Profile of the Environmental Business Sector in Egypt

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Contents

Executive Summary 1

Introduction and Overview 7

- Purpose of the Report 7
- Definition of the Environmental Business Sector 7
- How to Use the Report 8
- Overview of Egypt's Environmental Situation 9
- Best Business Opportunities 13

Business Activities in the Environment 14

- Environmental Monitoring and Testing 14
- Municipal Water and Wastewater Treatment 19
- Industrial Wastewater Treatment 28
- Environmental Consulting Services 35
- Water Purification Systems 40
- Municipal Solid and Hazardous Waste Collection and Disposal 43
- Waste Recycling and Associated Businesses 49
- Point Source Air Pollution Control 55
- Renewable Energy 60
- Mobile Source Air Pollution Control 65

What is Needed to Take Advantage of the Opportunities 69

- Information on Market Opportunities 69
- Access to New Technologies and Approaches 70
- Participation of Foreign Environmental Companies 70
- Development of Operation and Maintenance Capabilities 71
- Training 71
- Financing for Feasibility Studies and Capital Investments 71
- Creation of Market Demand 71
- Privatization of Industrial Enterprises 72
- Elimination of Trade and Non-Trade Barriers 72

Appendices

- A. Environmental Problems and Trends in Egypt A1
- B. Business Climate in Egypt B1
- C. Regulatory Framework C1
- D. Resources D1
- E. Selected Bibliography E1
- F. Report Methodology F1
- G. People Interviewed G1
- H. Acknowledgements H1

EXECUTIVE SUMMARY

This report is the first of several activities supported by the Project in Development and the Environment (PRIDE) and designed to help the Egyptian and U.S. private sectors participate in environmental business development in Egypt. It defines the environmental business sector in Egypt, describes products and services that the country will need, identifies opportunities, and offers other useful information. The findings presented here were developed through field and survey research conducted in Egypt in April and May 1992.

Egypt suffers from a number of serious environmental problems. The degradation of its air, water, and land results from a burgeoning urban population, heavy dependence on a single body of water, the Nile, and industrial/commercial growth that has occurred with little regard for environmental concerns. Intensive fertilizer and pesticide use also contributes to the environmental deterioration. Water scarcity is a perpetual problem; water conservation and treatment will become critically important in the coming decade as Egypt attempts to maintain adequate water supplies. Air pollution and solid waste management have also become serious problems. Over the last 40 years, air quality has declined in Cairo along with the expansion of industries and motor vehicle use. Pollution levels in Cairo often exceed World Health Organization standards. An estimated 1,700 tons of solid waste uncollected each day in Cairo is either burned or left to decay. Only a small percentage of hazardous industrial waste is safely disposed of or treated.

The Government of Egypt (GOE) has numerous environmental laws, regulations, and decrees, but monitoring and testing are inadequate and enforcement is limited. Public awareness of environmental issues, generally a precursor to action, is minimal so far. In addition, the GOE cannot afford many of the environmental controls and end-of-pipe treatment approaches used in developed countries.

Despite the paucity of enforcement and the limited public awareness and funding, an environmental business sector does exist in Egypt. The authors estimate that over 100 companies operating in the country (Egyptian and foreign-owned) already provide some products or services defined as environmental business. Like the Egyptian economy, this sector is a mix of public and private enterprises; for the most part, the former manufacture equipment, whereas the latter provide services. Few of these companies are dedicated

exclusively to providing environmental goods and services. They generally fall into one of the following categories:

- large engineering and design companies (mostly privately owned)
- construction companies that build infrastructure, especially sewers (mixed private and public)
- agents/distributors of imported equipment (mostly private)
- public sector manufacturers of equipment for water supply needs (pipes, bricks, valves, pumps), some of which have added manufacturing lines for air and water control equipment
- consultants: individuals, research institutes, and private companies

Foreign companies participate in Egypt's environmental business sector primarily in two ways. The most common approach is to directly export equipment and supplies (including chemicals) to Egypt. The exporters typically work with exclusive agents/distributors who receive 5% commissions on sales of equipment and supplies. More than 50 agents/distributors in Egypt import environmental business equipment. The other approach is to contract directly with donor agencies or the GOE. For U.S. companies, this has generally meant contracting with the U.S. Agency for International Development (USAID). No foreign firms have invested directly in manufacturing facilities in the environmental business sector. Licensing of technologies has not been particularly popular with U.S. companies in Egypt, in part due to poor protection of intellectual property rights.

It is difficult to estimate the size of the environmental market in Egypt because no specific market statistics exist. Nearly 70% of respondents to a direct mail survey indicated that they did not know the size of Egypt's environmental market. The 1992 market is roughly estimated at $430 million, less than 2% of Egypt's total gross domestic product. Over the next five years, the total environmental market is expected to reach $1,150 million, representing annual growth of about 20%. Up to 40%, or $175 million, represents business for U.S. companies. Little of the existing $1.7 billion of direct U.S. foreign investment (excluding USAID) is in the environmental business sector. Over the next 10 years, direct foreign investment in this sector may begin, as local manufacturing opportunities emerge and public sector manufacturers are privatized. For the time being, public sector companies account for 70% of production, but there are more private sector companies.

Present and projected market size estimates by environmental business segment are shown on the next page:

Environmental Business Sector: Market Size Estimates by Market Segment

Market Segment	1992 Estimate (in US$ millions)	1997 Estimate (in US$ millions)
Municipal water and wastewater treatment	$350 (U.S. and donor assistance)	$550 - $700
Waste recycling services and equipment	$5	$8 - $10
Industrial wastewater treatment	$9	$100 - $150
Air pollution control	no information available	$100 - $150
Water purification systems	$30	$50 - $60
Municipal solid waste	no information available	no information available
Renewable energy (mostly wind)	$12	$20
Mobile source air pollution	$0	$10
Air and water monitoring and testing	$6	$10
Environmental consulting	$15	$40
Total estimated environmental market	**$430**	**$890-$1,150**

More than 60 private companies indicated in interviews that market demand is the most important factor in their review of environmental business opportunities. Given sufficient demand for products and services, the dynamic, growing private sector will begin to mobilize on its own.

The authors believe that expansion in existing businesses combined with the emergence of new opportunities will spur growth in the environmental sector. The clients for environmental businesses include the GOE and its ministries, donor agencies, governorates, large public sector companies, private sector companies, industrial estates, tourism developers, and individual consumers.

In terms of size alone, the environmental market is dominated by the $350 million per year municipal water and wastewater treatment segment that is largely driven by GOE infrastructure spending and support from donors, especially USAID. To some extent, the estimated $15 million environmental consulting market is also supported by donor funding and the environmental objectives of donor-supported projects.

Existing markets such as municipal wastewater and water purification systems are projected to continue to grow at more or less historical rates of 10% to 15% per year. Growth rates and the timing of new market development are more difficult to estimate.

For example, markets for point source air pollution and industrial wastewater treatment are in their infancy (except for some existing industrial air emission control and wastewater treatment facilities that were part of original industrial plant designs). These markets are poised to grow rapidly (over 25% per year) once the GOE steps up enforcement of air and water regulations. Several Egyptian companies are preparing to enter these markets, which they view as the best business opportunities over the near term.

Several environmental market segments do not depend on GOE enforcement or regulatory actions. For example, market forces drive waste recycling and sales of equipment for water purification and pretreatment for commercial and industrial use. The recycling industry in Egypt, like many other informal business sectors, operates almost exclusively on market supply and demand. The $30 million market for water purification and industrial pretreatment has grown out of water scarcity, industrial process requirements, and commercial needs that are unrelated to environmental regulations. These markets, then, are projected to grow at the same pace as the rest of the Egyptian economy.

The outlook is mixed for municipal solid waste collection and disposal. The demand for collection and disposal services and equipment is tremendous, but the current system structure is not sufficient to adequately service most areas. Some private sector collection activity has begun, an encouraging trend that hopefully will continue. However, few of the companies interviewed for this report expressed an interest in entering this market.

Other business opportunities are tied to the success of the GOE's economic policy reforms, privatization, and sectoral adjustment programs. For example, renewable energy and energy conservation markets are growing rapidly with the reduction in energy price subsidies, which will be fully removed in 1994. Sectoral adjustment in the water utility area could provide opportunities for private operation and maintenance services. Privatization will put more manufacturing and testing capability in private hands.

The table on the next page highlights the most attractive features of each of the 10 environmental business sectors described in the report.

Most Attractive Features of Environmental Business Segments

TYPE OF BUSINESS	Fast Growth Expected	Opportunity for U.S. Business	Opportunity for Egyptian Private Sector	Near-Term Market	Long-Term Market
Municipal water and wastewater	◑	●	●	●	●
Waste recycling	◑	○	●	◑	◑
Industrial wastewater	●	●	●	◑	●
Air pollution	●	◑	◑	◑	◑
Water purification	●	●	●	●	●
Municipal solid waste	◑	◑	◑	◑	◑
Renewable energy	◑	◑	◑	◑	●
Mobile source air pollution	○	○	◑	○	◑
Air & water monitoring and testing	◑	◑	◑	◑	◑
Environmental consulting	●	◑	●	●	●

KEY
○ = Low
◑ = Medium
● = Best

To realize these business opportunities, the private sector will need assistance in several important areas. First, the business community lacks the necessary technical skills. Training in environmental specializations will be necessary, especially in technical consulting and operation and maintenance. Second, the private sector needs access to products and services that are available in foreign countries. Agents/distributors and industrial companies need to know how to find suitable equipment to import. Third, the companies contacted frequently cited inadequate access to financing as a business constraint.

Foreign equipment suppliers must learn to adapt their products to meet Egyptian requirements. Generally, this means offering low-cost technologies that are easy to maintain and do not require expensive replacement of spare parts. Where spare parts are required, mechanisms should be developed to obtain them, such as local assembly and manufacturing or quick import.

Appendix D of this report lists organizational resources available to Egyptian and U.S. business people interested in the environmental business sector in Egypt, including GOE ministries, foreign chambers of commerce, Egyptian business organizations, U.S. government resources in Egypt and Washington, D.C., and USAID business development programs.

In conclusion, the Egyptian private business community should be considered an important participant in developing solutions for the country's environmental problems. More than 100 private companies are already in the business, and many more are ready to enter it once market demand increases. While selecting the "best" business opportunities is a subjective exercise, the authors feel that the five described below are the best bets in the environmental business sector.

Five Best Near-Term Business Opportunities

Industrial Wastewater Treatment: Equipment, Design and Process Engineering

- Great potential in industrial pollution prevention and materials recovery/recycling potential since it is often associated with cost recovery or increased profits
- Rapid market growth if GOE increases enforcement
- U.S. company opportunity to sell new technologies
- Little local competition for Egyptian companies in this very new field

Air Pollution Control: Equipment and Design

- Near-term opportunity if anticipated GOE programs to improve air quality are implemented
- Donor funding for air pollution projects may become available
- Good opportunity for Egyptian companies to sell design services
- For foreign companies, an opportunity to sell equipment

Environmental Consulting Services

- Fast growth (over 20% annually) expected
- New business opportunities for Egyptian firms to work with donor agencies
- Retention of foreign consultants for specific areas of expertise

Design and Installation of Desalination Units

- Consideration of privately-owned desalination units by tourism developers along the Red Sea
- Major project opportunities for U.S. suppliers of desalination units

Plastic Recycling

- Demand for more sophisticated recycling equipment
- Recycling industry already exists in Egypt
- Expectation that demand for and supply of plastic will increase steadily

INTRODUCTION AND OVERVIEW

Purpose of the Report

PRIDE (Project in Development and the Environment) has targeted the private sector as an important player in the delivery of solutions to environmental problems in Egypt. This report assesses the level and types of existing private sector business activity and their future potential. An important objective of the report is to identify and characterize the most attractive private sector business opportunities in the environmental goods and services sector. This has been done by analyzing the forces that drive the market, including the clients for such products, the market size, the competition, and the forces defining supply and demand.

This report will be made available to companies and other interested parties in Egypt and the United States to inform them of opportunities in Egypt's environmental market and provide them with a compendium of relevant business information. In addition, it is expected that the report will interest economic development officials who may want to include the private sector in environmental improvement projects.

Definition of the Environmental Business Sector

The environmental business sector includes companies that produce or sell products or services involved with: conserving natural resources or industrial materials; preventing, reducing, and controlling pollution; disposing of or recycling wastes and hazardous materials; protecting water supplies; conserving energy; providing energy from alternative sources; restoring the environment and its resources; and producing "environmentally safe" products. Numerous companies also provide support to the sector, including management consulting, advertising, and public relations firms that deal with environmental issues, and lawyers, financial institutions, and accounting firms with environmental practices.[1]

This report focuses on 10 types of environmental goods and services that reflect Egypt's specific environmental problems. Each of these categories addresses the

[1] *Massachusetts Environmental Industry/Education Resource Directory*, 1992.

deteriorating quality of water, air, or land resources. Together, they serve as a general definition of the environmental business sector in Egypt.

- Air and water monitoring, testing, and analysis equipment and services
- Municipal water supply and wastewater treatment equipment and design, construction and operation
- Industrial wastewater treatment equipment, design, and operation
- Environmental consulting services, including:

  -- industrial waste minimization and resource recovery consulting
  -- preparation of environmental impact assessments
  -- policy and regulatory, and economic management consulting
  -- environmental education and training services

- Water purification equipment and installation for industrial, commercial, and domestic use
- Solid waste collection and disposal, including hazardous waste
- Waste recycling services and equipment
- Point-source air pollution control design, equipment, and operation
- Renewable energy and energy conservation
- Mobile source air pollution control equipment and services

How to Use the Report

This report is divided into three sections and several appendices. The first section highlights what the authors consider to be best business opportunities in the environmental business sector in Egypt. It also provides an overview of Egypt's environmental problems and a definition of the environmental business sector. A more detailed description of Egypt's environmental problems, GOE organization and environmental laws, and background information on the business climate is found in Appendix A.

The *Business Activities in the Environment* section provides a detailed description of ten environmental market segments. Each section is organized in the same way to provide an overview; a table assessing the appeal of each market; a description of the products, services, and technologies in each segment; and information on potential clients, market demand, supply, competition, ownership, and strategies for and costs of entry. The last section suggests what is needed to take advantage of the opportunities.

Resources—organizations, individuals, and government agencies and ministries—are listed in Appendix C. The remaining appendices contain a list companies and people who participated in interviews, a bibliography, the study methodology, and acknowledgements.

Overview of Egypt's Environmental Situation

Egypt's high population density, along with the rapid growth of intensive agriculture, industrialization, and urbanization, have given rise to several chronic environmental problems. With an annual population growth rate of approximately 2.4%, pressures on Egypt's natural resource base will continue to increase. The construction of the massive Aswan High Dam, which was completed in southern Egypt in 1970, has allowed the country to harness energy and stem seasonal flooding. The country's dependence on the Nile River is great: over 99% of its water comes directly or indirectly from the Nile. The Nile Valley and the Delta contain virtually all Egypt's arable land.

The lack of government emphasis on protecting Egypt's water resources, along with industrial growth, have led to significant decreases in Nile River water quality in the past few decades. This decline results from the agricultural runoff of chemicals and minerals, industrial and municipal waste, and high silt concentrations. For lack of other water resources, the growing demand will have to be met by tapping more water from drains, which receive used, untreated water from municipal, industrial, and agricultural sources. Relying on wastewater as a source for agriculture and other uses forebodes numerous hazards. Nonetheless, projections show that without water conservation measures, drainage waters will be increasingly used for agricultural, domestic, and commercial purposes. As a result, water conservation and treatment will become crucial to maintaining adequate water supplies in the coming decade.

Currently 90% of Egypt's effluent is untreated. Industries dump effluent at 20 monitored locations along the Nile and at some 80 unmonitored locations on irrigation and drainage canals. Most Egyptian villages lack wastewater treatment and collection systems. Egypt's freshwater lakes in the Delta region, which provide 50% to 60% of Egypt's total fish catches, have also felt the results of uncontrolled effluent discharging. The water quality of two of the five largest lakes in the Delta region, Lake Manzala and Lake Maryut, has dramatically declined. The heavy use of pesticides and fertilizers has led to high concentrations of residues in agricultural runoff waters, rendering them unsuitable for reuse.

Over the last 40 years, air pollution has become a serious problem in Egypt. Air quality has declined rapidly in Cairo and Alexandria as a result of industrialization, and the increase in motor vehicles, large industries, workshops, small industries, and thermal power stations. Heavy air pollution is adversely affecting human health, soil, water, agricultural crops, buildings, and livestock. Pollution levels in the Cairo city center often exceed World Health Organization standards.

The Mediterranean and the Red Sea coastlines comprise about half of Egypt's boundaries, 2,000 km (1,240 mi). The environmental quality of the coastal regions is threatened by oil exploration, production, and transportation by tankers in the Red Sea region, as well as urbanization, industrialization, and tourism development in Egypt's coastal

zones. Improperly planned coastal development, unsafe trash and raw sewage disposal, and poorly managed boating and fishing activities threaten the natural resources of coastal areas.

Egypt's rapid growth has surpassed its ability to dispose of its solid waste adequately. Currently, composting plants and sanitary landfills in Greater Cairo have a combined maximum capacity of 1,200 tons/day, only 22% of the 5,300 tons/day generated. Indiscriminate dumping on city outskirts, in drainage canals, and in other inappropriate spots is common. In Cairo, about 68% of municipal solid waste generated is collected, but only 15% is collected in smaller municipalities. An estimated 13,000 tons of hazardous hospital waste and 50,000 tons of industrial solid hazardous waste are generated each year in Cairo.

Since 1946, Egypt has passed eight laws pertaining to water quality and wastewater discharges. In most cases, the new law has replaced a previous law. Currently, Law No. 93 of 1962 and Law No. 48 of 1982 and its supplemental implementation decrees form the standing regulatory framework for wastewater discharges and water quality management. Law 93 and its resolutions address a variety of water- and sewerage-related issues and apply to all kinds of water bodies. According to the law, emitters of wastewater must obtain licenses that "should indicate the standards and specifications of such wastewater." Samples from sewerage treatment plants should be analyzed periodically. The law also sets standards for eight conditions of wastewater discharged into public sewers (temperature, pH, settleable solids, granular solids, hydrogen sulphide, fats, poisonous substances, and sublimating gases susceptible to ignition).

Law 48, "Regarding the Protection of the River Nile and Waterways from Pollution," and its Decree No. 8 define targeted water bodies and discharge types much more specifically for a long list of site types, discharges, and conditions. Water bodies falling under the jurisdiction of Law 48 include fresh surface waters, brackish surface waters, and groundwater reservoirs. Of particular interest are the conditions under which permits and licenses must be obtained. The law is quite specific, defining standards for over 30 parameters for some water and effluent classifications, including a variety of organic and inorganic chemicals.

While few laws address air pollution control exclusively, 25 laws and decrees within several ministries contain sections on the subject. Penalties and enforcement procedures often overlap among agencies and tend to be poorly defined. The GOE has defined ambient air quality standards for a sizable list of gaseous and particulate components, but its standards tend to be inconsistent with international air quality standards, ranging from much higher to much lower. A clean air law which would unify existing regulations is coming before the Egyptian Parliament this year.

