manufacturing which have been found to result in pollution prevention include extended cooking which removes 25 to 50 percent of the residual lignin and recycles it in a recovery boiler. This cuts AOX by 50 percent, PCP by 60 percent, and screen rejects by 90 percent. Extended cooking can cost from $3 to $45 million; and oxygen delignification which removes 40 percent of residual lignin before bleaching and also reduces AOX by 50 percent and PCP by 60 percent at a cost of $28 million.

Pollution prevention technologies tailored specifically to existing facilities may not be immediately economical. However, as pollution prevention becomes a part of a developing country's culture, these ideas can be implemented in new factories. Technologies exist in the paper industry which can result in a zero discharge, but until pollution prevention becomes a priority in the Near East, these will not be implemented.

Figure 4.5
Chromium Sulfate Recovery in Leather Tanning





: Overcash, 1986.

4.2.8 Phosphate Industry

One industry which is particularly prevalent in the Near East is the Phosphate industry. This is perhaps Morocco's and Jordan's most important single commodity. Phosphate is used to manufacture numerous secondary products which are a major source of export income. One company in San Diego has discovered a way to recover sulfuric acid from phosphogypsum waste. In the process phosphogypsum is mixed with coal and pyrite and sprayed into a furnace at 1,340° C with O_2 enriched air. The calcuim sulfur ($CaSO_4$) is reduced to calcium oxide (CaO) and SO_2, and CO_2, more than adequate for making H_2SO_4. This H_2SO_4 can then be sold at a substantial profit.

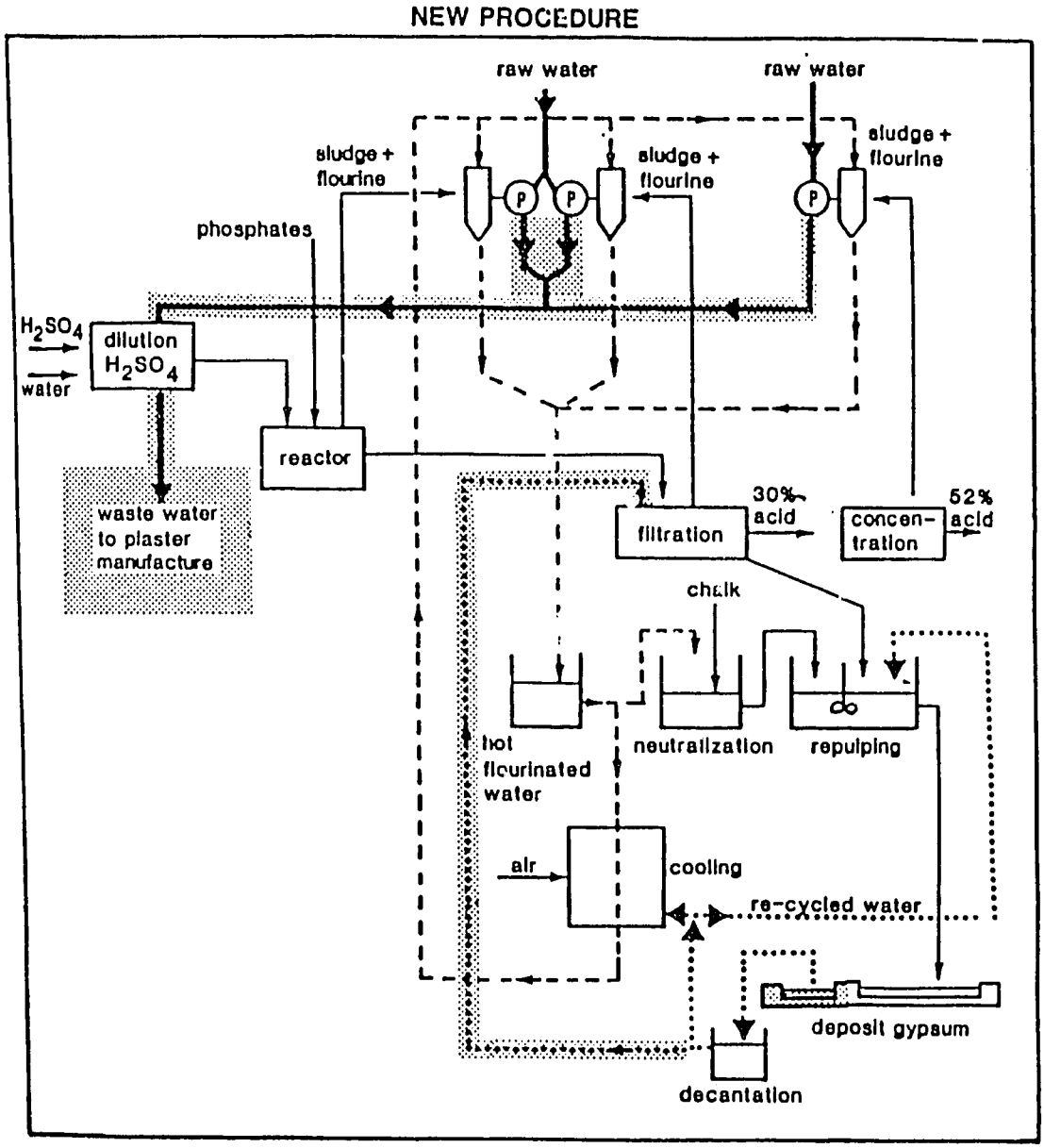
The fertilizer industry is a huge consumer of phosphate. Phosphoric acid, the backbone of phosphate fertilizer, is formed by mixing phosphate rock with sulphuric acid. The waste stream of greatest concern in phosphoric acid manufacture is fluoride. A simple process change in phosphoric acid manufacture can result in a reduction of fluorine ions and less wastewater discharge. Recycled wastewater is placed back into the repulping bath while raw water is used in H_2SO_4 dilution. This change requires an investment of over $120,000 but requires annual operating costs of only $1,928 as opposed to the old method with annual operating costs of $42,846. This could result in a payback of about three years. A new procedure for phosphoric acid manufacture can be found in Figure 4-6.

