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CAIRO AIR IMPROVEMENT
PROJECT PAPER

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PROJECT AUTHORIZATION

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ACRONYMS

CAIP	Cairo Air Improvement Project
CNG	Compressed Natural Gas
CRA	Comparative Risk Assessment
CTA	Cairo Transit Authority
CATA	Cairo Traffic Authority
DANIDA	Danish International Development Assistance
ECEP	Energy Conservation and Environment Project
EEAA	Egyptian Environmental Affairs Agency
EETP	Egyptian Environmental Training Program
EOPS	End of Project Status
FEI	Federation of Egyptian Industries
GOE	Government of Egypt
MIC	Ministry of International Cooperation
MOP	Ministry of Petroleum
MOU	Memorandum of Understanding
OECP	Organization of Energy Conservation and Petroleum
O&M	Operations and Maintenance
PEO	Public Enterprise Office
PLLA	Partnership Lead Abatement Activity
SO	Specific Objectives
TA	Technical Assistance
TCOE	Technical Cooperation Office for the Environment
TIMS	Tabbin Institute for Metallurgical Studies
TSP	Total Suspended Particulates
VETT	Vehicle Testing and Tune-Ups
WHO	World Health Organization

EXECUTIVE SUMMARY

Among the world's largest cities, Cairo has the worst air pollution in terms of suspended particulates and lead. A 1994 comparative environmental risk assessment (CRA) for metropolitan Cairo identified air pollution as the highest environmental health risk in Cairo and specified total suspended particulates (TSP) and lead as the pollutants most injurious to health. Each year in Cairo air pollution causes an estimated 10,000 to 25,000 deaths. Children reared in Cairo lose on the average an estimated 4.25 I.Q. points as a result of lead pollution. A 1992 environmental assessment of the Helwan area of Cairo conducted for the World Bank concluded that the concentration of TSP in the air is more than eight times the proposed World Health Organization (WHO) standard and that the lead content in the air near one lead smelter exceeded the WHO criterion by more than fifty times. A 1993 document issued by the Egyptian Environmental Affairs Agency (EEAA) stated that, in greater Cairo, pollutants arising from the transport sector have been identified to significantly contribute to the deterioration of air quality. The CRA notes that 90 percent of the lead in the environment starts in the air and falls to the ground where it enters water, soil and food.

The seven-year, \$60 million Cairo Air Improvement Project (CAIP) represents a major effort to begin to address very serious air pollution problems in Cairo. It will be a focal point in USAID's efforts to achieve its current environmental strategic objective of **adoption of water and air protection practices** as well as the proposed revised strategic objective of **reduced generation of industrial/commercial pollution**. The specific indicators used to measure impact at the strategic objective level will be measured reductions in TSP and airborne lead which are also used as end of project status indicators that will be used to measure achievement of project purpose. The reductions in TSP and airborne lead should lead to reduced rates of mortality and morbidity due to air pollution. The Project's **goal** is to reduce mortality and morbidity rates due to air pollution. The project **purpose** is to reduce emissions to Cairo's air that have the greatest health risks. *AKL-22*

The project complements other elements of USAID's pollution reduction strategy that are being implemented through other mechanisms. Major program elements which currently contribute to reduced air pollution are the electricity tariff increases which are conditions to obligation of funds under the Power Sector Support and Power Sector Support II activities; the shift to the use of natural gas from fuel oil in Egypt's thermal electricity generation capacity that has been financed by the same projects; and the introduction of energy saving and pollution prevention technologies in Egyptian industry through the Energy Conservation

and Environment Project. These interventions are estimated to have reduced air pollution (TSP) by 3,500 mt. in 1994. The project is also a major tool to implement the lead abatement strategy that has recently been identified as a major element of the joint U.S. - Egyptian Partnership for Economic Growth and Development. The adoption of the lead abatement strategy is also one of the policy measures contained in the Sector Policy Reform II Program and which is therefore part of USAID's ongoing policy dialogue with the Government of Egypt (GOE).