Law No. 38 of 1967 and its amendment by Law No. 31 of 1976 regulate the collection and disposal of municipal solid waste. The law mandates that waste can be disposed of only in areas designated by local government councils. Law 3 of 1982 on urban

planning sets land use criteria, some of which pertain to industrial areas. This law is implemented by the Ministry of Reconstruction, Housing and Development.

No regulations are currently on the books regarding industrial and hazardous waste, but some tangential laws do apply. For example, the transport, handling, and storage of chemicals are considered in laws specific to chemicals. Also, if the disposal of the hazardous waste were to affect water quality, it would fall under the jurisdiction of Law No. 48 of 1982. Finally, no laws exist that regulate hospital and laboratory waste.

Until the GOE released its Environmental Action Plan this year, it had no concise statement of its environmental policy objectives. The result is that enforcement of the environmental laws scattered among agencies and ministries has been limited. While legislative instruments and standards exist, they are overlapping and unenforceable in several areas. Their administration has been assigned to various ministries, which have issued implementing regulations. To date, however, they are uncoordinated among the ministries or by an overarching authority such as the Egyptian Environmental Affairs Agency (EEAA), which was created by prime ministerial decree in 1982. The EEAA was intended to fulfill three tasks: 1) to coordinate efforts of the various ministries and agencies on environmental matters, 2) to prepare environmental legislation, and 3) to follow up on the implementation of environmental laws. It is hoped that the release of the Environmental Action Plan, coupled with increased interest in the environment, will lead to improved enforcement.

An additional problem has been that standards tend to be too rigid, often on a par with international or Western norms, instead of formulated to fit the Egyptian context. In the case of Law No. 48, for example, the release of waste requires a license that is granted based on set standards, but the GOE has neither the administrative nor the technical infrastructure to supply the licenses, let alone to investigate non-compliance.

Most of Egypt's current regulatory process is based on pollution discharge sanctions, or the "polluter pays" principle. Point polluters are responsible for keeping pollution discharges below some standard, generally an international pollution standard. One reason this approach has not been effective is that the standards generally do not allow reasonable flexibility for both the polluter and the GOE regulatory agency to reach quick agreement on a compliance schedule. Instead, much of the regulatory process consists of informing the polluter of a violation, without any provision for a phased period in which to achieve compliance. Finally, the lack of a centralized and consistent enforcement mechanism combined with the unenforced laws, may further reduce the willingness to comply.

The GOE has already taken significant action to stem industrial pollution; evidence indicates that polluting industries are feeling ever greater pressure to control pollution. The government is beginning to interact with plants to sample their wastes, and in selected situations, is requiring the industry to reduce discharges. For example, in Alexandria, a paper products plant is installing over $1 million of waste treatment equipment as a result of visits by what employees call the "pollution police." Another facility in Alexandria which

manufactures household appliances is investigating how to minimize wastes and prevent pollution. The mayor of Alexandria has stated that all people and institutions in the city must begin to conserve water and reduce their atmospheric, liquid, and solid discharges into the environment. He is considering a major environmental information program while studying ways to encourage and require industry to be more environmentally conscious.

In Cairo and surrounding areas, a large pharmaceutical plant has recently installed an incinerator because of the lack of environmentally acceptable disposal sites for solid wastes and off-spec materials. Also in Cairo, a textile factory has begun to recycle its process water because of rising water costs and fear that enforcement of sewage discharge regulations will increase, leading to possible surcharges for industrial discharges to the municipal sewerage system.

Best Business Opportunities

The best opportunities in the environmental business sector are businesses in market segments that are expected to grow rapidly (over 20% per year) over the next five years. For some, market growth depends upon government enforcement of environmental regulations, which many feel might become more stringent. Other business opportunities relate more to the general economic growth of the Egyptian economy or to government spending for municipal infrastructure development.

Industrial Wastewater Treatment: Equipment, Design and Process Engineering

- Great potential for industrial pollution prevention and materials recovery/recycling since it is often associated with cost recovery or increased profits
- Rapid market growth if GOE increases enforcement
- U.S. company opportunity to sell new technologies
- For Egyptian companies, little local competition in this very new field

Air Pollution Control: Equipment and Design

- Near-term opportunity if anticipated GOE programs to improve air quality are implemented
- Possible availability of donor funding for air pollution projects
- Good opportunity for Egyptian companies to sell design services
- For foreign companies, an opportunity to sell equipment

Environmental Consulting Services

- Fast growth (over 20% annually) expected
- New business opportunities for Egyptian firms to work with donor agencies
- Retention of foreign consultants for specific areas of expertise

Design and Installation of Desalination Units

- Consideration of privately-owned desalination units by tourism developers along the Red Sea
- Major project opportunities for U.S. suppliers of desalination units

Plastic Recycling

- Demand for more sophisticated recycling equipment
- Existence of recycling industry in Egypt
- Anticipated steady increase in demand for and supply of plastic

BUSINESS ACTIVITIES IN THE ENVIRONMENT

Environmental Monitoring and Testing

To develop more reasonable and respectable environmental management programs, the GOE will need to improve and increase its monitoring and testing capabilities. Over the next five years, increased sales of imported monitoring and testing equipment to the GOE can be expected if enforcement and monitoring programs are implemented. Increased demand for laboratory testing services would accompany the development of new monitoring programs. Important market drivers are 1) the level and timing of the GOE's enforcement of existing or new regulations, and 2) new environmental legislation that includes budgets for more monitoring and testing.

Few statistics are available on the size of Egypt's current market for environmental monitoring and testing. One company estimated the market for laboratory equipment at LE 20 million ($6 million), including medical laboratory equipment, but it is difficult to estimate how much the GOE currently spends on its monitoring programs.

At least seven government- or university-sponsored research institutes have the capabilities to perform scientific testing and analysis for the sporadic monitoring and testing needs of the government ministries and industries. Initially, private companies may have difficulty competing with government-sponsored research institutes, but as the market grows, the ability of research institutions to serve the entire market will decrease. For the private sector to become more involved in this area, it will be necessary for donor agencies to work with private laboratories and for the GOE to privatize some of its fully equipped research laboratories.

Products and Services

Environmental testing equipment and services apply to air, water, and soil. Sampling equipment is required to extract specimens, and testing equipment is used to determine the nature of the samples. Skilled laboratory workers and properly equipped laboratories are required to carry out testing and analysis.

Environmental Monitoring and Testing

TYPE OF BUSINESS	Fast Growth Expected	Opportunity for U.S. Business	Opportunity for Egyptian Private Sector	Potential for U.S./Egyptian Alliances	Near-Term Market	Long-Term Market	Level of Competition (● = Lowest Level)
TESTING AND ANALYSIS SERVICES	◑	○	◑	○	◑	●	○
TESTING AND ANALYSIS EQUIPMENT	◑	◑	○	◑	○	◑	◑
MONITORING MANAGEMENT	◑	◑	◑	◑	◑	●	●

KEY
○ = Low
◑ = Medium
● = Best

Water and soil testing equipment is used to detect the presence and quantity of a wide variety of pollutants, ranging from heavy metals and salts to pesticides and organic waste. Equipment needs for water and soil testing include specific ion and pH meters, oil extractors, electrocolorimitors, and conductivity meters. Air testing equipment can be used to determine the amount of a given gaseous compound present, such as O_3 or NO, or to determine levels of hydrocarbons or heavy metals in the sample. This equipment includes gas chromatographs, hydrocarbon analyzers, mercury vapor analyzers, and high-volume samplers.

Clients

The GOE and its ministries are the major clients for monitoring and testing programs. Research institutes are potential clients for equipment, although several research institutes, such as the Tabbin Institute for Metallurgical Studies, already have fully equipped environmental testing laboratories supplied by grants from USAID and other donors. Donor agencies from Canada, Denmark, the United States, and Germany, and the World Bank are currently working on environmental projects that contain monitoring and testing components, including additional equipment. Nearly all the donor agencies are working with government-sponsored research institutes.

Over the medium and longer term (three to ten years), private laboratories and industrial companies may emerge as potential clients for laboratory equipment and services.

Demand

As environmental management programs develop in Egypt, the need for monitoring and testing facilities and scientific expertise will increase. In its Environmental Action Plan, the GOE estimated that less than half the needed environmental monitoring is being conducted.

The quantity of flow in the Nile River and canal system has been measured on an organized and systematic basis for many years, but water quality parameters have, until recently, focused on ionic constituent concentrations (which were important to the design and reclamation of irrigated agricultural projects) and BOD and COD. There has been little monitoring to detect trends or to develop environmental programs and policies. The EEAA and most donor agencies agree that environmental indicators, databases, and systems need to be developed to collect more information and make it available to the public. However, this does not necessarily translate into a current demand for such services.

The strongest needs for *water* quality monitoring programs are as follows:

- assuring that the drinking water being produced meets health standards
- measuring the quality of effluent from wastewater treatment plants
- measuring the quality of effluent from industries
- measuring the quality of canal water to assure its suitability for agriculture and/or drinking.

Some data on the generation and disposal of municipal solid waste have been collected to provide estimates of total quantities and general composition. No system has yet been established to monitor the treatment and disposal of industrial hazardous waste, solid or otherwise, and the GOE does not know much about its amount or composition.

Supply

Currently at least seven government-sponsored research institutes conduct environmental monitoring and testing, including the National Research Center, Drainage Research Institute, High Aswan Dam Side Effects Research Institute, the Ministry of Health, the Research Institute for Groundwater, the Central Laboratory for the Study of Industrial Pollution at the Tabbin Institute for Metallurgical Studies, and the Water Research Center.

On the whole, research institutions are inadequately used. There is duplication of data collection because most of the current monitoring and sampling are for specific scientific projects, not for policy or tracking. Frequently, results are not coordinated or made

available to the necessary parties or the public. As mentioned, proposed legislation will allow EEAA to take on a coordinating role for monitoring and testing programs.

A number of private Egyptian companies have some monitoring and testing capabilities including nine of the ones that were surveyed. Most provide laboratory services as only part of a diversified portfolio of businesses. Two private consulting companies indicated they provide laboratory services. Some private testing capabilities exist for medical laboratory testing, but not for environmental testing. Several companies may be involved in soil testing for agricultural purposes.

Laboratory and monitoring equipment tends to be imported from developed countries. Over $1 million of equipment for the Central Laboratory at Tabbin was imported from the United States as part of a USAID project. Most new equipment will continue to be imported, as Egypt does not yet have the sophisticated production facilities required to manufacture analysis equipment.

Competition

Competition within the environmental monitoring and testing market does not seem to be strong, primarily because most suppliers and major purchasers of goods and services are government entities, and the government has not fostered much competition. However, competition does exist among research institutions for monitoring and testing projects, mostly financed by GOE or foreign donors. Companies compete to supply imported equipment for testing and monitoring largely on the basis of cost and after-sales service. Companies that understand donor procurement procedures tend to have an advantage.

Ownership

The GOE both demands and supplies the vast majority of testing and monitoring. Undoubtedly, many of these tasks will remain in the hands of the public sector, particularly activities related to the actual enforcement of regulations. However, private testing and analysis companies could emerge to efficiently fulfill many of these tasks. Some public sector institutes that have already shown the ability to market their services (e.g., the Tabbin Institute) may be privatized. Some GOE ministries could also contract for services from private companies to operate ongoing programs or provide consulting services.

Strategies and Costs of Entry

The services side of the testing and monitoring business can be entered with a moderate amount of capital, although individuals or companies need to have the requisite skills and training. Entry costs consist primarily of obtaining trained staff and developing business. The equipment side of the business requires an initial outlay of capital to set up a laboratory. One estimate of the costs involved in establishing a basic testing laboratory to fit current Egyptian needs was approximately $100,000. Teaming with existing research institutes or working for donor agencies are potential ways to obtain business in this sector.

Municipal Water and Wastewater Treatment

Municipal water and wastewater treatment, including engineering, construction, manufacturing and operation, is an attractive market in Egypt. Already large, it is expected to continue growing. Actual market size and growth, as estimated by the U.S. Department of Commerce, USAID, and the GOE in 1992, is between $300 million and $375 million per year with growth rates of approximately 10% to 15% per year. To date, the market has been driven primarily by external donor funding for infrastructure projects. Although donor funding is expected to continue, the GOE is also committed to spending significant amounts of its own funds on municipal water and wastewater projects, especially for smaller cities and rural areas.

The U.S. Government, through USAID, is the largest single donor in Egypt for urban wastewater treatment projects in Cairo, Alexandria, and other medium-sized cities. Over the past 14 years, USAID has invested approximately $2 billion in this sector. British donor funds have also been extensive.

The continued gorwth of this large market creates business opportunities for foreign and Egyptian firms. However, because many companies already provide goods and services in the municipal water and wastewater market, competition is stiff. Nearly half the Egyptian environmental companies surveyed are already active in this market. Because USAID dominates donor funding in Egypt, U.S. companies have a distinct advantage in obtaining new business.

For foreign companies, opportunities exist for environmental engineering and the design of new treatment systems, sales of equipment for pump stations and waste water treatment plants, and possibly operation and maintenance contracts for secondary treatment facilities. For Egyptian companies and joint ventures between Egyptian and foreign companies, there are opportunities to construct new sewers, manufacture and sell components for compact water and waste treatment facilities, and manufacture and sell PVC pipes and valves. There may also be opportunities to operate and maintain existing water and wastewater facilities.

Products and Services

The products and services for the municipal water and wastewater treatment market include construction of pump stations, sewerage tunneling, design and engineering of sewer systems, construction of storage systems, construction management, construction of water transmission lines and primary and secondary wastewater treatment plants, operation and maintenance of plants, and training of operating personnel.

Municipal Water and Wastewater Treatment

TYPE OF BUSINESS	Fast Growth Expected	Opportunity for U.S. Business	Opportunity for Egyptian Private Sector	Potential for U.S./ Egyptian Alliances	Near-Term Market	Long-Term Market	Level of Competition (● = Lowest Level)
ENGINEERING AND DESIGN	◑	●	◑	●	●	●	○
CONSTRUCTION	◑	○	●	○	●	●	○
EQUIPMENT AND SUPPLIES	◑	●	●	◑	●	●	◑
OPERATIONS AND MAINTENANCE	◑	◑	●	◑	◑	●	●

KEY
○ = Low
◑ = Medium
● = Best

The technologies required include mostly primary treatment systems: skimming, screening, clarification, sedimentation, coagulation, sludge drying and land application, and lagooning.

Clients

The clients for these projects are water authorities, municipal governments, and governorates, including some of the following:

- Alexandria General Organization for Sanitary Drainage
- General Authority for Potable Water
- National Organization for Potable Water and Sanitary Drainage
- Cairo General Organization for Sanitary Drainage
- Cairo Wastewater Organization
- Suez Canal Authority
- Ministry of Housing and Public Utilities
- General Organization for Greater Cairo Water Supply
- Ministries of Local Administration and Social Affairs
- Egyptian General Authority for Drainage Projects
- General Authority for Alexandria Water Supply

Many of the above government authorities are inefficiently run and suffer from a shortage of trained staff, operational funding and incentives. The Suez Canal Authority, an exception, is considered to be very well-run. Economic and policy reforms are being

proposed or are already underway that will increase water prices and allow full cost recovery for water services. Eventually these reforms will enable water authorities to operate as autonomous regulated utilities with better ability to plan capital expenditures and operate without donor and GOE budget support. This is considered to be a long-term (over 10 years) process.

Demand

Egypt's municipal water and wastewater needs will continue to be overwhelming. The World Bank and USAID have estimated a need-based demand of about $600 million per year, which would just maintain present levels of service or replace deteriorated facilities. For water and wastewater facilities to keep pace with Egypt's population growth, another $900 million to $1.2 billion per year will be required. Actual annual spending has averaged about $350 million per year. The market for water and wastewater treatment services and products will grow if USAID, other donors, and the GOE continue to provide funding. In addition to providing services in Cairo, Alexandria, and the larger provincial cities, the GOE is committed to providing adequate water supply and treatment facilities in over 4,000 rural areas.

Areas of opportunity over the next 10 years include the following:

- For foreign firms, new business opportunities will shift from the construction of sewers to an emphasis on primary, and in selected cities, secondary treatment facilities for urban areas. Master plans for sludge disposal, which have already been developed, will require implementation. For Egyptian firms, the already considerable business in sewer construction will expand. Egyptian construction firms can continue to contract directly with USAID under the Fixed Account Reimbursable (FAR) program, and also with the GOE and other donors. USAID has already let out up to $100 million of sewer construction contracts to Egyptian contractors under FAR contracts. U.S. engineering and design firms with existing contracts will continue to benefit.

- The U.S. Department of Commerce has announced that the best sales prospects for U.S. exports of equipment include large pump stations with associated equipment, ground freezing systems, screw pumping stations, large-diameter ductile iron pipes, wastewater treatment plants and equipment, digging equipment, cranes and pipe laying equipment, and certain types of valves and pipe fittings.

- As the GOE begins to fund a larger portion of its environmental infrastructure projects, more opportunities will be created for Egyptian companies. New business will be created for Egyptian engineering and construction companies, and for manufacturers of various types of pipe and aluminum sulfate for use in

sewage treatment plants. The Egyptian domestic industry has the capacity to handle many of these projects. Less need for foreign technologies, and thus for foreign exchange, will allow the GOE to take the lead role in these projects. Because the municipal market is so large—up to 4,000 rural areas require water treatment facilities, it is one of the most attractive for Egyptian companies.

- In the near future, operation and maintenance (O&M) contracts of two or three years, and up to five years are likely to be an important component of all new water and wastewater facilities, especially for secondary treatment. Some primary treatment plants are largely inoperative because of a lack of skilled labor and incentives to conduct operations and maintenance. This means opportunity will arise for providers of operation and maintenance services. Over the next 10 years, private O&M contracts for existing facilities are also a possibility. Both the World Bank and USAID will support sectoral adjustment programs that raise water tariffs and establish regulatory frameworks for autonomous water and wastewater utilities. These utilities will be able to contract for services. Opportunities exist for both foreign and Egyptian companies to operate and maintain these plants.

A list of USAID-funded projects over the last 10 years and some future planned projects is provided on the next page.

Stage two of the Cairo Wastewater project should be completed in 1994. Planning for Stage III has begun. In Stage III, more unserved areas will be covered and three treatment plants will be expanded. Also, new sewers and pump stations may be constructed. Similar systems will also be needed in Dakahlia, Sharkia, Beheira, Alexandria, and the Canal cities.

The GOE's total contribution to water and wastewater projects, in addition to the Cairo project, has also been substantial: about LE 1 billion or over $600 million in the last five-year plan (1988-1992). Except for the massive Cairo project, other donors have not been active in urban water supply and wastewater systems, but some donor money has gone into rural water supply and wastewater systems. However, over the next 10 years, the World Bank and donors from other developed countries are expected devote part of their assistance to investments in urban water supply and treatment.