4.2.9 Printing and Film Developing

Printing and film developing are industries which involve relatively large amounts of contaminated aqueous and hazardous liquid wastes, as well as pollution from volatile organic compounds.

One solution to disposing of ink as a hazardous waste is to purify ink by using micro or ultrafiltration to filter out particles and mix old ink with new ink for reuse. Ink recycling systems can be purchased and installed for under $50,000. These systems have the capacity to blend inks of different colors with additives to make black inks. These inks are particularly good for newspaper printing where a lower grade ink is perfectly acceptable. Similarly there are several ways to combat inefficient ink consumption. Extending life of ink with ultraviolet inks which contain no solvents and which can remain in ink fountains for long periods without drying reduces the amount of waste ink which cakes around the sides of the fountains. Similarly using electron beam drying inks (for web presses) instead of heat-set inks, require less total ink, and the drying process is less energy intensive. Despite their advantages, these two ink replacements have serious drawbacks in terms of human exposure and should only be used when proper occupational safeguards (totally absent in the industrial facilities visited by the Team) are in place.

Figure 4.6
Phosphoric Acid Manufacture Procedure



Source: Overcash, 1986

For this reason vegetable-based inks should be considered as a replacement. These inks are generally made of soy oils and contain less than five percent VOC's compared to 30 to 35 percent for petroleum based inks. Paper printed with soybean inks require half the energy to recycle. Pine resins are utilized instead of petroleum resins, and alcohol is not required in lithographic operations. Furthermore, pigments are being developed which do not contain heavy metals. Soy-based inks, though better environmentally, are only competitive in certain applications such as sheet-fed, and form ink markets, but not heat set inks. Colored vegetable inks are comparable in price to colored petroleum inks. However, the cost of black vegetable inks is nearly 25 percent higher. (Pardue, 1992)

Ink waste and spoilage around the press can be prevented, and optimum inking conditions in the fountain can be maintained by installing an automatic ink leveler in the fountain. Alternative fountain solutions which do not contain isopropyl alcohol are also environmentally preferable.

Traditionally in the printing industry, mechanical vane-type pumps with impellers to pump ink through printing presses have been used. Standard pumps bring solvent-based ink to a temperature of 100°F (37.8°C), thus contributing to high levels of volatilization. Diaphragm pumps serve as an alternative to traditional pumps for sending ink through printing presses. These pumps bring the temperature of the solvent-based ink to only 80°F (26.7°C), thus decreasing the amount of solvent lost though evaporation.