The GOE made a significant commitment to address air pollution in its Environmental Action Plan (EAP) which was adopted in 1992 and in the promulgation of a new Environmental law (Law 4 of 1994). The EAP identified a number of specific actions that it would take over a period of years to reduce air pollution. These include: a total phaseout of energy subsidies; introduction of a gasoline tax; reduction of lead in gasoline and other policies to reduce vehicle emissions, especially in Cairo; reduced use of high sulphur fuel; development and implementation of air emissions policies (standards and means of enforcement); and development of public awareness of air pollution costs.

The CAIP represents the first donor assisted effort by the Government of Egypt that directly addresses the Cairo air pollution problem. As such it will be able to only begin to address Cairo's air quality problems. It is the first stage of what must be a long term effort to reduce the harmful effects of air pollution in Cairo. It will be designed to include activities that have some immediate impacts on reducing TSP and lead while setting the stage for a long term effort through demonstrations and pilot tests of alternative technologies and increased public awareness.

Although initial obligation of the project will be in FY 1995, the project is being structured to conform with the concept of a "results package" contained in the proposed revised USAID operations system. While some specific project interventions will be fully analyzed and ready to be implemented upon obligation, other interventions which require more study or analysis may be implemented later. However, all project interventions that are implemented must have a demonstrable causal linkage to the achievement of the strategic objective. While the project structure will be sufficiently flexible to accommodate a variety of discrete interventions, the number of actions will be constrained by the management capacity of USAID/Cairo as well as anticipated weaknesses in many of the partner agencies that will be involved in the project. Therefore it is likely that, as new activities are added to the project, less significant activities or activities in which insufficient progress is being made will be phased out.

The project will initially include the following interventions: 1) an effort to reduce lead emissions; 2) reduce particulate emissions through the conversion of buses to Compressed Natural Gas (CNG); 3) support a vehicle emissions testing and tune-up program; 4) institute air quality monitoring of CAIP-related interventions that will complement the monitoring network being introduced by DANIDA; and, 5) initiate a public awareness and communications campaign. These initial interventions were identified as feasible approaches to what a series of studies have identified as the most crucial air pollution problems amenable to USAID intervention. Other interventions aimed at the reduction of emissions will be identified upon completion of additional analyses. In addition, the project will conduct a policy dialogue aimed initially at reducing lead in the environment, particularly from leaded gasoline, and reducing industrial emissions from cement plants and other heavy industry. If the policy dialogue proves fruitful, it can be augmented to include technical assistance, studies, training and commodities.

Initial interventions to reduce lead emissions focus on improved process and emissions control for the smelting operations and policy dialogue to address other lead-related issues, such as the broad availability of unleaded gasoline. These interventions will result in substantial improvements to occupational health and safety conditions at the plants. The changes will also result in substantial gains in productivity and profitability for the smelter owners. Proposed project activities in this area will be planned and coordinated with the EEAA.

Reduction of TSP is a more complex area in that there are more sources that generate TSP. It is, concomitantly, more difficult to address. The initial activities aimed at reducing particulate emissions are: 1) a pilot project to convert to Compressed Natural Gas (CNG) part of two municipal bus fleets; and, 2) financing technical analyses and initiating a policy dialogue concerning cement plants and other industrial sources that will lead to reduced plant emissions.

Interventions to support vehicle testing and tune-ups will apply the lessons learned from a successful pilot effort recently undertaken in Egypt. Its objective is to develop a vehicle emissions inspection and maintenance network of economical, private sector testing and tune-up stations across Cairo that allow the GOE to certify vehicles to assure that emission standards are met.

The monitoring efforts to be undertaken as part of the CAIP will complement those of the GOE and be more directly related to an evaluation of project impacts. In addition, an analysis component will support the focussed and specialized studies designed to clarify avenues for further interventions by USAID through this project, other donors' projects, or those of the GOE.

As with the air quality monitoring and analysis activities, the public awareness and communications activities will be cross-cutting in nature, working in conjunction with all of the CAIP's interventions. Research will be carried out with the target audiences (the general public, the GOE, the private sector and/or the media) to identify the most effective messages for each activity. Once the message and media mix is determined the campaign will be initiated. By means of these focussed campaigns, the CAIP hopes to engender understanding, a constituency, and ultimately support for the project's efforts within the GOE and among the Egyptian public.