Project	Description	Funding	Years	Work to Be Completed
Alexandria Wastewater System Expansion	Design and construction of sewers	$328.4 million	1979-1993	Sludge management, undercrossing construction
Provincial Cities Development	Provision of urban infrastructure and technical assistance	$110 million	1981-1991	Completion of three water treatment plants, contracts for water and wastewater lines and rehab pumping stations
Cairo Sewerage II	Rehab of 330,000 m^3 treatment plant, construction of a 400,000 m^3 treatment plant	$816 million	1984-1994	Completion of treatment plant, construction of collectors and sewers, training for operation and maintenance
Canal Cities Water and Wastewater II	Wastewater treatment and water supply expansion in Port Said, Ismailia and Suez	$380 million	1987-1997	Construction, operation and maintenance, training
Cairo Water Supply II	Rehab and expand central city water transmission and distribution	$104 million	1988-1996	Construction of reservoirs, pump stations and transmirsion lines, equipping of Central Water Quality Laboratory
Cairo Water Supply I	Rehab and expand Rod el Farag Water Treatment plant	$97.4 million	1977-1989	None
Local Development II	Helping local governments with developmen:, including infrastructure	$481 million (not all environmental)	1985-1992	Low-cost wastewater technologies, equipment maintenance centers, solid waste collection
Alexandria Wastewater II	Pump station rehab,expansion into central zone, effluent treatment	to be determined	not available	Entire project
Secondary Cities Water and Wastewater	Establishment of water utilities, infrastructure in 5-10 cities	to be determined	not available	Entire project
Cairo Sewerage III	Creation of an independent water utility	to be determined	not available	Entire project

The U.S. Department of Commerce has estimated the market size for manufactured products (not including engineering and construction services), such as plastic and iron pipes, assorted valves, pumps and sewerage plants, as follows:

Municipal Water and Wastewater Equipment Market	1989	1990	1991 Estimated	Growth Per Year 1992 - 1994
Total market size (in US $ millions)	165	192	218	15%
Manufactured in Egypt (in US $ millions)	36	40	45	
Total Imported Amount (in US $ millions)	133	157	180	15%
Imported from USA (in US $ millions)	48	48	68	17%

Supply

The construction of the Cairo sewer system was one of the largest environmental engineering projects in the world, at one time employing up to 6,000 workers and engineers. Most of the work performed in Cairo and Alexandria has required sophisticated engineering, design, construction, and management, which was performed largely by U.S. engineering and design companies and their Egyptian partners. Egyptian construction companies also participated. The following table lists some U.S. companies that have been involved in specific USAID-funded projects.

Project	Description	Companies
Alexandria Wastewater System Expansion	Design and construction of sewers	CH2M Hill, Metcalf and Eddy, Fischback-Moore-Oman, McLean Grove
Provincial Cities Development	Provision of urban infrastructure and technical assistance	Wilbur Smith and Associates, L.A. Water Treatment, Montgomery/Harza, local contractors through FAR program
Cairo Sewerage II	Rehab of 330,000 m^3 treatment plant, construction of a 400,000 m^3 treatment plant	ABB-Susa, AMBRIC, Morrison-Knudsen, C2HM Hill, Fru-Con Construction, Fuller/Wallace, Sadelmi, Harbert/Jones, Egyptian contractors
Canal Cities Water and Wastewater II	Wastewater treatment and water supply expansion in Port Said, Ismailia and Suez	Black & Veatch, James Montgomery, Camp, Dresser, McKee, Metcalf and Eddy, Sabbour Associates
Cairo Water Supply II	Rehab and expand central city water transmission and distribution	CH2M Hill, James Montgomery, Egyptian contractors
Cairo Water Supply I	Rehab and expand Rod el Farag Water Treatment plant	ES Parsons, Howard-Harbert Jones, James Montgomery
Local Development II	Helping local governments with development, including infrastructure	DAC International, Wilbur Smith, Chemonics, EduSystems
Qene-Hurghada Pipeline Rehabilitation	Rehabilitation of water pipeline from Nile to Red Sea	ETC Engineering, Wallace O'Connor

Egyptian companies active in the municipal water and wastewater market include public sector contractors (construction companies), private engineering and design firms, manufacturers, and agents/distributors for imported equipment. Egyptian companies and U.S. exporters active in this market segment include the following:

Construction Companies	Engineering and Design Companies	Manufacturers	Agent/ Distributors of Imported Equipment	U.S. Exporters of Equipment
El Nasr General Co. for Contracts (public sector)	Sabbour Associates	Arab Industrial Organization (public sector)	Scarab of Egypt	American Cast Iron Pipes Co.
General Company for Sanitary Works Contracting (public sector)	Wardani Group	El Nasr Pipes Manufacturing Company (public sector)	Egyptian American Corporation	Ametek
Arab Contractors (public sector)	ECG	The Egyptian Company for Refractories (public sector)	Metito International Ltd.	Aquatech, Inc.
Hassan Allam (public sector)	Allied Engineering	Geochemica	COTECO	Aurora Pumps, Gould Pumps, Paco Pumps, Inc.
Misr Engineering Co. (private)	Adel Abdel Wirth	Amreya Metals Co.		F.E. Myers Co.

Already, the public-sector Arab Industrial Organization has signed a contract with the Ministry of Utilities to manufacture 300 compact water treatment plants for rural villages. Manufacturing will be done under a license from the Danish firm, Kruger.

Competition

Competition in the municipal water and wastewater market is strong; several U.S. companies have been involved for many years and will likely continue to receive new contracts. Competition is also strong among Egyptian companies; about 25 of them are participating in USAID-funded water and wastewater treatment projects.

Where local manufacturing requires economies of scale, military production companies have been contracted. Military companies, such as the Arab Industrial Organization, subcontract with privately-owned Egyptian manufacturers for specific component parts, such as valves. The public sector El Nasr Pipes Manufacturing Company manufactures pipes used in Egypt to collect wastewater. The Egyptian Company for Refractories manufactures acid-resistant bricks used to line the sewage tunnels.

Many foreign companies supply Egypt with manufactured parts for water and wastewater systems. The U.S. Department of Commerce has estimated market shares at 36% for U.S. companies, 21% for Japan, 17% for Germany, and 15% for Italy.

U.S. products are considered relatively expensive. A critical factor in purchase decisions is the availability of financing. Where USAID financing of imports is involved, U.S. companies have an absolute advantage.

Ownership

Both private and public sector companies are involved in the municipal water and wastewater sector. Egyptian and foreign engineering and design companies tend to be privately owned. Large-scale manufacturing tends to be public sector, including some military organizations, such as the Arab Industrial Organization. Private manufacturers tend to act as subcontractors to the large public sector manufacturers.

Strategies and Costs of Entry

The best way to enter this business is to subcontract with existing suppliers. Over the long term, the acquisition of public sector companies that are privatized is a means of entering the manufacturing side. Foreign companies seeking new contracts with USAID, the World Bank, or other donors should track bidding status and schedules.

The costs of entry into this sector will probably require significant capital investment, especially for Egyptian manufacturers. Public sector companies appear better able to add new manufacturing lines than private companies. Companies seeking to enter should initially joint venture with companies already in the business.

Industrial Wastewater Treatment

The market for industrial wastewater treatment is in its infancy in Egypt. It is attractive because the handful of companies that currently supply the market believe it will expand rapidly over the next five years. Both public and private sector polluters frequently mention the inevitability of having to address their effluent problems soon.

Estimates of current market size are difficult to obtain. According to a report from the Ministry of Industry, public sector industries have spent less than $5 million per year on wastewater treatment, most of which has been in the chemical, food processing, and textile industries. One private company estimated the market for industrial wastewater treatment at LE 30 million (US$9 million).

Estimates of Egypt's requirements to treat its industrial effluents to U.S. standards range from $1.2 billion to $2.2 billion, but treatment would require a regulatory and enforcement system unlikely to be established in Egypt in the near or medium term. Over the short term, demand will be for unsophisticated technologies that can be easily operated and maintained and that treat the most obvious pollutants. Process changes, improved housekeeping, and water conservation and reuse will be emphasized. Few full waste treatment systems have been installed, and some systems that are in place are not working due to a lack of spare parts and trained operators. Sophisticated effluent treatment equipment is not yet being produced locally, although much of the peripheral equipment could be manufactured currently. Generally, access to a broader range of technologies is needed.

Products and Services

Industrial effluent can be treated by a variety of methods that fall under biological, chemical, or physical treatment categories. Biological treatment methods rely on microscopic organisms to break down complex molecular contaminants. Biological processes can be either aerobic (using oxygen in the breakdown reaction) or anaerobic (breaking down in a near oxygen-free environment). The equipment used for these processes includes tanks, biological digestors, piping, pumps, clarifiers, filter media, and gauges. Lagooning, another biological treatment method, requires primarily materials associated with construction and lining, and effluent delivery to and from the lagoon.

Industrial Wastewater Treatment

TYPE OF BUSINESS	Fast Growth Expected	Opportunity for U.S. Business	Opportunity for Egyptian Private Sector	Potential for U.S./ Egyptian Alliances	Near-Term Market	Long-Term Market	Level of Competition (● = Lowest Level)
DESIGN AND CONSULTING	●	◑	●	●	◑	●	●
EQUIPMENT AND SUPPLIES	●	●	◑	◑	◑	●	○
OPERATION AND MAINTENANCE	◑	○	◑	○	◑	◑	◑

KEY
○ = Low
◑ = Medium
● = Best

Physical processes include many methods that physically extract or separate pollutants from effluent waste streams. Their technologies include activated carbon adsorption, air stripping, clarification, equalization, evaporation processes, filtration and separation processes, screening and cooling processes, and incineration. A large variety of equipment is associated with these processes.

Chemical treatment technologies make pollutants less harmful or completely decompose them. The chemical processes used to treat industrial wastewater include chemical oxidation and reduction, coagulation-precipitation, neutralization, ozonation, and sulfide precipitation. The equipment used for these processes tends to be less complex than that required for physical or biological methods, involving effluent delivery systems, chemicals, control equipment, and tanks.

The volume and concentration of effluent from most types of effluent-generating industrial plants can also be reduced by employing process changes or recycling and recovering materials. In almost all instances, this requires expertise in process engineering. Often, equipment is employed as part of the process change or to recover or recycle lost materials.

Clients

Potential clients include public sector industrial polluters in the Cairo and Alexandria areas, and many private sector companies located in the new industrial cities of 10th of Ramadan, 6th of October, New Ameria, and others.

Demand

The need for industrial wastewater treatment in Egypt is great. Currently the untreated effluent contributes as much pollution as would more than 6 million people; over 80% of the 540 million cubic meters of annual industrial discharges goes untreated directly into the Nile, canals, or municipal sewerage systems. There are 188 factories, mostly government-owned, located along the Nile in the Cairo area, about half of which dump untreated waste products directly into the river, according to the EEAA. A significant amount of wastewater from companies in Alexandria is dumped directly into the Mediterranean without treatment. Private sector industries generally pollute less since many are light manufacturers with relatively more modern manufacturing processes.

The Environmental Action Plan proposed by EEAA will stress the preservation of the Nile waters. One of the highest priorities will be action to reduce water pollution at its source in key industries, including food processing (sugar, edible oils, onion dehydration), cement, steel and iron, chemicals and fertilizers, and textiles, and especially factories located on the Nile.

External donors have been somewhat involved in this area. The companies surveyed indicated that they thought donor agencies would become more involved in industrial wastewater treatment over the next several years. For example, USAID, through its Industrial Pollution Control Project, provided approximately $17 million for pollution control equipment (not all for wastewater). Canadian and French donor agencies have provided some funding for effluent treatment programs at two separate public sector companies. German donor agencies are considering providing technical assistance to the 10th of Ramadan for industrial wastewater projects.

The table on the next page shows the amount of industrial water consumption, discharge, and loads by region and type of industry in the public sector. A pollution load-based cost estimate based on U.S. costs indicates a required capital investment of up to $650 million for primary treatment and $2.6 billion for secondary treatment, (assuming that every factory acquired treatment systems). One Egyptian consultant estimated that treatment systems could be installed in Egypt at 30% of the cost of foreign systems. This would put the cost of industrial treatment between $200 million and $800 million, depending on the type of treatment.

A Pollution Load–Based Estimate of Potential Demand For Industrial Pollution Control Equipment and Services For Egypt

INDUSTRIAL SECTOR	sector discharge mil gal/day	average discharge per plant mil gal/day	per plant capital investment for secondary treatment mil $	total capital investment for secondary treatment for sector mil $	per plant/yr. O&M cost of secondary treatment mil $	total annual O&M costs of secondary treatment for sector mil $
Chemical	70.9	1.3	8	424	0.7	37.1
Food	200.5	1.7	10	1190	0.8	95.2
Textile	63.7	0.8	7	525	0.5	37.5
Engineering	8.7	0.2	4	156	0.3	11.7
Metallurgical	43.4	3.9	16.5	181.5	1	11
Mining	10.1	0.3	4.5	148.5	0.2	6.6
Total	397.4			2625		199.1

Source: Industrial Environmental MAP Progress Report, General Organization for Industrialization, 1991
1) All figures in 1989 $ (original 1984 $ have been adjusted using implicit price deflators form the Stat Abstr of the US 1991)
2) Conventional industrial secondary treatment estimates based on effluent volume and assume a BOD load of 1000 mg/l
3) Capital investment and operation and maintenance cost curves taken from EPA Report # EPA – 600/8–84–010, "The Cost Digest: Cost Summaries of Selected Environmental Control Technologies", 1984
4) All secondary treatment figures include primary treatment

Annual Average Public Sector Industrial Water Consumption, Discharge and Loads by Region

	No.	mil m3/yr use	mil m3/yr discharge	t/day BOD	t/day COD	t/day Oil	t/day SS	t/day TDS	t/day HM
Greater Cairo	126	162	127.5	71	120	93	97	135	0.75
Alexandria	85	110	88	91	186	446	40	246	0.17
Lower Egypt	60	146	125	34	42	24	86	224	0.5
Upper Egypt	35	211	204	72	37	5	68	532	0.2
Canal and other	24	7.2	4.5	2	3	14	5	14.6	0.03
Total	330	638	549	270	388	168	296	1151.6	1.65

Annual Average Public Sector Industrial Water Consumption, Discharge and Loads by Industry

Industrial Sector	No.	mil m3/yr use	mil m3/yr discharge	t/day BOD	t/day COD	t/day Oil	t/day SS	t/day TDS	t/day HM
Chemical	53	127	98	26	178	23	33	241	0.94
Food	119	296	277	182	142	110	168	666	0.17
Textiles	75	114	88	39	47	24	64	191	0.3
Eng	39	13	12	5	6.6	2	3	13	0.03
Metallurgical	11	69	60	15	14	8	24	29	0.2
Mining	33	19	14	3	0.4	1	4	11	0.01
Total	330	638	549	270	388	168	296	1151	1.65

Source: Industrial Environmental MAP Progress Report, General Organization for Industrialization, 1991

However, USAID engineers have indicated that the costs of sewer and power projects, for example, are about the same as they would be in the United States.

Companies are beginning to take preliminary steps toward changing industrial processes in order to reduce or recycle water and separate discharge streams. Most of the pollution prevention and control actions taken by industry have resulted from these realizations:

- Costs for raw materials such as energy, water, and other inputs to the manufacturing process are rapidly increasing.
- Discharges from the plant often contain valuable raw material which is unnecessarily lost.
- End-of-pipe treatment of discharges is an added cost, while pollution prevention and waste minimization returns revenue to the manufacturing operation.
- The government is beginning to interact with plant owners to sample their wastes and, in selected polluting situations, to require the industry to clean up their discharges.

To date, industrial pollution control measures have been implemented at some public sector factories under the Ministry of Industry's 1987/1991 five-year plan. The GOE's total allocated investments during this period were LE 80 million; only LE 36 million was actually spent, however. Public sector companies implemented 14 water pollution control projects at an average investment of $1.4 million per plant. Projects included the separation of sanitary and industrial waste streams, oil and chemical reduction and extraction, primary treatment and subsequent connection to municipal treatment systems, the installation of closed-circuit systems, water reuse where feasible, and the collection and reuse of potentially useful waste materials such as fodder production from organic waste. In general, investments in water pollution control measures have focused on those that provide at least some financial benefit to the company, such as saving water through recycling and recovery, or creating a product with potential economic value.

Industrial wastewater treatment projects for private sector manufacturers have been infrequent, primarily because regulations are not enforced. However, this is expected to change over the next five years. Markets will emerge for effluent treatment in private sector industrial cities such as 10th of Ramadan and 6th of October. In 10th of Ramadan, for example, nearly all discharges go directly to municipal sewer systems, which were not designed to handle industrial wastes. The municipal systems consist of an oxidation pond outside of town that can no longer handle industrial wastes. An estimated 60 to 70 plants will require effluent treatment. While their problems may be less serious than those of the large public sector companies, it is estimated that within three or four years, these private industrial cities will be seeking solutions. Two representative projects are as follows:

- BTM Textiles has started its own a small-scale pilot treatment system and is working with a consultant on ways to treat effluents from its finishing and dyeing plant (effluents of hydrolyzed dyestuffs, alkalies, fibers and lint, pigments and kerosene). The pilot process consists of sedimentation and separation. Currently the company is discharging to pits in the desert. The company estimates the cost of primary treatment at LE 175,000.

- Mecca Carpets in New Ameria (Alexandria) stopped injecting wells with industrial effluents containing several polymers, and in their place has installed a biological treatment unit. Treated water is then used to irrigate green areas on the company's premises, which protect buildings from wind and sand corrosion.

The technologies in demand that are available outside Egypt include surface aerators, mechanical screens, and sedimentation tanks.

Supply

Many companies in Egypt have the capability to select and procure imported equipment and chemicals to treat industrial effluents, but few really specialize in this area. Over half of those surveyed said they had such capabilities. However, the industries themselves have done most of the treatment to date, sometimes with the help of outside consultants or research institutes. Many companies that claim to have capabilities do little marketing in the area.

Some public sector companies may have in-house capabilities to design systems, recommend process changes, and procure equipment.

Some systems that have been imported and installed do not function properly due to difficult and costly operation and maintenance processes. Some installed systems are not operating because of the prohibitive cost of chemicals. With little enforcement of existing regulations, industries have no incentive to maintain the few systems that are installed.

Two companies surveyed said they were planning to enter the industrial wastewater treatment market by developing new relationships with foreign equipment suppliers, adding a new equipment assembly or fabrication line, or licensing foreign technologies. One company in Alexandria already designs and manufactures systems with almost no foreign content. Others stated that at least 80% of the equipment required could be manufactured in Egypt.

Only a few companies in Egypt can provide operation and maintenance services for industrial wastewater treatment facilities.

Competition

A wide range of foreign and Egyptian companies provide engineering and design services, and equipment and chemicals for this market, although most of these supply the water purification and pretreatment market (see section below).

Several companies that service the municipal wastewater market are in a good position to begin manufacturing for the industrial wastewater treatment market, such as the Arab Military Organization and ORASCOM, both of which have recently added new manufacturing lines.

Ownership

Most companies providing engineering and imported equipment are privately owned. In-house capabilities, where they exist, are more likely to be found in public sector companies.

Strategies and Costs of Entry

Entering this market requires initial market research on the companies that may be targets of government enforcement and thus will need new equipment or design services, and research on the types of technologies that may be appropriate. Developing relationships with potential buyers early on will be helpful. As the GOE implements regulations that it can enforce, more companies will begin to comply with the regulations. For foreign companies, business development and marketing trips are recommended.