In photo processing, generation and disposal of silver-contaminated wastewater is the cause of most of the pollution. This can be combatted either by using silver-free films (vesicular, diazo, and electrostatic films), or by exercising silver recovery through an automated, closed-loop, fixed management system.

One such system involves electrolytic recovery. In this process, silver which is complexed with thiosulfate ion, is subjected to a current at low voltage. At the stainless steel negatively charged cathode, the silver-thiosulfate complex is disassociated into its components and then to metallic silver and free thiosulfate. Silver is then recovered and the sulfite is oxidized from the reusable fixer bath at the positively charged graphite anode. Ion exchange is also effective, but it requires extreme care in monitoring and operating and it requires regular changes of the ion exchange resins to avoid too much biological growth. Ion exchange is also only effective in recovering silver from the washes at certain stages, not in recovery from end-of-pipe wastes.

Wastes from image processing can be minimized with electronic pre-press systems. Images are fed into an electric scanner and edited on a display monitor rather than on paper, thus reducing the amount of silver and waste paper consumed. This technology increases productivity with capital investment costs of well over $50,000. Countercurrent washing can also be used to curtail liquid wastes. In countercurrent rinsing, the water from previous rinsing goes into the film washing stage. Fresh water is used only at the final rinse stage, at which point most of the contamination has already been rinsed off the film.

Conventional black and white films for diagnostic hardcopy production require wet chemicals and result in generation and disposal of hazardous waste. These films which are used primarily for radiology in hospitals can be replaced by a dry-process digital laser imaging system which eliminates the need for wet chemicals. Similarly, traditional water-based paper and film developing units generate large amounts of fixer waste. This waste can be decreased by installing waterless paper and film developing units.

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ANNEX A
Indefinite Quantity Contract (IQC) and Specifications

UNITED STATES OF AMERICA
AGENCY FOR INTERNATIONAL DEVELOPMENT

Advisory or Assistance Services YES (X) NO ( )

1. Countries of Performance: Jordan, Egypt, Morocco, Tunisia, & U.S.A.

2. Indefinite Quantity Contract PDC-5517-I-00-0104-00, Delivery Order No. 12 (Incorporating FAR and AIDAR Clauses)

NEGOTIATED PURSUANT TO THE FOREIGN ASSISTANCE ACT OF 1961, AS AMENDED, AND EXECUTIVE ORDER 11223

3. CONTRACTOR (Name and Address): International Resources Group, Ltd. 1400 I Street, N.W. Washington, D.C. 20005 DUNS No. 195-251-889 TIN No. 112-490-777	4a. ISSUING OFFICE: Agency for International Development Office of Procurement OP/B/HNE Washington, D.C. 20523-1424 4b. ADMINISTRATION OFFICE: Agency for International Development Office of Procurement, MS/OP/B/HNE Washington, D.C. 20523-1424
5. PROJECT OFFICE: Agency for International Development NE/DR/ENR, Room 200, SA-2 Washington, D.C. 20523-0225	6. PAYING OFFICE: SUBMIT INVOICES TO: Agency for International Development PFM/FM/CMPD/DCB, Rm. 700, SA-2 Washington, D.C. 20523-0209
7. EFFECTIVE DATE: July 20, 1992	8. ESTIMATED COMPLETION DATE: November 20, 1992

9. ACCOUNTING AND APPROPRIATION DATA:

Amount Obligated:	$201,191	PIO/T No.:	See ARTICLE XVIII
Ceiling Price:	$201,191	Project No.:	298-0249
Appropriation No.:	See ARTICLE XVIII	Allotment No.:	See ARTICLE XVIII
		Budget Plan Code:	See ARTICLE XVIII

10. The United States of America, represented by the Contracting Officer signing this Order, and the Contractor agree that: (a) this Order is issued pursuant to the Contract specified in Block 2 above and (b) the entire Contract between the parties hereto consist of this Order and the Contract specified in Block 2 above.