*data
collected*

USAID-financed inputs will include: (1) technical assistance; (2) commodities; (3) training; and, (4) local support. These inputs will provide USAID the flexibility to respond quickly to remedy air pollution problems as they are identified by the project's analyses and monitoring or by other sources.

Air pollution prevention in Cairo involves numerous GOE agencies and private entities. USAID's principal partner under CAIP will be the Egyptian Environmental Affairs Agency (EEAA), which is the GOE organization mandated to set and enforce environmental standards. USAID has successfully collaborated with EEAA on previous and ongoing projects. EEAA representatives will participate on the project Advisory Committee which will provide overall direction to CAIP implementation. EEAA will also work directly with CAIP to implement the vehicle emissions testing and tune-up (VETT) program. Other partners have been identified for each particular activity.

I. STATEMENT OF PROBLEM, PROJECT PURPOSE, AND ASSISTANCE INTERVENTIONS

A. Problems to be Addressed

1. The Egyptian Environment

Environmental conditions in Egypt show great contrast. Because of the concentration of population and industrial activity in a few areas, many outlying areas of Egypt have excellent air and water quality. The Red Sea, for example, is one of the least spoiled enclosed seas in the world. It is the populated areas, Cairo in particular, that are cause for concern.

Less than three percent of the land in Egypt is under cultivation, and competing for the land is a population of about 55 million. The land available for habitation is a severe constraint. The limited agricultural resources compete with housing and other uses. Land resources are also being degraded in productivity. Since the building of the Aswan High Dam, salinization of the soil has required increased fertilizer to maintain productivity. The increasing use of fertilizers and pesticides has had negative environmental consequences.

Egypt's fast-growing population multiplies the environmental damage. Although the population growth has declined, the current rate of population growth still predicts a substantial increase from the current population of 57 million to double that amount early in the next century. Much of this population increase is in the Cairo area where workers from the rural areas seek industrial employment.

The sum of these trends is the potential that higher air pollution levels will concentrate in an increasingly densely populated urban airshed where residents are under increased economic pressure.

2. Cairo Air Quality and Sources of Emissions

Considerable modernization has taken place in the last two decades in Cairo, and improvement is noticeable particularly in the city's infrastructure (thanks in part to USAID). While these improvements invite increasing industrialization and competition in the global economy, along with industrialization comes the challenge of controlling its impacts on the environment.

A series of environmental studies identified air pollution as the most critical environmental problem in Cairo, with particulate matter and lead as the two greatest health risks in Cairo's air. In fact, according to a USAID-financed Comparative Risk Assessment (CRA) undertaken in 1994, Cairo has the worst air pollution in terms of suspended particulates and lead in the world. Each year in Cairo air pollution causes an estimated

10,000 to 25,000 deaths. Children reared in Cairo are in danger of losing on the average an estimated 4.25 IQ points as a result of lead pollution. A 1992 environmental assessment of the Helwan area of Cairo conducted for the World Bank concluded that the concentration of TSP in the air is more than eight times the proposed World Health Organization (WHO) standard and the lead content of the air near one lead smelter exceeded the WHO criterion by more than fifty times. A 1993 document issued by the Egyptian Environmental Affairs Agency (EEAA) states that, in greater Cairo, pollutants arising from the transport sector have been identified as contributing significantly to the deterioration of air quality. The CRA also notes that ninety percent of the lead in the environment starts in the air and falls to the ground where it enters water, soil and food.

Both the GOE and segments of the private sector are now aware of the danger presented by air pollution and have begun to take substantive steps towards identifying and addressing the problems. It is these types of initiatives that this project hopes to support and encourage.

B. Project Purpose

The seven-year, \$60 million Cairo Air Improvement Project (CAIP) represents a major effort to begin to address very serious air pollution problems in Cairo. It will be a focal point in USAID's efforts to achieve its current environmental strategic objective of **adoption of water and air protection practices** as well as the proposed revised strategic objective of **reduced generation of industrial/commercial pollution**. The specific indicators used to measure impact at the strategic objective level will be measured reductions in TSP and airborne lead which are also used as end of project status indicators to measure achievement of project purpose. The Project's **goal** is to reduce mortality and morbidity rates due to air pollution. The project **purpose** is to reduce emissions to Cairo's air that have the greatest health risks.