The cost of entry for companies not currently in this market can be high, especially for manufacturers. One manufacturer of valves and pumps for municipal waste systems estimated that it would require a backlog of at least 25 to 30 projects before manufacturing for industry would be cost-effective. Companies already involved in the manufacture of municipal systems clearly have a manufacturing cost advantage over new entrants. Foreign companies wishing to sell equipment initially will have lower entry costs than local manufacturers.

Environmental Consulting Services

Consulting services are needed to develop and implement environmental policies and practices, conduct environmental audits, and incorporate environmental management practices into new facilities and projects. Environmental issues related to certain sectors, such as tourism and the management of Egypt's antiquities, are relatively new and will also require technical expertise.

Some environmental consulting expertise exists in Egypt, but much more will be required. Until more environmental consultants are trained, there will be a market for foreign environmental consultants acting alone or in partnership with Egyptian firms and individuals. Environmental training services are also in strong demand.

A good portion of the demand for environmental consulting will initially come from the World Bank, the Egyptian Environmental Affairs Agency and other donor-funded projects.

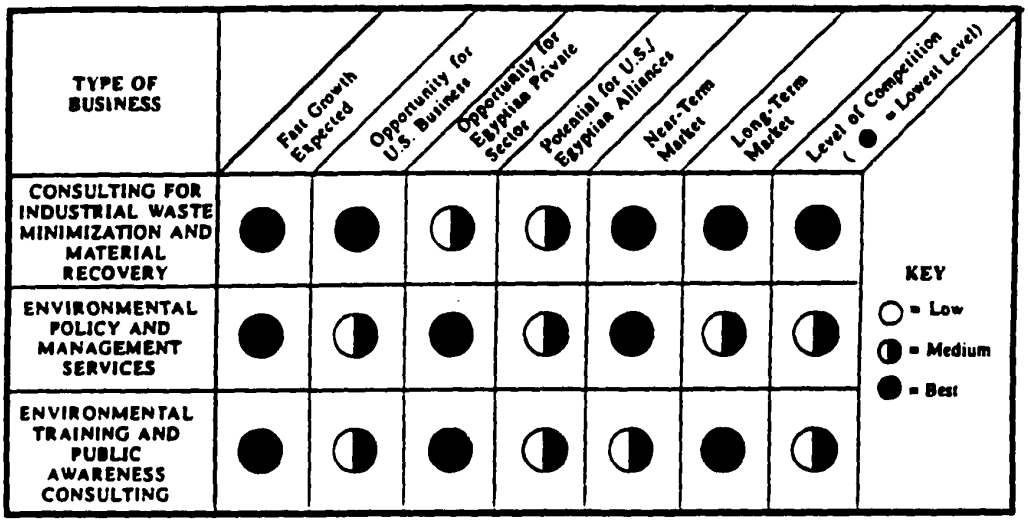
Products and Services

Environmental consulting includes professional services contracted for a specific job and period of time that address the environment, including the following:

- consulting for industrial waste minimization and materials recovery, including the performance of environmental audits (see also Industrial Wastewater Section)
- consulting on environmental policies, regulations, economics and management, including the preparation of environmental impact assessments
- preparation and administration of environmental training, education, and public awareness campaigns

Environmental consulting companies employ an interdisciplinary professional staff with a wide range of technical qualifications including basic scientists, environmental engineers, industrial engineers, economists, policy planners, lawyers, and educators.

Environmental Consulting Services



Clients

The number and range of potential clients for environmental consulting are the largest of all categories of environmental businesses discussed in this report. Central ministries and authorities, governorates, public sector industries, research institutes, private sector companies, and foreign corporations are all potential clients for environmental services. Some of the most likely target customers are as follows:

- Tourism Development Unit
- private tourist developers
- private and public sector manufacturers
- Egyptian Environmental Affairs Agency
- companies beginning to build new factories
- oil exploration and production sharing companies
- Egyptian General Petroleum Company.

Many of the above clients will be seeking donor funding to pay for environmental consultants.

Industrial Waste Minimization/Materials Recovery

Demand. Consulting for waste minimization and pollution prevention presents some of the most attractive business opportunities in Egypt, because the demand for such services can occur prior to GOE enforcement of environmental regulations. Waste minimization and material recovery have economic benefits unrelated to environmental improvement and can be marketed aggressively on the basis that industrial plants can benefit from cost reductions due to process changes that conserve or recycle materials of value. Also, if enforcement of effluent and emission regulations eventually increases, industrial plants can reduce their investments in treatment facilities by reducing the amount of waste requiring treatment. Many of the initial recommended waste minimization improvements are low/cost, no/cost changes that can be implemented quickly with little investment.

The potential for instituting waste minimization and pollution prevention measures is great. Together, six industries in the public sector (chemical, food, textile, engineering and manufacturing, metal/metallurgical, and mining) discharge 549 million cubic meters/year of effluent. Total daily pollutant load levels from public sector plants alone are estimated at 270 ton/day BOD. 388 ton/day COD, 168 ton/day oil, 296 ton/day suspended solids, 1,151 ton/day total dissolved solids, and 1.65 ton/day heavy metals.

There is a demand for waste minimization services in Egyptian industries today, but information, technologies, and skilled pollution prevention professionals are in short supply.

Supply. An ongoing USAID research project has supported a number of waste minimization and pollution prevention projects. For example, at the El Nasr Leather Tanning Company, a project was implemented to recover 60 tons/year of chromium that would otherwise have been discharged into marine waters. This translates to an annual savings of LE 125,000. At the Abou-Qir Company for fertilizers and chemical industries, a project was undertaken to recover 12.5 tons of urea daily, resulting in an added income for the company of LE 1.7 million per year. Similar projects have been implemented to recover cellulosic fibers lost from a paper mill, to find uses for waste steel slag in the construction industry, to utilize cement dust from a cement factory, to conserve water, and to optimize processes to reduce residues at a food manufacturing plant.

USAID is also supporting an energy conservation project that provides industries (both public and private sector) with technical assistance and equipment to realize costs savings from reduced energy consumption. As the prices of energy steadily rise toward market prices in Egypt, the market for energy conservation services improves as well.

Research institutes have implemented most of the existing waste minimization projects. Energy conservation projects have also been implemented by research institutes with the assistance of the Federation of Egyptian Industries, which publicized the availability of the services.

Beyond a few research institutes, the capacity to supply waste minimization services is minimal in Egypt, primarily due to the lack of knowledge and appropriate training.

Competition. Competition in waste minimization consulting has been limited to government-sponsored institutes, and has been weak. Projects funded by USAID have been awarded on a competitive basis with the same few research institutes competing for each award.

Preparation of Environmental Impact Assessments, Policy, Regulatory, and Economic Management Consulting

Demand. Public awareness of environmental issues in Egypt is increasing, though it is still low relative to other countries. Also the GOE, in its recently released Environmental Action Plan, is attempting to address environmental problems in a coordinated and systematic way. This effort will ultimately translate into greater enforcement of regulations and new donor funding for environmental projects which will, in turn, increase demand for environmental consulting services.

Demand already exists for such services. Where external donors support new investments, environmental impact assessments frequently must be completed. The tourism industry, particularly in the Red Sea area, provides a good example of an unmet demand for environmental consulting services. In connection with a $400 million World Bank loan, the Tourism Development Unit will need to generate and enforce regulatory guidelines for tourism development and monitoring systems for coastal zones, and institute land use management practices. Individual private tourist developers will need site-specific environmental impact assessments, master plans for environmental infrastructure, and tourism management plans for tourism projects. The management of Egypt's antiquities also calls for skilled environmental policy planners and managers.

Supply. Only a few Egyptian companies provide environmental management consulting services, such as Environmental Quality International (EQI), Environmental Resources, and Energy Environment and Technology Associates. Individuals affiliated with research institutes are often available on an assignment basis. Research institutes are also available to supply consulting services.

Competition. Because demand exceeds supply, the competition for environmental consulting is not strong at present. As more donor funds become available, it will be important to increase the number of available consultants to maintain competition.

Environmental Education, Training and Public Awareness Campaigns

Demand. To implement its Environmental Action Plan, Egypt needs to obtain training in a wide range of environmental specialties. Nearly every environmental project funded by donor agencies will have a training component.

In most countries, public awareness is a precursor to environmental action. In Egypt, the public is just beginning to become aware of the health hazards posed by existing air, water, and land pollution. Some environmental projects may include components designed to increase public awareness through advertising, film production, and publications.

Supply. Egyptians have few places beyond universities to obtain specialized training to perform environmental consulting jobs. Currently, few university programs offer environmental sciences or environmental engineering. Ain Shams University has an environmental program and the American University in Cairo is starting one. Some companies that provide management consulting may offer limited environmental training. Foreign consulting companies are available to supply training, but frequently at a high cost.

Competition. There is virtually no competition among Egyptian companies in this market.

Ownership. At present, public sector research institutes provide about half the environmental consulting services available in Egypt. Private consultants provide the other half. Individuals, some of whom are affiliated with research institutes, also offer these services.

Strategies and Costs of Entry

Environmental consulting is one of the few businesses that an individual can enter. The capital costs for starting a consulting business are not high, but most specializations require in-depth training and expertise that may be difficult or costly to obtain. The acquisition of foreign training and expertise may be necessary.

Water Purification Systems

The market for water purification systems in Egypt exists primarily in the treatment of industrial water influents. (For a discussion of municipal water works, refer to the section on municipal water and wastewater treatment). In 1990, the U.S. Department of Commerce estimated that the market for U.S. exports of water purification and filtering equipment to Egypt was $11.6 million. Total market size estimates provided by Egyptian companies range from $24 million to $30 million annually. The sale of desalination units is an attractive new business opportunity in this market, especially in tourist areas along the Red Sea coast.

Products and Services

Water purification products include industrial water pretreatment, desalination units, and compact water treatment units. Frequently, chemicals are required for operation. Services include the operation and maintenance of boilers, desalinization units, and other water treatment services.

Clients

The clients for water purification systems include commercial and industrial buyers, both public and private sector. Commercial users include hotels, especially resorts unattached to municipal water systems, and the marine industry. Industrial enterprises include companies with furnaces and boilers, textile companies, and food processing.

Demand

Egypt has had a market for water purification systems for at least five years. In the industrial sector and municipal water supply systems, market demand is unrelated to the enforcement of environmental regulations. Industrial market demand is driven by the need to incorporate water pretreatment into the industrial process. As water pollution becomes more of a problem in Egypt, the need for industrial water purification systems will grow. In the commercial sector, the hotel and boating industries represent potential markets for these systems.

Water supply is one area where there are opportunities to work with private resort developers. Although there are plans to upgrade water pipelines from the Nile to the Red Sea, they are not expected to be sufficient and may prove to be too expensive once water prices reflect real costs. Private resort developers in the Red Sea area are required to

Water Purification Systems

TYPE OF BUSINESS	Fast Growth Expected	Opportunity for U.S. Business	Opportunity for Egyptian Private Sector	Potential for U.S./ Egyptian Alliances	Near-Term Market	Long-Term Market	Level of Competition (● = Lowest Level)
INDUSTRIAL WATER PRETREATMENT	◑	●	●	◑	◑	●	◑
DESALINATION UNITS	●	●	○	●	◑	●	◑
COMMERCIAL AND HOUSEHOLD WATER TREATMENT SYSTEMS	◑	◑	◑	◑	◑	◑	◑

KEY
○ = Low
◑ = Medium
● = Best

develop their own infrastructure standards, one of which is an adequate supply of water. Opportunities exist for vapor compression and reverse osmosis desalinization units with capacities ranging from 500 to 3,000 cubic meters per day. Two large private projects are currently under development at Abu Soma and Al Queseir, both of which are considering desalinization units and will be looking for companies to supply them.

Egypt needs unsophisticated, unautomated or semi-automated technologies that can be maintained with relative ease. Even with unsophisticated technologies, qualified operation and maintenance providers of water purification equipment and systems will be in demand. Operation and maintenance of desalinization units will be critical.

Supply

Many foreign suppliers have agent/distributor relationships with Egyptian companies to sell water purification equipment. To date, most of this equipment is imported, although Egyptian companies are beginning to manufacture water treatment systems for municipalities. Equipment such as tanks and pumps are manufactured in Egypt, but chemicals and filters are imported. Companies in France, the United States, and Great Britain are major suppliers of equipment. The equipment vendors generally provide after-sales services.

Competition

Competition is strong among foreign suppliers, including Permutit, Culligan, Dupont, Drew Chemicals, Imex, and Amerest. Competition among Egyptian companies has not yet emerged. Some of the proposed desalination plants for the Red Sea tourism projects will be financed by a World Bank loan, and awarded through international competitive bidding.

Ownership

This market is supplied primarily by the foreign private sector working with Egyptian agents/distributors. To the extent that suppliers also provide water treatment systems for governorates, there may be some public sector participation in local manufacturing.

Strategies and Costs of Entry

A foreign company wishing to sell equipment or chemicals in Egypt needs to have an agent/distributor. Entering the Egyptian market frequently requires significant capital investment and access to a relatively secure market.

Municipal Solid and Hazardous Waste Collection and Disposal

The outlook is promising for municipal and hazardous solid waste equipment and services in Egypt. The demand in services and equipment for municipal solid waste will develop more quickly than for hazardous waste. In general, the sale of large pieces of equipment represents the best opportunity for foreign firms, while services and the sale of smaller equipment represent the best opportunities for Egyptian firms. Hazardous waste services that require experience and a high degree of technological sophistication will initially need to be provided in cooperation with foreign companies.

The need for household waste collection is greatest in large urban areas. The current collection system is insufficient to meet needs. Assuming a favorable government response, the market is expected to grow in the coming decade due to a growing population and current insufficiencies. The recyclable value of municipal waste is often a deciding factor in whether it is collected. Waste tends to be more valuable in high-income areas than in low-income areas.

Chemical and fertilizer hazardous wastes are also discarded in an uncontrolled manner, with little regard to site preparation or location. Should GOE interest in regulating industrial polluters continue to increase, companies able to provide better disposal services will be sought out by industries wishing to comply with regulations. The amount of unused fertilizer disposed of annually is not known.

At present, most hospital waste (including hazardous and infectious waste) is mixed with municipal waste. However, as hospitals are forced to comply with new laws, a market for incinerators is expected to develop. Action against hospitals might be delayed, since most hospitals are government owned.

Products and Services

Transport vehicles and waste movement equipment, collection services, and disposal services and equipment constitute the major products and services market for municipal solid waste. The waste may also be burned (sometimes as a fuel source) in incinerating units. Organic waste may be composted in composting containers that control drainage and aeration, and may have mechanically turned decomposition. Maulers are sometimes used to reduce the volume of non-compactable waste components. Landfill covers can be used to increase landfill capacity by replacing dirt, in addition to suppressing vapors, odors, and disease vectors.

Municipal Solid and Hazardous Waste Collection and Disposal

TYPE OF BUSINESS	Fast Growth Expected	Opportunity for U.S. Business	Opportunity for Egyptian Private Sector	Potential for U.S./ Egyptian Alliances	Near-Term Market	Long-Term Market	Level of Competition (● = Lowest Level)
COLLECTION EQUIPMENT	●	◑	◑	◑	●	●	◑
COLLECTION SERVICES	●	○	●	○	●	●	◑
DISPOSAL SERVICES AND EQUIPMENT	●	◑	◑	○	●	●	◑
HAZARDOUS WASTE	◑	◑	●	●	◑	●	Not enough information

KEY
○ = Low
◑ = Medium
● = Best

The forms of hazardous waste treatment include incineration in kilns, engineered landfills (a variety of lining methods can prevent seepage), chemical fixation, the reuse of high-energy potential wastes (oils, solvents, paint sludge, organic compounds, pesticides, etc.) as a fuel source as in a cement or lime kilns, and bioremediation, which can be used for wastes containing low and medium concentrations of hazardous organic matter. The transport of hazardous waste can require vehicles specially designed for hazardous waste transport where safety is a concern.

Clients

The growing number of private providers of municipal solid waste collection indicates that private firms will increasingly be the buyers of collection equipment.

Financial commitments have been limited for municipal solid waste disposal equipment relative to the volume of waste generated. Egyptian municipalities will probably be the main purchasers of composters, landfilling equipment, and incinerators, but the operation of facilities may be contracted out to private companies.

Both private and public sector industries will need industrial solid and hazardous waste disposal and treatment equipment and services in the coming decade, as environmental regulations become more stringent. The pace at which this need will materialize, however, is not certain. Currently, the public sector accounts for about 70% of industrial production, but the private sector has more plants.

Hospitals represent a potentially large clientele for incineration equipment, since few hospitals in Egypt have incineration systems, and again, regulations are likely to become more rigid.

Proposed municipal wastewater treatment plants in Cairo and Alexandria will create 700 to 1,000 kilo tons of sewage sludge per year. These plants are potential buyers of sludge disposal equipment.

Demand

Currently, municipal solid waste is collected in one of three ways. First, municipalities account for some of the collection. Second, the Zaballeen and Wahis have a contracting system whereby they provide for waste pickup from households for a fee. Third, a growing number of private enterprises (85 companies in 1991) collect and deliver solid waste to either Zaballeen communities or directly to disposal sites.

Significant demand is expected for equipment and services in municipal waste collection and disposal as a result of Egypt's increasing population and anticipated environmental regulatory enforcement mechanisms. Opportunity also exists to recover methane gas from municipal waste and domestic sewerage sludge. The current demand for municipal waste collection in urban areas is estimated at 16,900 tons/day. In rural areas, the total demand is 5,200 tons/day. In Cairo alone, about 6,000 tons of municipal solid waste are generated daily. About 1,700 tons/day of municipal waste are left uncollected in Cairo, and then burned or left to decay. Egypt's increasing population will generate an estimated 31,000 tons/day solid waste in the year 2000, and 56,000 tons/day in 2020.

As demand for waste collection and disposal equipment increases, a need for maintenance and parts suppliers will also develop. Even now, many composting and incineration plants are not used at full capacity for lack of spare parts.

From 2 million to 3 million tons of compost could be used as fertilizer annually based on current levels of waste production. Egyptian farmers are intensive users of fertilizer, creating a good business for companies supplying composting equipment and services.

Estimates of the total non-hazardous industrial solid waste generated in Egypt range from 150,000 tons to close to 1 million tons annually. While hazardous solid waste is likely to be a priority, non-hazardous solid waste is a nuisance at best, and will also prompt a market for removal and disposal services in some industries.

Markets will also expand for hazardous waste handling equipment and services. Industries produce an estimated 50,000 tons of hazardous waste annually, which is disposed of with other industrial waste. The steel, textile, and food industries account for much of the hazardous waste generated. Other growing industries that are expected to produce increasing amounts of hazardous waste include chemicals and fertilizer, petrochemicals, pharmaceuticals, pulp and paper, and engineering manufacturing. Demand will expand for incineration, landfills, transfer stations, and transport technologies for hazardous waste.

In many private industrial areas, hazardous solid waste is brought to unappraised, and possibly unsafe dump sites. Most factories do not have environmental specialists, so lack of information about safe, appropriate disposal is a large problem. Many firms do not even know they are polluting, much less what to do about it. As new regulations are enforced, industries will be forced to find adequate disposal solutions. Disposal cost recovery systems, such as using some kinds of hazardous waste as a kiln fuel source, will be particularly attractive. A market for low-cost, engineered landfills will emerge over the next decade.