11a. NAME OF CONTRACTOR: International Resources Group	11b. UNITED STATES OF AMERICA AGENCY FOR INTERNATIONAL DEVELOPMENT
BY: (Signature of authorized individual) Robert A. Delemarre	BY: (Signature of Contracting Officer)
TYPED OR PRINTED NAME: Robert A. Delemarre	TYPED OR PRINTED NAME: Orion Yeandel (ERB)
TITLE: Group Manager	TITLE: CONTRACTING OFFICER
DATE: 7/16/92	DATE: JUL 16 1992

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ARTICLE I - TITLE

Environmental Private Sector Initiatives for the Near East
(PD&S 298-0249)

ARTICLE II - BACKGROUND

Near East countries are facing an environmental crossroads due to rapid urbanization and industrialization resulting in additional degradation of the environment. Industries are being faced with increasing pressure to clean up their operations and increase their efficiency. However, their current choices tend to lean toward the more expensive end-of-pipe control technology. The newer concepts of waste minimization/pollution prevention and conservation are needed to be brought to their attention of these industries. They need to avail themselves of the most current environmental technology and industrial philosophy from the United States in order to best address these problems in a low cost sustainable manner.

The time has come to share with Near East developing nations the costly lessons learned by the United States: that preventing environmental problems is much less expensive than cleaning up pollution and contamination of the environment. Sustainable economic development requires environmentally responsible technologies, industries, and public policies, as well as a full range of resource conservation strategies.

There is potential for the formation of a new private sector partnership between the United States and the Near East nations to share clean technologies and water conservation techniques to meet a broad range of urban, industrial, and agricultural needs. With such a program in place, Near East countries will have the opportunity to rapidly leap-frog conventional, costly, and often ineffectual pollution controls nd waste management strategies to use clean technologies, clean products, and water conservation techniques essential for sustainable development in the face of rapid population growth. This anticipated program could act as an initiative or catalyst to put U.S. private sector suppliers in direct contract with exactly the right people in the industrial and agricultural sectors in Near East countries focusing on specific needs and market opportunities.

This initiative could be a major vehicle for mobilizing U.S. companies to market a host of environmentally responsible technologies, processes, products, and services. Participating U.S. companies will not be merely from the traditional pollution control and waste management sector, but more importantly they

will be from virtually every sector of the American economy, because pollution prevention thinking reconfigures core industrial and agricultural technologies to use less valuable resources and to produce less waste and pollution from the onset.

The purpose of this delivery order is to conduct a feasibility study necessary to identify the main potential actors and develop the conceptual framework for such an initiative in U.S. industry and the Near East. The study will assist the Near East Bureau determine if it is feasible to develop an initiative that would put in place an expeditious, fast-track delivery system for supplying U.S. products and services to serve targeted Near East industrial/agro-industrial and environmental needs.

ARTICLE III - OBJECTIVE

To conduct a feasibility analysis for development of an initiative to form a private sector partnership between the U.S. and Near East countries to supply pollution prevention and waste minimization technology.

ARTICLE IV - STATEMENT OF WORK

General

The Contractor shall conduct a feasibility study for the development of an environmental partnership initiative for the Near East.

Specific Tasks

The Contractor shall perform the following tasks:

Task Number 1 - Initial Analysis and Profile

The Contractor shall conduct and prepare an initial analysis and profile of current and longer-term environmental issues and needs of industry in the A.I.D. Near East countries of Egypt, Morocco, Tunisia and Jordan. The Contractor shall analyze and assess currently available measurement methods at the company, industry, and national levels for specific environmental problems (e.g. water pollution, air pollution, waste generation, etc.). Based on this analysis and consultations with the A.I.D. Project Officer, the Contractor shall select one of the Near East countries for the preliminary market analysis (see Task 3).

Task Number 2 - Analysis Summaries

The Contractor shall prepare a 1-2 page summary of the analysis conducted for each country listed in Task No. 1 above (a total of 4 summaries).

Task Number 3 - Market Analysis

The Contractor shall conduct a preliminary market analysis of most needed U.S. products and services for the selected Near East country (see Task No. 1). A focus of the analysis is on the incentives for industry to ameliorate their environmental problems.