The project complements other elements of USAID's pollution reduction strategy that are being implemented through other mechanisms. Major program elements which currently contribute to reduced air pollution are the electricity tariff increases which are conditions to obligation of funds under the Power Sector Support and Power Sector Support II activities; the shift to the use of natural gas from fuel oil in Egypt's thermal electricity generation capacity that has been financed by the same projects; and the introduction of energy saving and pollution prevention technologies in Egyptian industry through the Energy Conservation and Environment Project. These interventions are estimated to have reduced air pollution (TSP) by 3,500 mt. in 1994. The project is also a major tool to implement the lead abatement strategy that has recently been identified as a major element of the joint U.S. - Egyptian Partnership for Economic Growth and Development. The adoption of the lead abatement strategy is also

one of the policy measures contained in the Sector Policy Reform II Program and which is therefore part of USAID's ongoing policy dialogue with the GOE.

The Government of Egypt (GOE) made a significant commitment to address air pollution in its Environmental Action Plan (EAP) which was adopted in 1992 and in the promulgation of a new Environmental law (Law 4 of 1994). The EAP identified a number of specific actions that it would take over a period of years to reduce air pollution. These include: a total phaseout of energy subsidies; introduction of a gasoline tax; reduction of lead in gasoline and other policies to reduce vehicle emissions, especially in Cairo; reduced use of high sulphur fuel; development and implementation of air emissions policies (standards and means of enforcement); and development of public awareness of air pollution costs.

CAIP will have an impact on certain well-defined targets in terms of both ambient concentrations and emissions to the environment. The following are the conditions that will indicate that the project's purpose has been achieved, i.e., the end of project status (EOPS). Key results are described in more detail in Section III below:

- Lead emissions from smelters will be reduced by 90 percent;
- TSP will be reduced by 90 percent from CNG converted buses;
- Eighty percent of randomly sampled vehicles will be in compliance with GOE emissions standards.

C. Assistance Interventions

The CAIP is an umbrella project designed to have the capacity to respond quickly and with flexibility to unforeseen problems and opportunities as they arise. As such, it brings together under one title and funding mechanism a group of disparate activities. CAIP includes a mix of highly visible activities that have a significant short-term impact (such as lead smelter clean-up) as well as the implementation of long-term activities that can be continued by the GOE, the private sector or other donors after this project is completed (e.g., the pilot CNG bus conversion).

The project will initially include the following discrete activities designed to: 1) sharply lessen lead smelter emissions; 2) reduce particulate emissions; 3) support a vehicle emissions testing and tune-up program; 4) institute air quality monitoring of CAIP-related interventions that will complement the monitoring network being introduced by DANIDA; and, 5) initiate a public awareness and communications campaign. These initial interventions were identified as feasible approaches to what a series of studies have identified as the most crucial air pollution problems amenable to USAID intervention.

In addition, the project will conduct a policy dialogue aimed initially at reducing lead in the environment, particularly from leaded gasoline, and reducing industrial emissions from cement plants and other heavy industry. If the policy dialogue proves fruitful, it can be augmented to include technical assistance, studies, training and commodities.

1. Lead Pollution Reduction

The activities described in this section are designed to reduce emissions of lead to the environment. Interventions focus on improved process and emissions control for the smelting operations and policy dialogue to address other lead-related issues, such as the broad availability of unleaded gasoline. These interventions will result in substantial improvements to occupational health and safety conditions at the plants. The changes will also result in substantial gains in productivity and profitability for the smelter owners. Proposed project activities in this area will be planned and coordinated with the EEAA.

During the design of the lead smelter component of the CAIP, the institutional, economic and policy complexities of the issue quickly became apparent. Although practical engineering solutions to the lead smelter emissions problem were identified in the design process, it is essential that these solutions be developed and applied in the context of an appropriate overall policy, financial and enforcement framework. Considerable uncertainty exists within this framework at present, which precludes a complete or immediate definition of a comprehensive solution to the lead smelter problem in the Greater Cairo area.