Hospitals produce approximately 13,000 tons per year of hazardous waste. The market for incinerators of hospital waste is expected to grow quickly, since few hospitals have incinerators at this time.

Supply

Public and private sector enterprises in urban areas collected and disposed of roughly 15,200 tons/day of municipal waste in 1990. Cairo is experiencing and will continue to experience service shortfalls due to increasing population, with 40% to 60% of Cairo households served irregularly or not at all. About 80 incinerators located at municipal waste dumpsites throughout Egypt have capacities ranging from 0.4 tons/hour to 1.0 tons/hour. Incinerators have been introduced at eight locations (80 plants with a capacity of 0.4 to 1.0 tons/hour). However, the lack of incentives for upkeep and difficulties in obtaining spare parts, combined with high operating costs keep many of them from functioning.

Egypt has five composting plants with a combined capacity of 42 tons/hour. Alexandria, Cairo, and Damietta each have a 10 tons/hour plant; Cairo and Giza each has a 6 tons/hour plant. Cairo's composting plants and sanitary landfills are able to handle 1,200 tons/day.

Due to lack of demand, few companies offer hazardous waste treatment or safe disposal services.

No collection and disposal system exists for hospital waste, apart from disposing of it with municipal waste. Hospital waste incinerators present a substantial business opportunity; their introduction will be regulation driven.

Competition

The competition for municipal waste collection services is already strong, with approximately 85 small private collection companies operating in Cairo alone. Competition, however, is not keen for large-scale collectors using large-capacity equipment. Some garbage trucks are used, but they are often mismatched with the type of waste, or they experience poor road conditions or restrictions on the weight of their loads. The major competitors for landfill operations are municipal government agencies. Foreign companies will supply most advanced landfilling, incineration, and composting technologies. Equipment manufacture for these purposes presents ideal joint venture possibilities for developed country engineering firms and Egyptian manufacturers.

The Egyptian market for hazardous waste collection, disposal, and treatment is undeveloped, so few if any Egyptian companies can supply the necessary technology at present. The potential is good for joint ventures between U.S. and Egyptian companies whereby the equipment manufacturing plants would be established in Egypt. Competition for this market will come from developed countries. The same holds true for hospital waste incineration systems. Competition from firms experienced in the engineering and logistics of hazardous waste will be limited to developed countries at this time.

Ownership

Both municipal agencies and the private sector provide municipal waste collection services. Landfills are still under the auspices of government agencies. Experience with incineration and composting plants in Egypt is too limited to determine who will own or operate landfills.

Hazardous solid waste collection and disposal services will probably develop primarily in the private sector, which would cater to public and private sector industries. An exception might be large public sector companies which will seek to dispose of hazardous waste independently, but even they will need to acquire some technologies from outside the public sector.

Strategies and Costs of Entry

The costs of entry into the municipal waste collection and disposal market are relatively low and primarily require transport vehicles and labor. Egypt has not yet developed experience in disposal technologies, but it does have a sizable technically educated work force that could easily undergo specialized training in municipal waste disposal technologies.

Incineration and engineered landfills are the primary technology options for handling hazardous waste that require high initial investment costs, while reuse of the waste as a fuel and bioremediation require low investment costs.

Operational costs can be high for hazardous waste treatment systems since these technologies are relatively new to Egypt and require extensive training. Technologies that can draw upon pre-existing experience will have an advantage. Bioremediation and incineration are at one end of the scale, requiring extensive training, while landfilling and reuse as a fuel are at the other end.

Waste Recycling and Associated Businesses

Recycling business activity in Egypt is considerable. The potential for upgrading the quality of recyclable products and adding new products is good. Also, more efficient waste collection and a growing urban population will increase the demand for recycling equipment and recyclable products. Currently, plastic, rubber, cooking oil, batteries, metals, glass, and certain organic wastes are recycled. The best new opportunities are in the recycling of paper, plastic, and motor oil. The potential market for large-scale recycling plants has spurred some Egyptian companies to begin seeking foreign recycling plant manufacturers to form joint ventures.

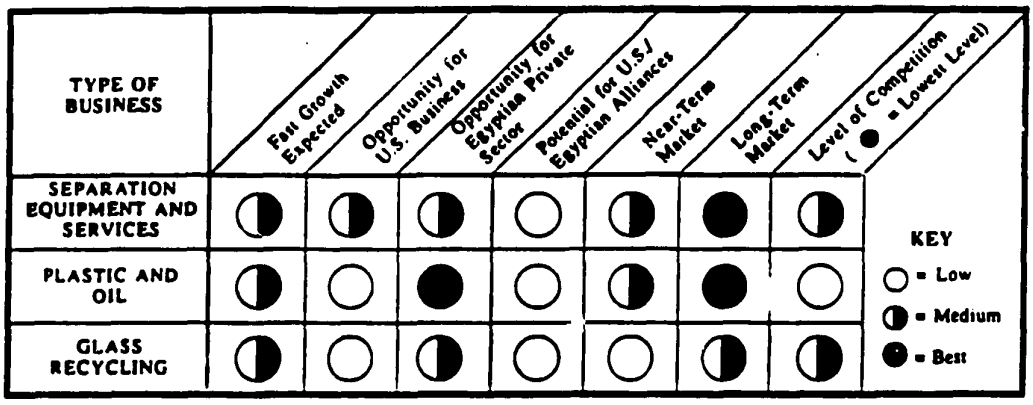
Products and Services

The main types of solid waste in urban areas are household, commercial and industrial, street, and construction waste. Of potential value in this waste stream are organic waste, plastics, rubber, motor oil, cooking oil, household batteries, metals, and any item that can have value added for resale to consumers, such as used shoes, or to industries, such as recycled plastic and glass.

Separation, the first step in extracting recycled materials from municipal waste, can be done manually or by automation. To date, most separation of municipal solid refuse in Egypt is done by hand. The following table lists general technologies and equipment needs for recycling various wastes.

Recyclable Product	Technology or Equipment Employed
Plastic	sorting, cutting, washing, granulation, and molding
Cooking and motor oil	sieving and dehydrating devices
Metal	hammer mills and ball mills for shredding and grinding
Glass	separators, washing tubs, batching equipment, furnaces, annealing equipment, molding and shaping machinery
Rubber	tire resurfacing and retreading, pressing, shredding, firing, cracking, injection and extrusion molding
Paper and wood	shredders, pulpers, wood hoggers, repulping tubs, dewatering presses, and fiber balers

Waste Recycling and Associated Businesses



Clients

The market for recycled products includes individual consumers and small-scale industries. The buyers of raw waste and recycling equipment are the many small-scale and some large private recyclers, including the Zaballeen (a garbage collection and recycling collective). New entrants to the market may include larger paper and pulp and chemical (plastic) companies.

Demand

Most recycling in Egypt is related to the solid waste management system in Cairo, where long-established private sector waste collection, sorting, dealer networks, and recycling workshops operate. Private sector collectives and individuals collect approximately one-third of Cairo's waste. The tables on the next page show the amount and composition of municipal solid waste. Increasing population and greater efficiency in municipal waste collection will result in a larger supply of recycling materials. The demand for recycling equipment and services thus stands to grow.

1990 Production of Municipal Solid Waste

Large cities (Alex., Cairo, Giza)	9,416 t/day
Medium cities	2,205 t/day
Small cities	3,617 t/day

Source: "Solid Waste in the ARE," World Bank Draft Document, 1991.

Composition of Solid Waste

garbage/grass	51%
papers	23%
textiles	6%
plastics	9%
metals	6%
glass	4%
other	1%

Source: USAID internal document from Wilbur Smith Associates.

Plastic makes up the largest market for recycling equipment and services in Egypt today. According to some estimates, 1,500 to 2,000 tons of waste thermoplastics are recycled in Cairo each day. Half of this amount originates from the municipal solid waste stream and the remainder, from industrial scrap sold directly to dealers. Currently, about 70% of collected plastic waste is recycled. The table below shows that plastic prices in Egypt have steadily increased. In 1991, recycled plastic sold for $180 to $225 per ton, or about half the cost of imported primary polymers.

Recycled Plastic Prices

Year	Price (LE/ton)
1981	60 - 80
1983	80 - 120
1985	150 - 200
1987	250 - 350
1989	400 - 500
1991	600 - 750

Note: LE estimates not standardized to one year
Source: *The Recycling of Solid Waste in Cairo Egypt*, EQI report, 1991.

Rough estimates indicate that about 17% of Cairo's plastic waste is collected for recycling, up to 70% of which is recycled. The total market size for Cairo in 1991 was estimated to be about $5.5 million per year. The potential market for Cairo and Alexandria, without considering future population growth or changes in waste creation habits, is estimated at about $50 million per year.

Large plastics factories do not now participate in recycling due to the sensitivity of their machinery to the impurities found in recycled materials. New opportunities exist for recycling equipment manufacturers able to overcome this problem.

Automobile tires and innertubes are the greatest rubber waste producers. According to an Egyptian report, 660,000 tires and 2,250,000 innertubes become waste every year in Cairo. Nearly 90% of innertubes but only 1% of tire waste (which is increasing at 25.3% annually) are recycled, because hard rubber is more difficult and costly to recycle than soft rubber.

The market for recycled oil has been poor in the past because the government subsidizes the price of oil. With government policy moving away from subsidies, the market for used oil stands to increase, presenting potential opportunities for recyclers. This would be most feasible for large-scale recycling plants using sophisticated machinery; unlike small recycling plants, they could produce high-quality lubricants that could compete with products made directly from petroleum. According to estimates, 50% of the 1.75 million tons of oil used annually in Cairo is recycled and 20% is used directly as fuel.

Paper recycling produces only low-grade paper at present. However, given that paper represents 23% of all waste generated in Egypt, the potential for expanding markets is great. For example, the American Chamber of Commerce in Egypt has begun a paper recycling project that will collect up to 15 tons of unsoiled paper products to recycle and return as computer paper. Although some additional equipment will probably be necessary for this project, the greatest challenge will be to collect sufficient quantities of unsoiled paper.

Supply

Recycling plants in Cairo range in size from small individually owned workshops to factories of up to 500 workers. For example, the recycling capacity for rubber waste ranges from 200 kilograms (440 lbs) per day per workshop to two tons per day per workshop. From 450 to 500 small manufacturers work with recycled materials. Most are low-technology workshops producing low-quality, low-cost goods for consumer markets. The informal sector has been very successful at filling the need for small-scale recycling plants.

An important element supporting the recycling industry in Egypt is the well-adapted labor force engaged in recycling, which is responsible for manufacturing and operating innovative recycling machines and processes. GOE policy has attempted to encourage the recycling industry as a local alternative to importing these materials. With plastics, for example, this is sound policy, considering recovered plastics cost about half as much as imported primary polymers.

Equipment for small-scale recycling businesses is almost always manufactured by local suppliers who are able to supply a low-cost, specifically adapted recycling apparatus.

Few large companies have entered the recycling business. The only foreign company that indicated it was currently involved is Shell, which may be conducting some in-house recycling.

Competition

Competition among small-scale Egyptian recycling companies is strong, since they rely on a limited source of materials. Competition is limited in the market for large-scale recycling plants, which is not yet fully developed. However, several companies surveyed said they were considering entering the recycling business.

Ownership

The current recycling system is based primarily on private sector service providers. Private sector recycling is operated largely by a unique subculture consisting of two groups of collectives, the Wahis and the Zaballeen. The Wahis act as the administrators of this system and the Zaballeen, as the collectors.

Strategies and Costs of Entry

Foreign companies should consider joint venturing or licensing with the larger companies that produce recycling equipment, or with plastic and paper manufacturers.

To upgrade the quality of recycled plastic and paper products, new equipment will be required, some of it imported. No equipment cost estimates have been made; total costs depend on capacities and equipment specifications.

Point Source Air Pollution Control

Point source air pollution comes from industrial activities and thermal power plants. Egypt's largest concentrations of air pollution are in industrial areas surrounding Cairo and Alexandria. The methods for addressing air pollution include increasing prices to reduce consumption, implementing energy-saving programs, converting to cleaner fuels, such as natural gas, and installing pollution control equipment. According to the EEAA, a combination of all these methods will be used to address Egypt's air pollution problems.

Many Egyptian companies provide services and products to address air pollution, although none specializes in air pollution controls because the market is too small.

The market for pollution control equipment and services is expected to grow as enforcement increases. However, the GOE may be reluctant to invest in advanced pollution control technologies without first trying to reduce energy consumption and encourage fuel substitution.

Products and Services

The equipment used to remove particulate matter such as dust consists of many types of mechanical collectors, fabric filters (baghouses), electrostatic precipitators, and wet scrubbing devices. Several different processes can remove gaseous pollutants depending on the targeted pollutant. Sulfur dioxide can be removed from coal burning power boilers using flue gas desulfurization processes. Molecular sieves are used in sulfuric plants for sulfur dioxide removal, in nitric plants for NO_x removal, and in caustic chlorine plants for mercury removal.

The methods for controlling odors and toxic pollutants include thermal incineration (after burners), catalytic oxidation, activated carbon adsorption, and condensation.

Equipping an industrial plant with air emission control equipment requires a high level of experience and technical expertise to obtain good performance. Engineering consulting services from specialized firms are often required before equipment is purchased and installed.

Converting to natural gas requires investments in new burners and boilers, as well as investments to increase the production and delivery of natural gas to industrial sites.

Point Source Air Pollution Control

TYPE OF BUSINESS	Fast Growth Expected	Opportunity for U.S. Business	Opportunity for Egyptian Private Sector	Potential for U.S./ Egyptian Alliances	Near-Term Market	Long-Term Market	Level of Competition (● = Lowest Level)
AIR POLLUTION CONTROL ENGINEERING AND CONSULTING SERVICES	●	◑	◑	◑	◑	●	○
AIR POLLUTION CONTROL EQUIPMENT	●	◑	◑	○	◑	●	○
ENERGY CONSERVATION SERVICES AND EQUIPMENT	●	◑	◑	◑	●	◑	◑
FUEL SUBSTITUTION	○	◑	◑	○	○	◑	○

KEY
○ = Low
◑ = Medium
● = Best

Industrial energy conservation includes improving energy efficiency through better maintenance, improved combustion controls, power factor correction and cogeneration.

Clients

The major potential clients for point source air pollution control equipment and services include the following companies, listed by location:

Helwan
Portland Cement Co.
Sigwart Asbestos Co.
Helwan Iron and Steel
Ceramics and Porcelain
National Co. for Cement
Pottery Industries
El Nasr Coke and Chemical
Helwan Cement
General Co. for Metals
Misr Spinning and Weaving
Steel Pipes
Electric Station at Tabbin
South Cairo Electric Station

Shoubra El Kheima area
El Delta Steel Company
Igward Company
National Plastics Company
El Nasr Co. for Glass and Crystals
Abu Zaabal Co. for Fertilizers
General Company for Ceramics

Alexandria area
Abou Qir for Fertilizers and Chemical Industries
General Company for Paper
Paper Industrialization (Verta)

Coke, Chem. & Fertilizers

Lower Egypt
Talka Fertilizer Factory
Dying Material and Chemicals

Canal Area
El Nasr Co. for Fertilizers

Misr Chemical Industries
El Nasr Co. for Tanning
Plastics Company
Nile Match Company

Upper Egypt
Kima Chemical Company
Misr Aluminum
Ferro Silicon Plant

Demand

Many of Egypt's industrial facilities were built without air pollution prevention or control measures, except for certain cement and fertilizer plants. In a survey conducted by the Ministry of Industry, few industrial respondents admitted to [illegible]ting any air pollution since they were unaware of what such pollution might include. Although much less testing has been done for air pollution than for water pollution, the assumption is that in addition to high levels of suspended particulate matter, the level of heavy metals emissions, particularly lead, is also unacceptable.

The treatment of Egypt's air pollution problems will take many years and cost several hundred million dollars. The Egyptian Environmental Affairs Agency estimates that phase one industrial pollution control will cost $165 million, while phase two will cost $330 million. Sources of funding for such a clean-up are still unclear.

The Ministry of Industry has implemented several projects to reduce air pollutant emissions, including the installation of filters to detain dust; stack towers for gas absorption; electrostatic filters and scrapers, cyclones, ammonia neutralizers, and stack towers for ammonia collection; separators for condensing lead vapors; and reduction furnaces to prevent the emission of lead vapors. How much was spent on these projects is unknown.

The cement industry is a major cause of air pollution, particularly in the Cairo area. In Helwan, three cement plants emit 1,650 tons/day of dust. Most of these plants have baghouse filters and sometimes electrostatic precipitators, but they are not properly operated. Baghouses and electrostatic precipitators have been installed in two cement plants, Suez Cement and Quattamia. USAID financed both plants, which required advanced pollution control technologies. Some problems have arisen in equipment operations at these plants.

The market for point source air emissions will be defined largely by increased government enforcement and the level of funding from donor agencies. The public is growing more aware of air pollution and the health effects of poor air quality. Enforcement of regulations will probably increase along with public awareness.

Donor agencies have expressed some interest in funding air pollution control projects. The German government is planning to provide a DM 36 million grant for a project to reduce dust emissions in the cement industry, perhaps in cooperation with the Danish government and the World Bank. At El Nasr Casting, the German government is reviewing a project that would reduce air and water pollution. USAID's Energy Conservation and Efficiency Program sponsors energy-saving projects that reduce air pollution.

GOE may intervene with a tax on high-sulfur fuel to encourage use of low-sulfur fuels, which will require industry to invest in new burners and boilers.

Supply

Several companies in Egypt, including Orascom and Alexandria Shipyards, manufacture dust collectors and baghouse filters. Twenty companies interviewed said that they provided products or services that address air pollution problems. No company specializes in air pollution, and many of the 20 respondents are agents/distributors for foreign manufacturers of air pollution control equipment. Several respondents are large engineering and design firms.

Consulting services are available from private companies as well as from research institutions. Foreign consultants, although more expensive, are also available.

Competition

Competition does not appear to be significant at this early stage of market development. To the extent that the market is donor-financed, equipment will be sourced from the donor country providing funds. Equipment for World Bank projects will be selected by international competitive bidding.

Research institutes, such as the Tabbin Institute and Cairo University, also provide engineering and consulting services.

Ownership

Heavy industrial air polluters mostly are publicly owned, but they may be scheduled for privatization. The majority of the companies treating air pollution are privately owned by Egyptians. Some public sector companies manufacture air filters. In addition, some large foreign engineering companies, such as Bechtel, have offices in Egypt.

Strategies and Costs of Entry

Establishing a presence in Egypt is the best way to enter the point source air pollution control market. Companies like Bechtel are probably in the best position to provide sophisticated engineering and design services because of their presence in Egypt. If setting up an office is not possible, foreign equipment suppliers should establish relationships with Egyptian engineering and design companies to be ready to submit bids once projects are announced. Imported equipment should be adapted to meet Egyptian requirements: easy to maintain, low cost, and not highly automated.

Renewable Energy

Renewable energy is extracted from non-depletable resources such as sunlight, wind, geothermal heat, hydropower, and plant matter. The effect of this type of energy on the environment relative to other energy sources is minimal. In Egypt, sunlight and wind are the most abundant and best suited renewable energy resources. Wind machines are being used on a pilot basis to generate electricity in the Red Sea/South Sinai region.