Task Number 4 - Main Report

The Contractor shall prepare a main report which shall incorporate the preliminary market analysis (see Task No. 3) and shall include the following:

a. An analysis of how the capabilities, technologies, and products of U.S. industry including trade associations, private companies, and universities can be tapped. The Contractor shall emphasize the following methods: low-cost/no-cost ways to improve systems and operation to cut water use, materials use, and waste outputs; improved closed loop and external recycling of water, materials, and wastes; improved technologies, operations, and procedures; and improved water treatment, pollution control, and waste management techniques which cut costs and assist resource conservation and minimize generation of residuals. The Contractor shall also describe the currently available methods of identifying key technologies.

b. The identification of opportunities to serve Near East environmental needs with U.S. technologies and products.

c. An examination of the feasibility of implementing a new type of private sector organization, which focuses on mobilizing the American private sector to address specific Near East needs. The Contractor shall interview U.S. private sector professionals to obtain their recommendations for making the concept practical and effective.

d. The identification of important opportunities for cooperation with Near East bilateral and centrally funded A.I.D. projects and with private sector organizations. The Contractor shall examine current A.I.D. supported programs with special attention to the Project in Development and the Environment (PRIDE), with which the proposed initiative should work cooperatively to avoid redundancy.

Based on the above sub-tasks (a - d), the Contractor shall provide findings and recommendations and shall develop the conceptual framework of the recommended program elements for the proposed initiative. The Contractor shall focus on the feasibility of the proposed initiative, including options for administration and management, and identify costs, and benefits.

ARTICLE V - REPORTS AND DELIVERABLES

Report Number 1 - Initial Analysis and Profile

The Contractor shall submit/deliver one hard (1) copy of the initial analysis and profile (see Task No. 1 above) to the A.I.D. Project Officer (see Block 5 of the Delivery Order cover page) no later than 14 calendar days before finishing the initial site visits to the region.

Analysis Summaries

a. The Contractor shall submit/deliver one hard (1) copy of the analysis summary prepared for Egypt (see Task No. 2 above) to the A.I.D. Project Officer and one (1) hard copy to the USAID/Cairo technical representative prior to leaving Egypt.

b. The Contractor shall submit/deliver one hard (1) copy of the analysis summary prepared for Morocco (see Task No. 2 above) to the A.I.D. Project Officer and one (1) hard copy to the USAID/Rabat technical representative prior to leaving Morocco.

c. The Contractor shall submit/deliver one hard (1) copy of the analysis summary prepared for Tunisia (see Task No. 2 above) to the A.I.D. Project Officer and one (1) hard copy to the USAID/Tunis technical representative prior to leaving Tunisia.

d. The Contractor shall submit/deliver one hard (1) copy of the analysis summary prepared for Jordan (see Task No. 2 above) to the A.I.D. Project Officer and one (1) hard copy to the USAID/Amman technical representative prior to leaving Jordan.

Report Number 2 - Market Analysis

The Contractor shall submit/deliver one hard (1) copy of the market analysis (see Task No. 3 above) to the A.I.D. Project Officer no later than 21 calendar days of completion of the field work in the selected target country.

Report Number 3 - Draft Main Report

The Contractor shall submit/deliver one hard (1) copy of the draft main report (see Task No. 4 above) to the A.I.D. Project Officer for comment no later than 30 calendar days after the submission of the market analysis (see Report No. 2).

Report Number 4 - Final Main Report

The A.I.D. Project Officer shall provide comments on the draft main report to the Contractor no later than 14 days after receipt of the draft report from the Contractor. After incorporating the comments provided by the A.I.D. Project Officer on the draft main report (see Report Number 3 above), the Contractor shall prepare the final main report. The Contractor shall submit/delivery thirty (30) hard copies of the final main report (see Task No. 4) to the A.I.D. Project Officer for comment no later than 14 days after receipt of the comments from the A.I.D. Project Officer.

ARTICLE VI - RELATIONSHIPS AND RESPONSIBILITIES

Technical directions during the performance of this delivery order will be provided by the A.I.D. Project Officer (see Block 5 of the Delivery Order cover page) pursuant to Section F.5. of the contract.

ARTICLE VII - TERMS OF PERFORMANCE

A. The effective date of this delivery order is the date shown in Block 7 of the cover page and the estimated completion date is the date shown in Block 8 of the cover page.

B. Subject to the ceiling price established in this delivery order and with prior written approval of the A.I.D. Project Officer (see Block 5 of the cover page), the contractor is authorized to extend the estimated completion date, provided that such extension does not cause the elapsed time for completion of the work; including the furnishing of all deliverables, to extend beyond thirty (30) calendar days from the original estimated completion date. The contractor shall attach a copy of the A.I.D. Project Officer's approval for any extension of the terms of this delivery order to the final voucher submitted for payment.