Consequently, the first step in the project, planned as a pre-implementation activity, will be the development of a Lead Smelter Action Plan to guide the detailed design and implementation of this critical project component. This Action Plan will, in approximately one year, critically assess a series of interrelated issues, make recommendations for action, reach agreement on the strategy among interested parties (i.e., EEAA, private and public sector smelter owners and managers, and USAID) and prepare a final implementation plan. The issues concerning lead smelter pollution that need to be resolved include:

Relocation Study. The EEAA is a strong proponent of relocating the existing private-sector smelters outside of the Cairo population center. The advantages and disadvantages of this action must be reviewed along with the roles of the potential participants. It should be noted that the GOE has included in its suggested "cooperation program" with the U.S. under the Partnership for Economic Growth Initiative the "relocation and technological upgrading of Great Cairo Lead Smelters."

Preliminary Design. During project paper development, a conceptual design was prepared to upgrade the technologies in use at the public-sector lead smelting plant, General Metals, and consolidate the five smelters owned by one private smelter operator. The same flexible design can be applied to both facilities. Part of the Lead Smelter Action Plan will be to further refine the design and its cost, and investigate the availability of components in Cairo, although the bulk of the smelter would be sourced in the U.S.

Remediation Plan. The ground and facilities surrounding the smelters are highly contaminated with lead. This lead must be removed or prevented from contaminating the environment. A plan will be developed that will outline remediation actions, including who should carry them out.

Privatization/Buy-Out. The revised understanding of the structure of the secondary lead smelter industry gained during the design process raises a series of issues to be resolved concerning the public sector General Metals smelter vis-a-vis the private sector smelters. For instance, it must be determined whether this grossly inefficient public-sector plant is needed if the private-sector smelter owner builds a more efficient, environmentally-sound, modern facility. Would a "buy-out" of General Metal's lead production facility be the most cost-effective and fastest means to eliminate a major polluter? How would upgrading General Metals affect the opportunity for it to be privatized? These thorny issues must be studied before a final decision is made regarding General Metals.

Financial Considerations. The appropriateness and implications of subsidizing General Metals, a parastatal, while perhaps only giving technical assistance to more efficient private sector industries may be inappropriate and must be evaluated.

Enforcement Mechanism. The long-term reduction of emissions will depend greatly on the level of maintenance and care of the smelting operation. Relying solely on the motivation provided by the prospect of increased profits is not adequate. During development of the Action Plan, agreement should be reached on a viable mechanism for enforcement of lead smelter standards.

With the information gathered in the above analyses, more extensive consideration can be given to the options available to finance smelter improvements, either through the CAIP or another mechanism. Following is a discussion of the general conditions in the lead smelting sector and suggested engineering solutions to the critical problem of airborne lead pollution. These options are subject to further analysis, modification and negotiation through the Action Plan.

a. Modernize the Secondary Lead Processing Plant at General Metals

The equipment currently in use in General Metals' lead line was constructed in the 1930s. The lead is processed by shattering used car batteries with sledge hammers. The plastic cases are discarded, the lead is melted in a rotary furnace and, after the slag is poured off, is transferred to open cauldrons for mixing with cyanide and other additives, and then poured into billets (ingots).

The Technical Analysis in Annex D.4 presents a conceptual design for replacing the entire smelter with a new blast furnace-based operation at a cost of approximately \$5 million, not including civil works and utilities connections. Such a revamping would substantially reduce lead emissions and would also greatly improve the severe occupational exposures associated with the current smelting operation.

The management of General Metals has indicated its willingness to provide the land, utilities and civil works required for the upgrading. The company's actual contribution to the replacement of the polluting technology and/or the site remediation will be a key part of the negotiated implementation plan.

b. Support Improvement and Possible Consolidation of Larger Private Smelters

The Technical Analysis shows that a group of five smelters owned by one person produces much more lead than the General Metals facility, in addition to being more efficient. The technical solutions to improving operations at the larger plants are similar to those proposed for General Metals. One option would be for USAID to provide assistance to the private sector through the Commodity Import Program (CIP). The balance of support to the private sector and to the public sector, and the implications of this support for the Egyptian lead industry as a whole, will have to be further examined during preparation of the Action Plan.