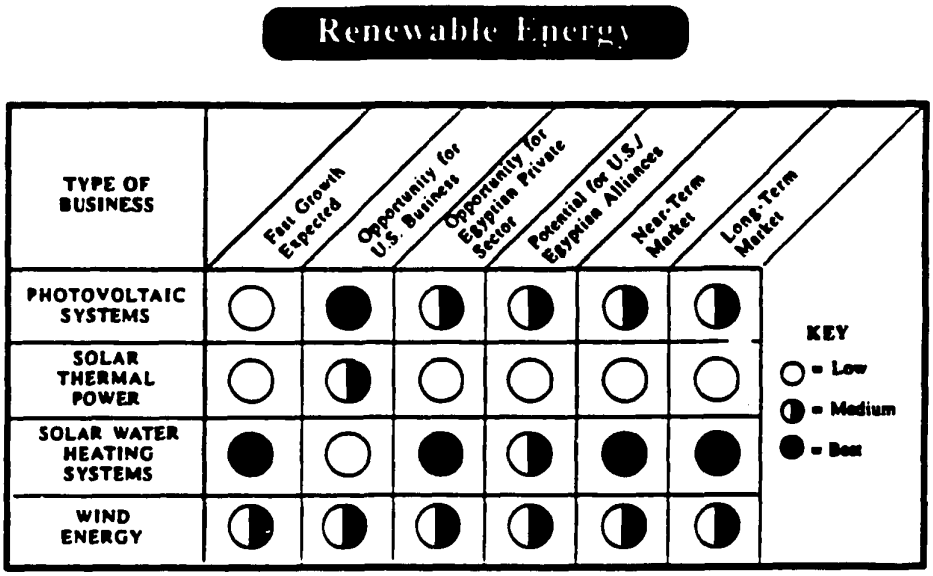
The GOE's Five Year Plan, 1992-1997, calls for the procurement and installation of an estimated $66.8 million in wind turbines. The U.S. Department of Commerce estimated the 1991 market for imported windmill equipment in Egypt at $7 million and annual growth of 25% per year. However, the Ministry of Electricity has been the sole buyer of wind-generated electricity, and so far it has purchased it only with donor funds.

Products and Services

Wind energy is best employed where winds are strong and reliable. Two basic types of wind machines, horizontal axis wind machines (resembling an airplane propeller) and vertical axis wind machines (resembling a wind dial) are common. Wind machines can be used to pump water and do other mechanical tasks. Commercially available wind turbines vary in capacity from a few hundred watts to several hundred kilowatts. They use a simple, and reliable technology.

The technologies used to harness solar energy include photovoltaic and solar thermal. Photovoltaic systems consist of solar cells and collateral equipment (DC/AC power inverters, voltage regulators, storage batteries, power controls, and instrumentation). Most solar cells are made from a semiconductor material that converts solar radiation to an electric current. Given current technology and the high cost of producing solar cells, this technology is best suited for remote small-scale electricity needs.

Unlike photovoltaic systems, solar thermal systems use heat energy derived directly from solar radiation. Solar water heaters are the most common examples of this technology. Solar thermal electric power systems concentrate solar radiation using curved mirrors to focus the heat on a dark surface that absorbs it. The heat drives an engine which converts this energy to electricity. This power can be used or stored in batteries.



Clients

In 1986, the Ministry of Electricity established the New and Renewable Energy Authority (NREA), which is currently considering several wind farm projects on an experimental basis. The clientele is limited, however, because the GOE Electricity Authority has a full monopoly on generating and selling electricity. Private developers may install such systems for new tourist communities, for example, but in most cases, wind supplies only enough energy to supplement other sources.

Solar water heaters are generally used on a small scale to heat water in commercial or residential buildings. The potential clientele for solar water heaters consists of any public or private sector building owner or development company for whom this system is economically advantageous.

Because the uses for photovoltaic energy are smaller and more specialized, private sector companies will probably be the primary clientele. Demand will come from those willing to pay more per unit of energy in return for reliability and independence from the electricity grid. Thus, remote outposts, villages, and tourist villages are the most likely candidates.

Demand

By 1994 the GOE is expected to discontinue its price subsidies for electricity. To meet its increasing demand for energy (projected to be 49 million tons of oil equivalent by the year 2000), Egypt will need to increase its energy supply. Renewable energy may become a larger component than it has been in the past, especially considering its environmental benefits, but near and medium term growth in this market will be slow, since non-renewable energy sources such as natural gas are still considerably cheaper and more available.

Three wind machines currently operating, have proven cost-effective, according to a U.S. Department of Commerce report on wind energy in Egypt. Their capital costs are higher on a per kilowatt-installed basis, but operation and maintenance costs are much lower. Whether successful operation and maintenance can be carried out in the long run is still in question, however. Only a few areas with sufficient wind have installed wind energy systems. They are found along the Red Sea and the north coast.

According to the U.S. Department of Commerce, the estimated 1991 market for imported windmill equipment is $7 million and annual growth of 25% is expected. Sources in Egypt involved in renewable energy put the number lower. The GOE's Five Year Plan 1992-1997 calls for an estimated $66.8 million worth of turbines to be installed, but only if financed by donors.

In Ras Ghareb, a wind farm has been constructed with four 100 kilowatt wind turbines with a 6.6 kV grid distribution system, which generates 1.2 million kWh (3,480 barrels of oil equivalent) of electricity annually.

The demand for solar heaters should increase substantially, particularly given Egypt's climate. Israel and Cyprus have successfully used solar heaters. Photovoltaic systems are a cost-competitive alternative for small power demands that have largely been filled by small generators and batteries. They are too expensive to meet large demands, however, given current technology.

Supply

According to the NREA, local manufacturers can produce 40% of the wind turbine components used in Egypt, including rotor blades and turbines. Efforts are being made to increase this capability. The Iron and Steel Company in Helwan manufactures towers and turbines, and the Port Tawfik Maritime Shipyard in Suez manufacture the blades, but the scale of the manufacturing is uncertain.

Component parts used in solar heaters are quite simple, usually involving plastic piping, pumps, gauges, storage containers, and other equipment for the circulation systems, all of which are available in Egypt. There may, however, be a shortage of experienced engineers to design such systems, as this technology has not been widely employed.

Numerous foreign companies would like to sell imported renewable energy systems in Egypt.

Competition

According to the U.S. Department of Commerce report on wind energy, Danish windmills are firmly established in the Egyptian market, accounting for 60% of installations in 1990. Danish firms have had the advantage of a $30 million grant to develop wind energy. The next largest supplier is the U.S., accounting for 30% of sales. Imports from the U.S. have grown by 20% per year. In 1991, the local production of equipment accounted for an estimated $2 million or 29% of the total market.

The suppliers of windmills to the Egyptian market include Bergey Windpower (U.S.), US Windpower (U.S.), MAT (Denmark), RISO (Denmark), Sabroe (Denmark), and Wincon (Denmark).

Ownership

The GOE will probably undertake large-scale renewable energy development. The private sector will require smaller applications. Most renewable energy suppliers are privately owned.

Strategies and Costs of Entry

The costs of entry associated with wind energy systems tend to be high due to economies of scale. It is more expensive to install 10 small wind turbines than one large one. Thus, potential manufacturers must be prepared to cover the high start-up costs for the manufacture of large systems. Customs duties in Egypt are 20% on windmills; a 10% sales tax has also been imposed on windmills.

Because solar heating systems are built with easily manufactured components, and can be assembled in small and medium-sized manufacturing facilities, the cost of entry is relatively low. To enter the market for designing and installing solar heating systems, a firm needs experienced professionals.

The sophisticated technology and high precision required to manufacture equipment for solar thermal electricity generation systems is very expensive.

Mobile Source Air Pollution Control

Emissions from vehicles contribute substantial air pollution in Egypt, especially in Cairo. High air pollution levels have been linked to incidences of several medical conditions. The number of vehicles in Greater Cairo increased by 10% per year from 1980 to 1990, and is projected to continue increasing.

Legislation to stem mobile source air pollution is limited and not enforced. However, given the enormity of Cairo's air pollution problem, some controls on vehicle emissions will have to be required and enforced in the coming decade. The nature of such regulation is uncertain at this time.

An increase in the price of fuel is probably the greatest single factor leading to reduced vehicle hydrocarbon emissions. Higher fuel prices would give people an incentive to drive less and use alternative transportation modes. In addition, drivers would be more inclined to keep their vehicles tuned, so as to increase fuel economy, thereby decreasing emissions.

Products and Services

The equipment used to prevent vehicle air pollution includes vehicle tune-up equipment, exhaust analyzers, and catalytic converters. Alternative fuels can also reduce vehicle pollutant emissions.

On a municipal level, technical consulting services can be useful in determining optimal traffic flows and modeling air quality.

Last, the construction of non-polluting public transportation systems such as light rails is a costly endeavor, requiring specialized equipment and engineering services.

Clients

The initiation and enforcement of GOE standards for vehicle maintenance, or an increase in fuel prices to encourage optimal engine maintenance will create a private sector opportunity to provide vehicle tune-ups. Maintenance centers for commercial fleets (either private or government-owned) are potential consumers for tune-up and analysis equipment.

If cleaner burning fuels are mandated, vehicle owners will become the most numerous clients, but government vehicle fleets will also comprise a significant market for cleaner fuels.

Mobile Source Air Pollution

TYPE OF BUSINESS	Fast Growth Expected	Opportunity for U.S. Business	Opportunity for Egyptian Private Sector	Potential for U.S./ Egyptian Alliances	Near-Term Market	Long-Term Market	Level of Competition (● = Lowest Level)
VEHICLE TUNE-UPS AND INSPECTIONS	◑	○	●	○	◑	●	●
ALTERNATIVE FUELS	○	◑	◑	○	○	◑	●
LIGHT RAIL PUBLIC TRANSPORTATION	◑	◑	○	○	◑	◑	◑

KEY
○ = Low
◑ = Medium
● = Best

In fact, such a mandate may even be applied to government fleets first and individual vehicle owners later.

The GOE will be the primary client for the construction of public transportation systems; such systems may have donor funding. In the short to medium term, however, buses will probably be a cheaper and more attractive option.

Demand

Mobile source air pollution equipment and services are not expected to develop into a near-term market in Egypt. Over the long term, however, some of the market drivers described below will arise.

Egypt has a total of about 2 million vehicles, half of them located in Cairo and Giza. This fleet is composed of 1.26 million cars, 410,000 trucks, 330,000 motorcycles, and 33,000 buses. Vehicles tend to be old and are often poorly maintained.

The potential demand for mobile source air pollution control equipment and services depends on the imposition of mandatory maintenance to ensure efficient combustion engines, properly inflated tires, etc. Raising the price of fuel to create a concern for fuel efficiency would have a similar effect. This would create a market for maintenance stations and associated equipment such as engine tune-up devices and exhaust analyzers. In the distant future, more stringent practices might be mandated such as installing catalytic converters in all new vehicles.

It is also possible that the GOE will push for more use of cleaner-burning, alternative fuels in conventional automobiles, thus creating a market for such fuels as ethanol.

The new GOE Environmental Action Plan calls for the phaseout of leaded gasoline by 1995. This will have implications for both car manufacturers and petroleum refining companies, because it would increase demand for unleaded fuel. Such a phaseout would also pave the way for GOE to begin promoting or mandating the use of catalytic converters, which can only be used with unleaded fuel.

Supply

Sophisticated, computerized engine tune-up and exhaust analyzing equipment will not be manufactured in Egypt until demand is large enough to allow economies of scale for local manufacture. Given Egypt's petroleum refining industry and the expertise associated with it, the country will probably be able to supply its own alternative fuel production needs.

Egyptian oil companies will be able to supply unleaded gasoline to meet potential future demand.

Non-polluting public transportation systems can be designed and constructed through partnerships between Egyptian and foreign engineering firms. Foreign firms will probably supply equipment, such as train cars and switchboards.

Competition

Because the market for mobile source air pollution has yet to develop, there is currently no significant source of competition.

Strategies and Costs of Entry

Companies seeking to enter this business first need to convince the GOE of the benefits of addressing mobile source air pollution. Public awareness may be a precursor to any significant GOE action.

WHAT IS NEEDED TO TAKE ADVANTAGE OF THE OPPORTUNITIES

Information on Market Opportunities

Many companies interviewed for this study do not kwow the extent of Egypt's environmental problems and are thus unaware of the business opportunities these problems present. Private companies said they were generally unable to obtain the results of the GOE's environmental testing and monitoring programs for air and water pollution. Nor were they aware of the direction of environmental actions that the GOE is considering, particularly enforcement and expenditures for environmental improvements. Without this type of information, it is difficult for Egyptian companies to do much more than react to specific tender offers or bids. The ability to develop market and business plans and to enter new lines of business is thus significantly stifled for these firms.

Most business information in Egypt is obtained through personal contacts, and some is developed through membership in business organizations and associations. A business association that pulls together companies offering environmental products and services could serve a variety of functions, one of which would be to enhance the channels of information on environmental business opportunities. The Environmental Awareness Committee of the American Chamber of Commerce in Egypt is a good example of an organization that is beginning to take action. This committee has initiated a paper recycling project and taken steps to inform its membership about environmental problems.

Other business organizations, such as the Federation of Egyptian Industries, the Cairo and Alexandria Chambers of Commerce, and the Alexandria Businessmen's Association, could be requested to help increase the amount of information available to their members on environmental problems and potential business opportunities. This could be done by developing environmental business committees in each organization and an umbrella environmental organization for all the industry associations.

In addition, the GOE must increase information dissemination. The Environmental Affairs Agency should be responsible for providing relevant information to the private sector. If the agency wants to encourage the development of private environmental firms, it could participate more actively in policies and programs that involve the private sector. Initially, many of these programs would focus on information dissemination and identification of interested participants.

Access to New Technologies and Approaches

The Egyptian private sector lacks the technical capabilities to address many of the country's environmental problems. This is a constraint to the development of an environmental business sector, particularly for air pollution control, waste minimization, and industrial wastewater treatment.

Many solutions to environmental problems involve a combination of scientific analysis and testing, design and engineered systems, equipment procurement and installation, and ongoing operations and maintenance. Few private companies in Egypt have all the capabilities to provide such an integrated solution, and few have cooperated to combine their capabilities. Thus, environmental solutions provided by these companies often will be inadequate.

Egypt's large engineering industry is experienced in designing certain types of civil, mechanical, and chemical solutions for environmental problems, particularly for water purification, water treatment, and sewer construction. However, expertise is minimal in many areas. Few engineers understand industrial waste minimization and materials recovery programs. Engineers seldom include environmental criteria in their initial building and industrial designs.

Access to new technologies can be facilitated by organizing environmental business conferences and workshops, establishing technology databases, setting up environmental professional and trade associations, distributing buyers' guides, and linking foreign technology suppliers with the Egyptian business community through catalog exhibits, and trade and investment missions.

Participation of Foreign Environmental Companies

Agents/distributors of imported environmental equipment need to know how to import the best and most suitable equipment. The companies interviewed strongly agreed that highly automated technologies are generally not suitable in Egypt, particularly when they require substantial operation and maintenance.

Foreign equipment suppliers must adapt their products to meet Egyptian specifications. Generally, this means offering technologies that are easy to maintain and do not require expensive replacements or spare parts. Where spare parts are required, a mechanism to obtain them should be developed when the equipment is sold. For example, the operations of solid waste collection vehicles, and composting and incineration plants suffer from a lack of spare parts.

Foreign companies also need to consider how to lower the costs of their products and services to make them affordable in Egypt. Options include local assembly and manufacturing for certain technologies and use of manual systems.

Development of Operation and Maintenance Capabilities

Companies and individuals interviewed repeatedly pointed to existing installations of industrial pollution control facilities (chemical plants), solid waste disposal facilities (incinerators and composting plants), and some water and wastewater treatment plants (primary treatment plants in Cairo) that were not operating due to the lack of employee motivation, spare parts, or trained personnel. The GOE should encourage the small but growing group of private companies providing operation and maintenance services. The GOE also needs to support more private management contracting for public infrastructure services similar to its efforts in municipal solid waste collection. Water and wastewater authorities should also consider contracting to private companies for operation and maintenance services. The same could be done for air pollution control technologies. Resistance from GOE personnel who may lose jobs and suffer other consequences is likely to delay such changes, however.

Training

The private sector needs additional education and training to develop the specialization required to treat Egypt's air and water pollution problems. Little specialized expertise exists in environmental consulting. Advanced training in chemical and mechanical engineering is required. Environmental engineering training is also needed.

Financing for Feasibility Studies and Capital Investments

As new business opportunities develop in the Egyptian environmental market, prefeasibility and feasibility studies will be needed. In some cases, financing for capital investments will also be required. Feasibility studies and business plans need to be prepared to obtain project financing.

Feasibility studies will have to be done for several environmental sectors described in this report before companies will consider entering the business. These sectors include environmental consulting, the manufacture and design of industrial wastewater systems, and new solid waste recycling opportunities, such as paper or plastics.

Creation of Market Demand

According to the companies interviewed, market demand is the most important factor to consider in deciding whether to enter a new line of environmental business. Nearly every company interviewed said that better enforcement of environmental regulations would increase their business. Other important market factors frequently mentioned include market pricing of resources, such as water and energy, privatization of public sector enterprises, and more public awareness.

Strong market demand is especially important for Egyptian companies considering manufacturing equipment for the environmental market. Because manufacturing usually requires more up-front capital than investment in services, businesses and their bankers need to be convinced that the demand will justify the initial investment. For this reason, most manufacturing of environmental products is in the hands of public sector manufacturing facilities that have better access to GOE-controlled markets, have too much capacity, or do not need to justify their capital spending.

Privatization of Industrial Enterprises

Most companies agreed that privatization would benefit environmental businesses. First, the privatization of industrial enterprises will facilitate government enforcement of environmental rules and standards. Currently, it is difficult for the GOE to enforce its own polluters. Second, privatization will make enterprises more efficient and allow faster economic growth. Third, privatization will allow the GOE to procure more from the private sector.

Elimination of Trade and Non-Trade Barriers

Several barriers that exist in Egypt's business community in general also apply to its environmental business sector. High import duties discourage the import of many pieces of equipment important to the sector. High domestic taxes discourage the private sector from expanding. Difficulty in moving imported products through customs, especially spare parts, is a chronic barrier to doing business in Egypt.

Environmental Problems and Trends in Egypt

Egypt's population of 54 million people is almost entirely concentrated on a narrow band on both sides of the Nile River, which comprises only 3% of Egypt's land area. High population density, along with rapid growth of intensive agriculture, industrialization and urbanization have given rise to several chronic environmental problems. With an annual population growth rate of approximately 2.4%, pressures on Egypt's base of natural resources can only be expected to increase.

Rainfall in Egypt varies from 25 mm (.98 in) per year in arid regions along the Red Sea to 200 mm (7.87 in) per year Alexandria, but is less than 50 mm (1.97 in) in most parts of the country. The great majority of Egypt's population resides along the 1,000 km-long (620 mile) Nile flood plain which seldom reaches more than 20 km (12.4 mile) in width. The Nile River runs south to north, entering Egypt along the Sudanese border. The Nile Delta begins to fan out just north of Cairo, where it is bounded by the Rosetta and Damietta branches, which ultimately empty into the Mediterranean Sea. The Nile Valley and the Delta contain virtually all of Egypt's agriculturally productive land. The construction of the massive Aswan High Dam, which was completed in the south of Egypt in 1970, has allowed Egypt to harness the potential energy and to stem the once pervasive seasonal flooding of the Nile River. The resulting growth of the country has lead to an overwhelming dependence on its flow.