C. It is the contractor's responsibility to ensure that the A.I.D. Project Officer-approved adjustments to the original estimated completion date do not result in costs incurred which exceed the ceiling price of this delivery order. Under no circumstances shall such adjustments authorize the contractor to be paid any sum in excess of the delivery order.

D. Adjustments which will cause the elapsed time for completion of the work to exceed the original estimated completion date by more than thirty (30) calendar days must be approved in advance by the Contracting Officer.

ARTICLE VIII - WORKDAYS ORDERED

A. Functional Category & Specialist	Work Days Ordered	Burdened Fixed Daily Rate	Total
Environmental Engineer (J. Hirschhorn)	80	$469.50	$ 37,560
Environmental Engineer (W. Lacy)	72	$469.50	33,804
Pollution Control & Management Spec. (J. Rams)	42	$345.00	14,490
Economics/Natural Resource Economics & Policy Spec. (A. Banskota)	55	$352.17	19,369
Environmental Policy & Legislation Spec. (S. Ganguli)	80	$156.24	12,499
Information & Data Mgt (D. Whitten)	80	$170.40	13,632
Pollution Control and Management Specialist (S. Login)	23	$217.50	5,003
Information & Data Mgt (R. Russell)	30	$142.05	4,262
TOTAL			$140,619

B. The above-named individuals are designated as key personnel pursuant to Section H.3.a. of the contract.

C. Subject to the ceiling price established in this delivery order and prior written approval of the A.I.D. Project Officer, the contractor is authorized to adjust the number of work days actually employed in the performance of the work by each position in this order. The contractor shall attach a copy of the A.I.D. Project Officer's approval to the final voucher submitted for payment.

D. It is the contractor's responsibility to ensure that the A.I.D. Project Officer-approved adjustments to the work days ordered for each functional labor specialist do not result in costs incurred which shall exceed the ceiling price of this delivery order. Under no circumstances shall such adjustments authorize the contractor to be paid any sum in excess of the ceiling price.

ARTICLE IX - CEILING PRICE

For Total Work-Days Ordered	$140,619
Other Direct Costs	60,572
Ceiling Price	$201,191

ARTICLE X - USE OF GOVERNMENT FACILITIES OR PERSONNEL

The contractor, and any employee or consultant of the contractor, is prohibited from using U.S. Government facilities (such as office space or equipment) or U.S. Government clerical or technical personnel in the performance of the services specified in the contract, unless the use of government facilities or personnel is specifically authorized in this delivery order (see ARTICLE XIII), or is authorized in advance, in writing, by the Contracting Officer.

ARTICLE XI - PLACE OF PERFORMANCE

The duty post for this order is Washington, D.C.; Cairo, Egypt; Amman, Jordan; Tunis, Tunisia; and Rabat, Morocco.

ARTICLE XII - ACCESS TO CLASSIFIED INFORMATION

None

ARTICLE XIII - LOGISTICAL SUPPORT

None

ARTICLE XIV - WORK WEEK

Pursuant to Section F.2.d.(8) of the contract, a five-day work week is authorized while working in the U.S. While working overseas, a six-day work week is authorized with no premium pay.

ARTICLE XV - LANGUAGE REQUIREMENTS

None

ARTICLE XVI - EMERGENCY LOCATOR INFORMATION

The Contractor agrees to provide the following information to the Mission Administrative Officer on or before the arrival in a Cooperating Country of every contract employee or dependent:

1. The individual's full name, home address, and telephone number.

2. The name and number of the contract, and whether the individual is an employee or dependent.

3. The Contractor's name, home office address, and telephone number, including any after-hours emergency number(s), and the name of the Contractor's home office staff member having administrative responsibility for the contract.

4. The name, address, and telephone number(s) of each individual's next of kin.

5. Any special instructions pertaining to emergency situations such as power of attorney designees or alternate contact persons.

ARTICLE XVII - TERMS OF PERFORMANCE

The terms and conditions under which this order is issued are contained in Indefinite Quantity Contract No. PDC-5517-I-00-0104-00. Those terms and conditions are incorporated herein by reference. Nothing in this order shall amend or change the terms and conditions of the contract.