One substantive indication of private-sector interest in cleaner production is that the owner of the five smelters identified above has indicated an interest in replacing his five units with a consolidated, state-of-the-art facility. When the economic and efficiency benefits of a new lead processing line were described to him, the owner expressed possible interest in purchasing and installing the equipment with his own funds, provided the GOE gave him adequate assurance of fairness and stability in the enforcement of appropriate environmental regulations.

c. Clean Up Emissions of Smaller Private Smelters

As noted above, the GOE's preferred long-term solution is to move the smelters from the city center. Accordingly, the Governor of Cairo has ordered the closure of all private smelters in the Greater Cairo area. Information available to the design team, however, suggests that at least some small smelters continue to operate part-time in non-compliance with the government's wishes. Relocated or not, the small lead smelters will need appropriate filtration devices to operate more safely.

To address lead emissions from the smaller smelters, USAID could provide or facilitate the provision of filtration devices that would yield dual benefits to the communities and to the small smelter operators. The Technical Analysis in Annex D.4 suggests the use of both metallurgical dust collection equipment to receive the off gases from the smelter and a sanitary dust collection system to be applied at specific source points. Such filtration devices should eliminate 95 percent of lead particulate emissions at a capital cost of about \$150,000 per smelter. Moreover, the lead removed can be reused by the smelter.

It is important to note, however, that the project design team is concerned about the ability of these plants to operate in an economical and environmentally acceptable manner even with filtration equipment. In total, these operations represent significantly less than ten percent of total smelting capacity. The Action Plan will have to resolve serious policy issues concerning "environment vs. small business," and the possibility of the creation of a private sector monopoly due to the elimination of small producers.

An additional important consideration is that, while many filters remove particles larger than ten microns (1 micron = 0.001 millimeter), the most harmful particles from a health perspective are smaller than 10 microns. These smaller microns are more difficult and costly to control. Prior to implementation of activities to support the cleanup of the small smelter operations, the project will examine in greater detail the effectiveness and economics of the proposed filtration equipment.

d. Maintain Policy Dialogue with GOE and Donor Community

As part of the overall effort to reduce lead pollution, an ongoing policy dialogue with the GOE, and involving other donors, will be required. Two specific issues include: 1) policies on the use of unleaded gasoline; and 2) a consideration of supply and demand issues in the secondary lead industry.

Even more than lead smelters, leaded gasoline is the major contributor to lead pollution in the air. Consequently, priority will be given to addressing this problem. Note that this is an area in which the GOE has already made significant progress, including the establishment of specific time targets for reducing the lead content in gasoline. If required, an analysis will be carried out to determine the actual lead levels in gasoline so that a baseline can be determined. Through the CAIP and the Lead Pollution Abatement Action Plan (a policy benchmark under the Sector Policy Reform II Program and an element of the Partnership for Economic Growth), USAID will work with the GOE to encourage progress towards having the refineries reduce, and ultimately eliminate, lead in gasoline as quickly as is feasible.

The second area for policy dialogue is related to the secondary lead industry, where several issues remain to be clarified. For instance, the structure of the lead smelting industry in Cairo and Egypt is poorly understood. Estimates of the number of smaller private smelters vary widely. Another issue that will be explored, again in concert with the Lead Abatement Action Plan, is the impacts of future policy options (e.g., banning the use of lead pipe, elimination of lead in paint, etc.) on the demand for lead products. Finally, the implications of these policy changes on the viability of various sectors (public vs. large or small private smelters) needs to be better understood prior to USAID investment or assistance.

2. Reducing Particulate Emissions

Reduction of TSP is a complex task given the many sources that generate particulates. The initial activities discussed in more detail below are, briefly: 1) a pilot project to convert to CNG part of two municipal bus fleets; 2) financing technical analyses and initiating a policy dialogue concerning cement plants and other industrial sources that will lead to reduced plant emissions.

a. CNG Conversion of Municipal Buses

CNG vehicles emit about 90 to 95 percent less particulates than diesel-fueled vehicles, which are the most significant emissions associated with buses and trucks in Cairo. Preliminary results from USAID's source apportionment study of airborne particulate matter shows that diesel fuel is a leading source of fine particulate matter (i.e., particles ranging in size from 0 to 2.5 microns) and a significant source of coarse particulate matter (2.5 to 10 microns). The toxicity of fine particles tends to be substantially greater than that of coarse particles because the former can penetrate into the lungs.