Population Densities of Selected Metropolitan Areas in the World

	POPULATION DENSITY	
CITY	**per sq km**	**per sq mi**
Cairo	42,000	108,808
Bangkok	21,278	55,126
Mexico City	14,403	37,314
New York City	4,429	11,473
Hong Kong	95,344	247,004
Karachi	15,068	39,038

Sources:
1) *Environmental Action Plan*, Government of the Arab Republic of Egypt, 1992.
2) *Preliminary Survey of Environmental Problems in Egypt*, EQI, 1991.

A1

A3

Few countries in the world are as dependent on a single source of fresh water as Egypt is on the Nile River. Over 99 percent of Egypt's water stems directly from the Nile or from aquifers fed by the Nile. Lack of government emphasis on protecting Egypt's water resources along with significant and rapid industrial growth have lead to significant decreases in Nile River water quality in the past few decades. Agricultural runoff of chemicals and minerals, industrial and municipal waste, and high silt concentrations have all contributed to the abrupt change.

By international agreement, the Nile River provides 55.5 bil m^3/yr (14.6 trillion gal/yr) of water. Estimates are that the Nile could provide no more than another 8 bil m^3/yr (2.1 trillion gal/yr), which, according to projections, will be insufficient to meet future demands for water meeting minimum quality standards for agricultural, industrial, or domestic use. For lack of other resources, increases in demand will need to be met by tapping greater amounts of water from drains, which receive used, untreated water from municipal, industrial, and agricultural sources. Relying on wastewater as a source for agriculture and other uses forebodes any number of potential hazards. As a result, water conservation and treatment will become crucial in the coming decade in order for Egypt to maintain adequate water supplies.

Freshwater Resources for Selected Countries

	Annual internal renewable water resources		Annual water flow contribution from other countries		Annual consumption as percentage of total water resources	Annual per capita withdrawals	
	cubic km	trillion gallons	cubic km	trillion gallons	percentage	cubic m	thous. gallons
Egypt	1.8	.475	56.5	14.9	97	1,202	318
Tunisia	3.75	.990	.60	.159	53	325	85.9
Denmark	11.0	2.90	2.0	.528	11	901	238
Mexico	357	9.44	not available	not available	15	289	76
Saudi Arabia	2.20	.580	0.0	0.0	164 (incl. seawater)	255	67
Thailand	110	29.0	69	18.2	18	599	158
US	2,480	654	not available	not available	19	2,162	571

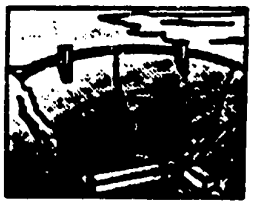
Source: *World Resources 1992-1993*, World Resources Institute

Water Use by Sector

(billions m³per year)

48.1
Agricultural Consumption and Evaporation

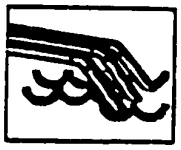
56.0



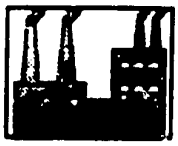
High Aswan Dam

3.8
Domestic Consumption

Polluted Drains



12.3
Drains to sea



2.7
Industrial Consumption

1.7
Unused water flow to sea

The High Aswan Dam

99% of Egypt's fresh water comes from the High Aswan Dam. By international agreement, its annual releases are limited to 55.5 Bm³, with a variation of ± 2 Bm³.

The Nile Trickle

Without conservation, Egypt's supply of unused water will soon be exhausted. After industrial, urban, and agricultural use, in 1990, only 3% of Nile water released at the Aswan Dam reached the Mediterranean Sea.

A Dangerous Prospect

Ever increasing demand for water in all sectors, combined with a limited water source means that Egyptians will be relying more on polluted water from drainage canals. According to projections, by the year 2000, Egyptians will acquire an additional 6.4 billion m³ of water per year from polluted drains compared with 1990.

A3

Over the past 10 years, the Nile River has undergone a rapid decline in water quality, with certain short segments classed as violating safe drinking water source standards, both as a result of excessive biological contamination such as fecal and total coliform bacteria as well as toxic pollutants such as heavy metals. According to the World Health Organization, 90,000 recorded deaths a year can be traced to water-borne diseases in Egypt. Currently 90% of Egypt's effluent is untreated. Industries dump effluent at 20 monitored locations along the Nile, and at some 80 unmonitored locations on irrigation and drainage canals. Most Egyptian villages have no wastewater treatment and collection systems. Agricultural drains discharge an estimated 3.2 million m^3/yr (845 million gal/yr) containing pesticides, fertilizer, and raw domestic sewage from some 5,000 rural municipalities.

% Population With Access to Safe Drinking Water and Sanitation 1988

	% Population with Access to Safe Drinking Water		% Population with Access to Sanitation Services	
	Urban	Rural	Urban	Rural
Egypt	96	82	100	34
Tunisia	100	31	71	15
Thailand	67	76	84	not available
Saudi Arabia	100	74	84	X
Mexico	79	49	100	12
Denmark	100	100	100	100

Source: *World Resources 1992-1993*, World Resources Institute

Egypt's freshwater lakes in the Delta region, the source of 50% to 60% of the country's total fish catch have also been affected by uncontrolled effluent discharging. The water quality of two of the five largest lakes in the Delta region, Lake Manzala and Lake Maryut, has dramatically declined. In the former, fish yields have declined by 90% over the past 10 years, while in the latter, the problem is so extreme that the lake has essentially been converted to a wastewater oxidation pond.

Egypt has among the most fertilizer and pesticide-intensive crop cultivation in the world, largely due to government fertilizer subsidies, which are now being eliminated. Average annual application of fertilizer is 384 kg/ha (.155 metric tons/acre), compared with 22 kg/ha (.0089 metric tons/acre) in Tunisia, and 95 kg/ha (.0384 metric tons/acre) in the

United States. Pesticide use is equally intensive. The average annual application of pesticides in Egypt in the years 1982-1984 was 7.57 metric tons/ha (3.06 metric tons/acre), compared with .283 metric tons/ha (.115 metric tons per acre) in Tunisia and 1.97 metric tons/ha (.797 metric tons/acre) in the United States. Heavy use of pesticides and fertilizers have led to high concentrations of residues in agricultural runoff waters, rendering them unsuitable for re-use. Nonetheless, projections show that without drastic water conservation measures, drainage waters will be increasingly relied upon for agricultural, domestic and commercial use.

Over the last 40 years, air pollution has become a serious problem in Egypt. Air quality has decreased rapidly in Cairo and Alexandria as a result of industrialization, and an increase in the number of motor vehicles, large industries, workshops and small industries, and thermal power stations. Dust plumes and smoke haze are common phenomena in industrial enclaves just outside Cairo, such as Helwan and Shoubra El-Kheima. High concentrations of particulate matter found in Cairo, emanating from natural sources such as desert dust and from industries such as cement plants, mix with CO, NO_x, HC, and heavy metal emissions, producing noxious air.

High air pollution levels are having adverse effects on human health, soil, water, agricultural crops, buildings, and livestock. Pollution levels in Cairo city center often surpass World Health Organization guidelines. Total suspended particulates are 10 times international standards, hydrocarbon levels almost three times these standards, and sulfur dioxide levels five times international levels. Health effects are already readily apparent. In Helwan, 29% of school children surveyed were found to have lung diseases, compared to 9% in rural areas. The cement industry is by far the greatest contributor to airborne dust in the greater Cairo area, accounting for over 93% of all man-made particulate matter, according to one study.

About half of Egypt's boundaries, 2,000 km (1,240 mi), are comprised of coastline along the Mediterranean and the Red Sea, which provide Egypt with valuable resources such as fish, oil, sponges, coral reefs, and minerals. Major threats to environmental quality stem from oil exploration, production, and transportation by tankers in the Red Sea Region, as well as urbanization, industrialization, and tourism development in Egypt's coastal zones.

The most polluted areas around Alexandria are along the Mediterranean coast. Drainage water carrying agricultural runoff and municipal and industrial discharges is fed into the Mediterranean. A major receiving body of industrial waste is the Abu Qir drain, which discharges into the Abu Qir Bay. West of the city, the El Mex region is fed continuous discharges of industrial wastes from chemical industries, a chlorine alkali plant and the Alexandria Petroleum Company. In addition, heavily polluted water from Lake Maryut is pumped into the area along with the expulsions of the Umum drain, which carries drainage waters mixed with pesticides and fertilizers.

Summary of Air Pollution Concentrations (1987-1989)
(in $\mu g/m^3$)

		Cairo Center	Residential Areas	Industrial Areas	International Standard	Egyptian Standard
TSP	AVE	700	590-600	600-840	50-70	-
	MAX	-	900	1200-1800	120-150	60
HC	AVE	140	70-130	60-150	50	-
	MAX	250	140	760	-	150
SO_2	AVE	260	100	105-155	50-80	-
	MAX	-	N/A	2430	125-150	200
NO_2	AVE	200	100	90-140	95	-
	MAX	-	160	200	150	200
Lead	AVE(3h)	-	2.8-12.5	-	1.5	-
Ozone	MAX	275	410	196-350	150-235	-

Source: *Environmental Action Plan*, Government of the Arab Republic of Egypt, 1992
AVE = Annual Average Value HC = Airborne Hydrocarbons
MAX = 24 Hour Maximum Value TSP = Total Suspended Particulates
- = indicates that these standards were either not used or not available

The principal threats to the Red Sea are posed by oil exploration, drilling and shipping, untreated coastal town sewage discharge, and tourism-related impacts such as increased liquid and solid wastes. Sources of oil pollution include the oil port at Eilat, the SUMED pipelines at Ain Sukhna equipped with docking facilities and supertankers, the Sinai oil fields near Abu Rudeis and El Tur, and the off-shore Gulf of Suez wells. Offshore oil drilling, tankers and pipelines have already affected many areas along the Egyptian coast from Suez to Hurghada. Slicks and residues show up on beaches, coral reefs, and nearby islands. There are also indications that oil residues have been responsible for reducing mangrove populations along the Gulf of Aqaba and Ras Mohammed. Dumping untreated sewerage in coastal towns can be lethal to nearby coral reefs because of their ecologically sensitive nature.

Improperly planned coastal development leads to detrimental trash and raw sewage disposal; poorly managed boating and fishing activities, also have deleterious effects on the

natural resources of coastal areas. Finally, the construction and continued dredging of the Suez canal also contributes to the environmental degradation of Egypt's coastal zones by creating turbid waters and soil displacement, which upset natural ecosystems.

Egypt's rapid growth has outstripped its ability to dispose of its solid waste adequately. Currently, composting plants and sanitary landfills in the Greater Cairo Urban Area have a combined maximum capacity of 1,200 tons/day, only 22% of the 5,300 tons/day generated. In addition, most existing composting plants characteristically operate at far less than capacity. Indiscriminate dumping on city outskirts, in drainage canals, and at other inappropriate spots is common. The first sanitary landfill was opened in Cairo in 1986. About 68% of solid waste is collected in Cairo, while that number decreases to 15% in smaller municipalities. Collection tends to be more complete in wealthier areas due to the waste generator's ability to pay for disposal, and the higher value of the generated waste. Resulting problems include higher incidences of infectious diseases such as hepatitis and dysentery.

An estimated 13,000 tons of hazardous hospital waste and 50,000 tons of industrial solid hazardous waste are generated in Cairo each year. The latter number is expected to increase manyfold as programs are initiated to reduce air and water emissions, and as industries are no longer able to dispose of waste in drainage canals and the air.

Business Climate in Egypt

Historically Egypt's enormous public sector has defined most aspects of doing business in Egypt. Beginning in 1930, Egypt launched an aggressive industrialization program, in which import controls and tariffs were the primary protectionist policy instruments. In 1961, the Nasser government began a program marked by massive public investments. The components of this policy included public ownership of industry, a public monopoly on foreign trade, administered prices, and a rigid program of wage and employment guidelines and controls. In 1970 President Anwar Sadat initiated an economic program to gradually reduce the size of the public sector and to liberalize trade.

The current President Hosni Mubarek has continued this policy by encouraging the growth of the private sector and supporting further trade, investment, and economic policy reforms. The government is now emphasizing decontrolled prices, and reduction and possible elimination of subsidies. Despite a push toward privatization, Egypt's public sector of nearly 400 industries accounted for about 75% of all industrial production in 1991. The number of primary private sector industries is estimated at approximately 730, accounting for 25% of industrial production.

The United States is Egypt's largest trading partner, accounting for 26% of total imports in 1990. Major U.S. exports to Egypt include agricultural commodities, telecommunications and transportation equipment, production machinery, and goods associated with the USAID program. In 1990, non-oil U.S. direct investment in Egypt was $308 million, and $ 1.718 billion including investments in oil. With 50 million consumers, Egypt boasts the largest single domestic market in the Middle East by population. To potential investors the country also offers the advantages of low labor costs, a skilled and semi-skilled workforce of almost 14 million, and many highly educated engineers, scientists, and managers.

In recent years the Egyptian economy has been marked by sluggish growth, inflation, growing unemployment and underemployment, and foreign exchange shortages. The effect of the Persian Gulf war on Egypt's economy was mixed. While indicators show that the economy was adversely effected, Egypt received over $13 billion as a result of the war in the form of assistance, military and other debt relief from the U.S. and Arab creditors. In 1990 and early 1991 the GOE took important steps to implement a new reform strategy under the auspices of the World Bank and the IMF, which addresses macroeconomic imbalances and reorients the economy toward free market forces. The new policy addresses inflationary fiscal and monetary policies and allows interest rates and exchange rates to respond to market forces.

Key Economic Indicators

DOMESTIC ECONOMY	FY87/88	FY88/89	FY89/90	FY90/91
Population (millions) (growth rate 2.7-3%)	52.7	54.1	56	
GDP (LE billion, current prices)	58.7	77.6	84.0	
GDP/Capita (LE, current prices)	1180	1511	1588	
Urban consumer price index (percent) (period)	19	17	21.2	
Commercial bank exchange rate (LE/USD)	1.50	2.21	2.61	
BALANCE OF PAYMENTS ($ millions)				
Trade balance	-6567	-7556	-7567	
Exports (f.o.b)	3274	2737	3206	
Imports (c.i.f)	-9841	-10294	-10773	
Services balance	1541	1796	1530	
Receipts	4575	5058	5580	
Payments	-2634	-3298	-4050	
Transfers	4081	4243	4824	
Current account balance	-545	-1553	-1214	
Total external debt	43.1	45.7		
U.S. aid to Egypt (US FY, $ millions, obligations)	2374	2475	2587	
U.S. trade with Egypt (calendar year, $ millions)				
Exports to Egypt	2340	2610	2249	
Imports from Egypt	222	227	396	
U.S. direct investment in Egypt (end-year stock)	1705	1718	1718	
Revenues	18118	21514	25416	32523
Expenditures	23059	28734	30306	41248
Deficit	4941	7220	4890	8725
Net Deficit	680	670	660	3775

In 1991, Egypt took a major step towards stabilizing its economy by introducing a free exchange rate system to replace the previous controlled exchange rates. Interest rates were freed in the domestic banking system, and a weekly auction of treasury bills was instituted that generates revenues to finance the budget deficit. Also, as of July 1990 individuals and companies of all nationalities are allowed to hold foreign currency accounts. Since the new regulations, foreign exchange availability has markedly improved, and the baking system is significantly more liquid.

Egypt has been striving to meet IMF criteria for a credit line. In May 1991, the IMF approved a stand-by loan status to Egypt which grants phased loan disbursements. To meet these, the GOE must reduce its budget deficit and subsidies such as those on energy and

pesticides, among other conditions. Such an agreement will be a crucial step toward increasing investment in Egypt, as it signals to investment communities Egypt's sound financial and macro economic policies. In trying to meet IMF demands, Egypt has had to place stringent temporary economic conditions which include high interest rates, less availability of credit to combat inflation, and shortage of liquidity.

The GOE has enacted two new laws that directly affect business activities in Egypt, Law 230 and Law 203. Intended to improve the country's investment climate, Law 230 was enacted two years ago to take the place of its predecessor Law 43 (1974). Law 230 permits free transfer and investment of foreign currency in Egypt, provides up to 15 years of tax exemption (for investment in new industrial cities), and eliminates restrictions on foreign ownership of land, profit restrictions, and price controls. Under Law 230, foreign capital investment ventures do not require Egyptian participation when they fall into the "Free Zone." Law 230 has also simplified the approval process so that applications for investment ventures are submitted from relevant agencies for approval to the Authority's board within 20 days.

A new public sector business law, Law 203, which took effect July 20, 1991, removes legal barriers to the sale of public sector companies by allowing for more independent management. Law 203 functions as a precursor to a law that will eventually make private and public industries subject to the same law. Companies previously operating under the old public sector law (Law 97) will be reorganized under newly created holding companies, each overseen by an independent board of directors. These holding companies have the authority to sell up to 100% of their existing shares to the private sector. If government holdings of a holding company drop below 51%, the company falls under the jurisdiction of the Corporations Law 159, which allows market forces to rule and subjects companies to only minimal government intervention. Under Corporation Law 159, changes in company objectives and activities are accomplished by holding an extraordinary general assembly meeting attended by representatives of the Corporations Authority, whose role is only to monitor the meeting.

Often public sector companies and government agencies will purchase equipment and other commodities by issuing international government tenders. By law, foreign firms are obligated to submit their bids through an Egyptian agent. For sales to private sector companies, no agent is required. When doing business with the military and petroleum sectors, foreign firms may bid directly. Firms bidding on projects financed by USAID are also not obligated to use an agent.

Regulatory Framework

Since 1946, eight laws have been passed pertaining to water quality and wastewater discharges. Most of them have replaced previous laws. Currently, Law No. 93 of 1962 and Law No. 48 of 1982 and their supplemental implementation decrees form the standing regulatory framework for wastewater discharges, water quality, and management.

History of Egyptian Laws Concerning Water and Wastewater Quality

Law Year and Number	Subject of Law
1946 - Law No. 35	wastewater discharge from public and industrial sources into public sewers
1950 - Law No. 46	wastewater discharge and sewage from buildings into public sewers
1953 - Law No. 196	wastewater discharge from public, commercial and industrial sources into watercourses
1954 - Law No. 645	ratification of Law No. 46 of 1950
1962 - Law No. 93	wastewater discharge and disposal
1967 - Law No. 38	public hygiene
1971 - Law No. 74	irrigation and drainage
1978 - Law No. 57	treatment of ponds and marshes
1982 - Law No. 48	protection of the Nile River and waterways from pollution
1983 - Decree No. 8	implementary regulations for Law No. 48 of 1982
1983 - Law No. 24	Regulation of fertilizers and pesticides, protection of marine life and regulation of fisheries
1984 - Law No. 12	regulation of discharge of wastewater and reuse of drainage water
1987 - Law No. 27	regulation of choice and use of water sources

Law 93 and its subsequent resolutions address a variety of water and sewerage related issues and applies to all general kinds of water bodies. According to the law, emitters of wastewater must obtain licenses which "should indicate the standards and specifications of such wastewater." Samples from sewerage treatment plants should be periodically analyzed. The law also gives standards for wastewater discharged into public sewers according to eight criteria (temperature, pH, settleable solids, granular solids, hydrogen sulphide, fats, poisonous substances, and sublimating gases susceptible to ignition). Receiving bodies are divided into three types: the Nile and its branches, drains, and seas and lakes. Wastewater is divided into two categories: public, commercial or industrial, and sewerage wastewater. Short lists of standards are then defined for each type of discharge into each of the three kinds of receiving bodies. In the case of discharge into seas and lakes, the law is very non-specific, forbidding discharges only when marine life is "harmfully affect(ed)."