ARTICLE XVIII - ACCOUNTING AND APPROPRIATION DATA

PIO/T Number: 298-0249-3-2632415
Approp. Symbol: 72-112/31021.8
Budget Plan Code: NDH2-92-33298-KG62
Allotment Sybmol: 268-63-298-00-61-21
Amount: $48,000

PIO/T Number: 298-0249-3-2632416
Approp. Symbol: 72-11X1021.8
Budget Plan Code: NDHX-92-33298-KG62
Allotment Sybmol: 678-63-298-00-61-21
Amount: $27,386

PIO/T Number: 298-0249-3-2632651
Approp. Symbol: 72-1121021.6
Budget Plan Code: NDSA-92-33298-KG62
Allotment Sybmol: 246-63-298-00-61-21
Amount: $13,208

PIO/T Number: 298-0249-3-2632652
Approp. Symbol: 72-11X1021.6
Budget Plan Code: NDSX-92-33298-KG62
Allotment Sybmol: 676-63-298-00-61-21
Amount: $53,060

PIO/T Number: 298-0249-3-2632653
Approp. Symbol: 72-112/31021.6
Budget Plan Code: NDS2-92-33298-KG62
Allotment Sybmol: 266-63-298-00-61-21
Amount: $59,537

ANNEX B
Industrial Firms Surveyed

Table B-1

Industrial Firms Visited by EPSINE Survey Team in Egypt, Jordan and Tunisia

Firm	Location	Public/Private	Industry
A. Egypt:			
1. Egyptian Leather Company	Cairo	Public	Tanning of leather, production of Shoes and Boots
2. General Metals Company	Helwan	Public	Mfg of cast Lead Smelter and parts for furniture and appliances
3. Tourah Portland Cement Company	Helwan	Public	Production of Cement
4. Verta Company	Alexandria	Public	Production of corrugated board, wrapping paper, coated papers, labels, toilet paper and polyethylene film
5. Philips/El-Nasr Electrical & Electronic Apparatus Co.	Alexandria	50% GOE 50% Philips	Mfg of glass, light bulbs and fluoresent tubes. Mfg components and assemble T.Vs, Radios, Refrigerators and Washing Machines
6. Edfina Company for Preserved Foods	Alexandria	Public	Can a large variety of fruits and vegetables. Produce juices and juice drinks, jams, jellies and condiments
7. ARABB	10th of Ramadan City	80% ABB 20% GOE	Mfg of switchboards and circuit breakers
8. BTM	10th of Ramadan City	Private	Mfg of high quality garments including shirts, trousers, skirts and blouses
9. Egyptian Int'l Pharmaceutical Co.	10th of Ramadan City	50% Private 50% GOE	Mfg of a wide variety of pharmaceuticals

Firm	Location	Public/Private	Industry
B. Jordan:			
1. Jordan Tanning Company	Zarka	Public	Tanning of hides and production of high quality leathers
2. Jordan Paper & Cardboard Factories Co.	Zarka	Public	Mfg corrugated boxes, fluting and liner material
3. Jordan Chemical Industries Co., Ltd.	Zarka	Public	Mfg of liquid bleaches, dish detergents, laundry detergents, shampoos, glass cleaners, and drain cleaners marketed under the HYPEX Label
4. United Chemical Co. (Unichem)	Amman	Private	Production of water-based emulsions, enamels and industrial epoxies
5. The Arab Pharmaceutical Mfg. Co., Ltd.	Salt	98.5% Private	Production of a wide range of pharmaceuticals, for domestic & export markets
6. Jordan Phosphate Mines Co.	El-Abiad El-Hasa	Public	Mining and processing (crushing, screening and drying) of phosphate ores
C. Tunisia:			
1. SNCPA	Kasserine	Public	Producer of high-quality paper for printing of money, and for cigarette paper. Producer of lower quality paper for writing tablets, bank forms, art work, etc.
2. Societé Gamouda, S.A.	Sidi Bouzid	Private	Producer of Tomato Paste
3. Societé Industrielle d'Acide Phosphorique et d'Engrais	Sfax	Public	Producer of Phosphoric & Sulfuric Acids, and fertilizers including. Triple Superphosphate; Superphosphate; Diammonium Phosphate; Ammonium Phosphate; and Di-calcium Phosphate
4. Sios - Zitex	Sfax	Private	Producer of edible olive oil, soaps and detergents
5. Societé Calembo	Sfax	Private	Largest Tunisian processor of seafood including shrimp, octopus & cuttlefish
6. Les Tanneries Modernes de la Manouba	Tunis	Private	Producer of high quality leather for export
7. Societé de Fabrication de Produits Chimiques	Tunis	Public	Producer of soaps, detergents and bleaches

Table B-2

Government and Private Agencies & Associations Visited by the EPSINE Survey Team in Egypt, Jordan and Tunisia

Group	Key Contact Person(s)	Location
A. Egypt:		
1. USAID	Henry Bassford, Director Chris Crowley, Associate Director for Program Development & Support Richard Rhoda, Environment Officer Magdy S. Khalil, Office of Finance & Investment Lawerence Brown, Director, Office of Finance & Investment Nagui Taha El-Fayoumi, Senior Advisor, Trade & Investment	Cairo
2. American Embassy	Larry Jensen, Commercial Counselor	Cairo
3. Federal of Egyptian Industries	Mohamed Kamal, Executive Director of Energy Conservation & Efficiency Project	Cairo
4. Egyptian Environmental Affairs Agency	Tarek Gemena, Director of International Cooperation Unit	Cairo
5. Tabbin Institute of Metallurgical Studies	Dr./Engineer Ahmed Amin Abdul Maguid, Executive Director	Helwan
6. Egyptian High Institute of Public Health	Dr. S. Saad	Alexandria
7. Environmental Quality International	Dr. Mounir S. Neamatalla, President	Cairo
8. Science & Technology Corporation	Dr. Fawzi Elrefaie	Cairo
9. American Chamber of Commerce in Egypt	Hisham Fahmy, General Manager Dalia F. Wahba, Membership Ronald G. Nardi, Chairman	Cairo
10. Government Office for Investment, Ministry of Industry, GOE	Faika O. Sedky, Under Secretary of State for Private Sector Investment & Information Center	Cairo
11. Ministry of Cabinet Affairs and the Environment	Dr. Atef Ebaid, Minister & Selah Hafez, Chairman of Egyptian Environmental Affairs Agency	Cairo

Group	Key Contact Person(s)	Location
B. Jordan:		
1. USAID	Thomas Oliver, Director B. Schouten, Deputy Director Carl A. Dutto, Director of Water, Environment & Agribusiness Abdullah A. Ahmad, Mission Engineer	Amman
2. American Embassy	James J. Turner, Economic/Commercial Officer	Amman
3. Royal Scientific Society	Dr. M. J. Bino, Director of Environmental Research Centre	Amman
4. The Jordanian Society for the Control of Environmental Pollution	Dr. Engr. Sager Salem Al Salem, Secretary General	Amman
5. The Royal Society for the Conservation of Nature	Dr. Anis Mouasher, President	Amman
6. Jordan Bureau for Water Consultation	Dr. Usama H. Mudallal, Managing Director	Amman
C. Tunisia		
1. USAID	J. Graham, Director H. Lakhdhar, Staff Engineer R. Nafti	Tunis
2. Association Tunisienne de la Protection de la Nature et l'Environment (ATPNE)	Dr. M. Ali Abrougui, President	Tunis
3. Ministry of International Cooperation	Salah Hannachi, Secretary of State	Tunis
4. ENIS (Industrial/Analytical Lab)	Rachio - Triki, Ministère de l'Environment and Dr. Khaled Medioub	Sfax
5. Cambre de Commerce et d'Industrie du Sud	Mohamed Amous, President	Sfax
6. L'Agence Nationale de Protection de l'Environment (ANPE)	Mohamed Ennabli, President	Tunis
7. Union Tunisienne de l'Industrie du Commerce et de l'Artisanat (UTICA) and Fédération Nationale de la Chimie (FNAC)	Tarak Cherif, President	Tunis
8. Audit Environmental	Baouendi Abdelkader, Consultant	Tunis
9. Institut Régional des Sciences Informatiques et des Telecommunications (IRSIT)	Mondher Makni	Tunis
10. Ministère de l'Environment et de l'Amenagement du Territoire	Fayez Ayad, Chef de Cabinet Hachmi Kennou, Président - Directeur General (ONAS)	Tunis
11. Corps International de Services des Experts (IESC)	Walter L. Vollum, Directeur - Général and Moncef Elaoud, Directeur Chargé des Relations Commercial	Tunis