Law 48, "Regarding the Protection of the River Nile and Waterways from Pollution", and its Decree No. 8, defines targeted water bodies and discharge types much more specifically for a long list of site types, discharges, and conditions. Water bodies falling under the jurisdiction of this law include fresh surface waters, brackish surface waters, and groundwater reservoirs. Of particular interest are conditions under which permits and licenses must be obtained. The law mandates that the Ministry of Public Works and Water Resources (formerly the Ministry of Irrigation) be responsible for issuing licenses, collecting fees from polluters, and managing discharge monitoring. The Ministry of Health is responsible for the actual monitoring and is to test and analyze each licensed discharger every three months. It is then the responsibility of the Ministry of Irrigation to cancel the discharging permit if the discharger has been found to violate standards. The law is quite specific, defining standards for over 30 parameters for some water and effluent classifications, including a variety of organic and inorganic chemicals. Finally, Law 48 also establishes a fund for the collection of tariffs and fines, which is to be used to facilitate enforcement.

While few laws address only air pollution control, 25 laws and decrees within several ministries contain sections on the subject. Penalties and enforcement procedures often overlap among agencies and tend to be poorly defined. The Government of Egypt has defined ambient air quality standards for a sizable list of gaseous and particulate components, but standards tend to be inconsistent with international air quality standards, with some standards being much higher and others much lower. A clean air law is coming before the Egyptian Parliament this year which would unify existing regulations.

Appendix C

Air Pollution Laws

LEVEL OF LEGISLATION AND DATE	INTENDED FUNCTION OF LEGISLATION
Presidential Decree No. 64/1969	Establishes committee for air pollution control
Ministry of Health Decree 470/1971	Max. limits for air pollutants
Ministry of Health Decree 240/1979	Add level max. for SO_2 in ambient air
Law 106/1967	Regulates building activities
Ministry of Housing Decree 380/1975	Specifications for industrial and commercial buildings
Ministry of Housing Decree 126/1958	Specifications for plant oil processing
Ministry of Housing Decree 58/1972	Animal farms
Ministry of Housing Decree 994/1959	Rubber work places
Ministry of Housing Decree 63/1972	Paper and paper pulp workplaces
Ministry of Housing Decree 65/1972	Metal welding
Law 371/1956	Public shops
Law 372/1956	Recreational places
Law 3/1982	Urban planning
Law 148/1959	Civil defense
Ministry of Housing 600/1982	Implementation of Law 3/1982
Law 66/1973	Traffic
Ministry of Interior 291/1974	Implementation of Law 66/1973
Law 137/1981	Labor
Ministry of Manpower 55/1983	Safety and Health in the Workplace
Law 27/1981	Mines and quarries
Ministry of Soc. Affairs 193/1959	Occupational safety in mines and quarries
Law 52/1981	Protection against smoking
Ministry of Health Decree 1/1982	Implementation of Law 52/1981
Ministry of Health Decree 444/1972	Use of ionizing radiation
Ministry of Industry 380/1982	Technology of pollution

Law No. 38 of 1967 and its amendment by Law No. 31 of 1976 regulate the collection and disposal of municipal solid waste. In towns, the jurisdiction of the law is at the discretion of the respective governor. The law mandates that waste may be disposed only in areas designated by local government councils. The local council regulates the collection process by issuing licenses.

Law 3 of 1982 on urban planning, sets land use criteria, some of which pertain to industrial areas. This law is implemented by the Ministry of Reconstruction, Housing and Development, which is also responsible for implementing Law 38 of 1967 on Public Cleanliness through Decree 134 of 1968. The decree classifies solid waste as domestic, commercial, or industrial, and gives specifications for the containers to be used, modes of transportation, frequency of collection, treatment method, and site selection.

Law 62 of 1947 on rural hygiene also has several clauses on solid waste covering dumping into ponds and marshes, and removing solid refuse and animal waste. In addition, Presidential Decree 284 of 1983 established the Cairo Giza Cleansing and Beautification Authorities to collect and dispose of municipal refuse. It covers the construction and operation of composting plants.

No regulatory legislation is currently on the books for industrial and hazardous waste, but laws covering for the transport, handling, and storage of chemicals do apply. Also, if the disposal of the hazardous waste were to affect water quality, it would fall under the jurisdiction of law No. 48 of 1982. Finally, no laws exist to regulate hospital and laboratory waste.

In the organizational structure of environmental legislation in Egypt, many ministries and agencies hold some jurisdiction over water and air quality and solid waste. The following table shows GOE bodies and their corresponding responsibilities.

Government Regulatory Bodies and Responsibilities

Responsible State Body	Legally Mandated Responsibilities
Egyptian Environmental Affairs Agency (EEAA)	Coordinating body for various Ministries and Agencies responsible for environmental matters
Ministry of Health - Center for Environmental and Occupational Health	Under Law No. 48, responsible for monitoring potable water and for pollution which affects public health, including point source effluent and receiving water bodies
Ministry of Reconstruction, New Communities, Housing and Utilities	Responsible for implementing Law No. 38 of 1967 through Decree No. 134 of 1968 which classifies types of waste and modes of transportation, types of collection containers, dumping sites, and methods of waste treatment; and by Law No. 57 of 1978, the Ministry is also responsible for the treatment of ponds and marshes. Within the Ministry, a number of organizations are responsible for regulating specific areas of environmental health, such as the Organization for New Settlements, the Organization for Physical Planning, and the National Organization for Potable Water and Sanitary Drainage (NOPWASD),
National Organization for Potable Water and Sanitary Drainage (NOPWASD)	Under the Ministry of Reconstruction, New Communities, Housing and Utilities, NOPWASD (an organization of over 2,500 engineers, although very few of them have been trained in the environmental sciences) assists in the implementation its laws, but only in specific areas of jurisdiction.
Ministry of Industry	Controls most of the seriously polluting parastatal heavy industries. Together, industry members make up the General Organization for Industrialization (GOFI) under the Ministry of Industry. It has an Environmental Control Division which employs over 100 professional engineers and technicians, who serve, rather than regulate the GOFI members.
Ministry of the Interior	Maintains the Waterways Police Force, which is responsible for protecting the Nile, its waterways, lakes, and coastal zones from pollution under Law No. 48. Also heads the Traffic Police Force which is to control air pollution from vehicle emissions and noise pollution.
Ministry of Public Works and Water Resources	Primary body responsible for irrigation and water resource management under Law No. 48. It has an extensive water research and water quality monitoring program, but clearly focuses its efforts to support irrigation users, not consumers of produce grown using irrigation water.
Ministry of Agriculture and Land Reclamation	formulates agricultural policy,including fertilizer and pesticide subsidies which were absolved in 1991 and 1992 rerpectively. The Ministry has under it several research centers and institutes, and it monitors pesticide contamination of water supplies.

Responsible State Body	Legally Mandated Responsibilities
Ministry of Petroleum	The Ministry of Petroleum has major responsibility for petroleum exploration, production and processing. It appears to be strongly influenced by the environmental awareness of foreign oil companies and has made major efforts to prevent oil related pollution. The Ministry also participates in determining energy pricing policy.
Cairo and Giza Cleansing and Beautification Authorities (CCBA and GCBA)	In Cairo and Giza, responsible for direct municipal sanitation activities dealing with solid waste. Regulates and supervises private service delivery arrangements and responsible for enforcement of all codes dealing with littering and waste disposal practices.
Ministry of Tourism	The Ministry of Tourism, through its Tourism Development Unit (TDU) is responsible for most of the GOE efforts to earn foreign exchange through tourism. The TDU is increasingly pressing for moderation in coastal developments, such as petroleum production, that reduce tourism demand. It is also concerned with the negative environmental effects of the large water and sewage requirements of tourists.

The Egyptian Environmental Affairs Agency was created by prime ministerial decree in 1982 to fulfill three tasks: coordinate efforts of the various ministries and agencies on environmental matters, prepare environmental legislation, and follow up on the implementation of environmental laws. Administered by the Ministry of Cabinet Affairs, the agency participates in several national, regional, and international activities, but often finds its technical, institutional and financial capabilities overtaxed. Thus far, the agency has no regulatory or enforcement authority.

The EEAA receives an average annual budget of about LE 6.5 million/yr (US$ 2.0 million) but is entitled to 50% of the tax levied on air and seafare tickets under a special fund for environment and tourism, in addition to receiving some external donor funds (bilateral and international cooperation). In its last Five Year Development Plan (1987-1992), taking all forms of income into account, the EEAA had a total budget of LE 118 million (US$35.6 million). In 1991 the agency underwent reorganization to increase its responsiveness. As part of the effort to coordinate other agency and ministry activities relating to the environment on a regional basis, an Office for Environmental Affairs has been established in each governorate. In May 1992, the Egyptian Government released its environmental action plan which seeks to strengthen environmental management in Egypt by introducing new legislation and initiating substantial investments in the environment.

Most of the current regulatory process is based on pollution discharge sanctions, or the "polluter pays" principle. Point polluters are held responsible for keeping pollution discharges below some standard, generally referenced to an international pollution standard, which may be unrealistic for Egyptian industries at present.

Resources

Egyptian Ministries and Government Agencies

Ministry of Industry
2 America El Latinia St., Garden City, Cairo
phone 3543600/3557034/3554826
fax 3548362

Ministry of Electricity and Energy
Extension of Ramses St., Cairo
phone 2616299/2616514/2616317
fax 2616302

Egyptian Environmental Affairs Agency
11 Abul Feda Street, Zamalek
phone 3417152/3401963
fax 3401963

Ministry of Reconstruction and New Communities
1 Ismail Abaza St.
phone 3557013/3557978
fax 3557836

Ministry of Scientific Research
101 Kasr el-Aini St.
Bab El-Louk
phone 3545205/3547642
fax 3545250

Ministry of Transport
104 Kasr el-Aini St.
phone 3555566/67/68

Ministry of Tourism
Miisr Tower
Abbasia Sq.
phone 2828430/8439
fax 2829771

Ministry of Irrigation and Water Resources
El Sheikh Rihan St., Cairo
phone 3545884
fax 3558008

Public Sector Authority for Foreign Trade
17 Abdel Salam Aref St., Cairo
phone 3938756/3938359
fax 3922525

Egyptian General Petroleum Corp. (EGPC)
Palestine St., 4th Sector, New Maadi, Cairo
phone 3531441, 3531438, 3531439

Egyptian General Organization for Sewerage Projects
25 El Gohainy St., Dokki, Cairo
phone 3497506

Egyptian General Organization for Coast Protection
P.O. Box Shobra El Kheima, Cairo
phone 2203406
fax 2204991

New and Renewable Energy Authority
Extension of Ramses St., Abbassia, Cairo
phone 2602480

Public Sector Authority for Power Distribution
4 Moussa Ebn Nosseir St., Nasr City, Cairo
phone 611206
fax 2602543

General Authority for Investment and Free Zones
8 Adly St.
Downtown
phone 3906796/6804/1017
fax 3907315

General Authority for Export and Import Controls
1 Ramses St.
Atlas Building
phone 742830, 750749

General Organization for International Exhibitions and Fairs
Nasr City
phone 2607810/19/34
fax 2607845

General Organization for Industrialization
6 Khalil Agha St.
Garden City
phone 3540677/8/9

Foreign Chambers of Commerce

American Chamber of Commerce in Egypt
Marriot Hotel, Suite 1541
Zamalekphone 3408888, ext. 1541
French Commercial Section
10 El-Aziz Osman St.
Zamalek
phone 3415701/5702
fax 3414955

German-Arab Chamber of Commerce in Egypt
2 Sherif Pasha St.
Downtown
phone 3931754/769237

Italian-Arab Chamber of Commerce in Egypt
33 Abdel Khalek Sarwat St.
Downtown
phone 3922275
fax 3912503

Japanese-Foreign Trade Organization
56 Gameat el-Dowal
el-Arabia St.
Mohandiseen
phone 3409942

Egyptian Business Organizations

The Federation of Egyptian Industries
26 A Sherif St.
Immobilia Bldg., Cairo
phone 3928319
fax 3928075

Federation of Egyptian Chambers of Commerce
4 Midan El Falaky, Cairo
phone 3558261

Cairo Chamber of Commerce
4 Midan El Falaky, Cairo
phone 3548491/3924025
fax 3541132

Alexandria Chamber of Commerce
31 Chamber of Commerce St., Alexandria
phone 4834157/4820812
fax 808993

Alexandria Businessmen's Association
18 Avenue El Horreya, Alexandria
phone 4836902/4834210
fax 4829576

Chamber of Engineering Industries
13 Sherif Street, Cairo
phone 3938904
fax 3921238

U.S. Government Resources in Egypt

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Garden City, Cairo
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International Executive Services Corps (IESC)
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Private Sector Feasibility Studies
Nile Tower Building
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21 Giza Street
P.O. Box 265 Orman
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U.S. Investment Promotion Office
21 Giza Street, Nile Tower Bldg.
Giza, Egypt
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Commodity Import Program
Small Business Office
Agency for International Development
Washington, D.C. 20523
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Resources in Washington

AID's Consultant Registry Information System (ACRIS)
Office of Small and Disadvantaged Business Utilization
Agency for International Development
Washington, D.C. 20523-1414
phone (703) 875-1551
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U.S. Department of Commerce
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Room 2039
Washington, D.C. 20230
phone (202) 337-4941

Office of Energy, Environment and Infrastructure
U.S. Department of Commerce
Room 3832
Washington, D.C. 20230
phone (202) 377-5225
fax (202) 377-3954

Office of Finance and Contracts
U.S. Department of Commerce
Room 3832
Washington, D.C. 20230
phone (202) 377-3277
fax (202) 377-5702

Committee on Renewable Energy Commerce and Trade
Department of Energy
Office of Conservation and Renewables
1000 Independence Avenue
Washington, D.C. 20585
phone (202) 586-5517
fax (202) 586-1605

Environmental Technology Clearinghouse
U.S. Environmental Protection Agency
401 M Street SW
Washington, D.C. 20460
phone (202) 260-2087
fax (202) 260-4470

Export Finance Group
Export Import Bank
Office for Africa and the Middle East
811 Vermont Avenue NW
Washington, D.C. 20571
phone (202) 566-8011
fax (202) 566-7524

Investment Development Department
Overseas Private Investment Corporation
Information Officer
1100 New York Ave NW
Washington, D.C. 20527
phone (202) 336-8636
fax (202) 408-5155

Office of International Trade
Small Business Administration
409 3rd Street, SW
Washington, D.C. 20416
phone (202) 205-6720
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Report Methodology

The basic methodology used to compile this report includes a combination of desk, field, and survey research and report synthesis and analysis.

The desk research consisted of obtaining information on the private sector in Egypt, U.S./Egyptian investment and trade relations, existing environmental projects, primarily those supported by USAID and World Bank, and information on environmental regulations and relevant institutions in Egypt. A list of contacts in relevant organizations was developed.

The main objective guiding the field research was to conduct interviews with as broad a mix of organizations as possible. Interviews were conducted with Government of Egypt officials, industry associations, Egyptian private companies, joint venture Egyptian/American companies, government-owned research institutions and laboratories, USAID contractors, USAID officials, U.S. Foreign and Commercial Service, and chambers of commerce. At each meeting similar questions were posed regarding a discussion of Egypt's environmental problems, the current regulations and enforcement, general market information on size, market forces, market opportunities, and market barriers. A great deal of information, much of it anecdotal and subjective and some of it quantitative, was received. In addition, a list of approximately 100 companies (both private and public-owned) that are currently operating in the environmental business sector was developed.

Two-thirds of the 100 environmental companies identified were interviewed. Each company was asked to complete a survey research questionnaire about the company's specific type of environmental business, company history and size, marketing strategies, technologies, perception of new business opportunities, and opinions on the likelihood of increased regulation and enforcement and its effect on business. Companies also answered questions describing their specific needs, such as increased technology transfer, financing, or credits.

A direct mail survey was also sent to a group of industrial companies identified by the Federation of Egyptian Industries (FEI). A total of 106 companies responded. The results of the survey were tabulated and translated into English.

People Interviewed

Government of Egypt/Public Sector

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International Cooperation Unit
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Environmental Attache
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Dr. Mohamed Elkotb
Professor, Department of Engineering
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Private Companies

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General Manager
Egyptian Company for Importing, Contracting and Trade (EGICAT) (equipment importers)

H.F. Sabbour
Chairman
Sabbour Associates (engineering and design)

M. Maher El-Sadek
Consulting Engineer
Sabbour Associates (engineering and design)

M. Nabil El-Hariry
Consulting Engineer
Sabbour Associates (engineering and design)

Martin C. Conisbee
Executive Vice President
Wallace O'Conner Inc. (water pipeline construction, AID contract)

Ahmed Gaber
Deputy Chief of Party, Local Development II
Chemonics

Louis Bishara
Chairman
BTM (textile company)

Ashraf Ghonima
Managing Director
Bechtel Egypt S.A.E. (engineering and design)

Richard E. Miller
Chief of Party, Local Development II Urban Project
Wilbur Smith Associates (municipal waste)

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Environmental Quality International EQI

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Environmental Management International EQI

Samy Saad Zakhary
Assistant General Manager
Mechanical Engineering Co. (manufacture of equipment for water treatment)

Al H. Denson
Vice President of Operations
Amoco Egypt Oil Co.

Farid W. Saad
Chairman
Egyptian Finance Company S.A.E. (investment bank for tourism development projects)

James Pringle
Vice President - Middle East Region
Morrison Knudsen Corporation

Samir Raphail
General Manager
Chemix Co. (manufacture, installation and maintenance of water treatment systems),

Essam El Wardani
President
Wardani Group (engineering and design)

Eng. Ali Galal
Cairo Office Director
Wardani Group (engineering and design)

Mostafa El Kady
Managing Director
Commerce Inc. (electrically driven vehicles)

Maher Nsouli
General Manager
Metito Universal Ltd. (water treatment and pollution control)

Fawzy Mostafa
President
Financial Industrial Trading Engineering Company (water treatment equipment importers)

David Moustafa
General Manager
Engineering and Marketing Services

Mohamed Nosseir
President
Alkan Establishment (water purification, desalination)

Mr. Colt
Engineer
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Ayman M. Soliman
President
AMS Engineering and Environmental

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Alaa Hafez
President (Head, Environmental Awareness Committee, American Chamber of Commerce)
Europcar - Max

A.I. Gazarine
Chairman
Federation of Egyptian Industries

Anuran Abd El Wahed
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Nasr City

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Eng. Ahmed Ramadan, Managing Director
General Engineering and Contracting Company
Fagallah

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Arab Union for Trade and Industry
Alexandria

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Arab Building Materials
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117