In addition to the public health benefits of replacing diesel fuel with CNG, conversion of diesel vehicles to compressed natural gas could reap large economic benefits. Currently, Egypt

imports its diesel at roughly \$230/ton (\$0.22/liter), distributes it nationwide and sells it retail for about \$0.10/liter (a subsidy of over 50 percent). Reduced importation of diesel would save an estimated \$31 M/yr. Removal of subsidies would convert this commodity from a deficit import to a source of income. A concomitant result is that an elimination or sharp cut in subsidies would reduce the demand for diesel, provided that there was an alternate fuel.

The CAIP will fund a series of activities aimed at supporting the introduction of CNG vehicle technology into the Cairo transportation sector. The primary focus of these activities will be a pilot test of the technology in two municipal bus fleets; the Cairo Transit Authority (CTA) and the Greater Cairo Bus Company (GCBC). Other significant activities will include TA, training, and local support directed toward assuring the success of the pilot test and expanding the technology beyond the initial test. Local support will be provided to the Organization for Energy Conservation and Planning (OECF) as the primary counterpart in the CNG activities, and Misrlab for implementation and operation of a diesel emissions test laboratory. CTA and GCBC, as operators of the pilot fleets, will be provided TA, equipment and extensive training, but not local support funding. The following summary describes first the pilot test, and then the ancillary activities. Note that the word "conversion" is used here in its broadest sense to mean adaption of CNG technology by the fleet. Conversion can include use of new buses built specifically for CNG, retrofit of existing buses with engines made to operate on CNG, or retrofit modifications to existing engines to operate on CNG.

Recognizing the "test" nature of the program, three approaches will be used to introduce CNG technology to benefit from certain advantages of each approach and to provide a broader set of alternatives for future expansion of the fleet. The number of buses indicated is tentative and will be refined early in the project, in terms of both total number and appointment between CTA and GCBC.

New U.S. CNG Buses. Several buses built in the U.S. for operation on CNG will be provided to OECF to operate for promotional purposes. One or more will be fitted to act as a classroom to explain the technology and its benefits and safety. These buses were not chosen as the primary method for introduction of CNG into the Cairo bus fleet for several reasons. The high cost of the U.S. buses relative to the existing Cairo buses and the great difference in the construction between U.S. and Cairo buses would complicate the test, increase its cost, and lessen the likelihood of wide-scale adoption beyond the pilot test fleet. These U.S. buses do have the advantage of being the most technically certain demonstration of the CNG technology and are an opportunity to showcase American technology. Although these buses are the method of choice of U.S. bus fleets for CNG fleet conversions, they are not appropriate for extensive use in this pilot test.

New CNG "Rolling Chassis" built in U.S. to fit existing Cairo buses. This will be the primary type of "conversion" applied in the pilot program. Using several Cairo buses shipped to the U.S. as guides, a U.S. company will "integrate" new U.S. CNG engines, U.S. transmissions, CNG storage cylinders, controls, axles, and wheels onto a new chassis that matches the existing chassis. These CNG chassis will be shipped to Egypt to be fitted with bodies by an Egyptian manufacturer. The integrator company will provide a warranty on all CNG components. They will provide extensive training and will work with Egyptian manufacturers to ensure rapid transfer of the technology and maximum use of local assembly and manufacturing. Approximately 100 new buses will be included in the pilot through this approach.

Retrofit of existing buses. The CTA purchases about 150 new buses each year. Thus, if only this mechanism were employed for introducing CNG into the fleet, complete conversion of the fleet would take a very long time. Thus, the pilot test will include a number of existing buses that will be retrofitted to operate on CNG using the "rolling chassis" design described above. New U.S. CNG engines and CNG storage tanks will be put into existing buses. Approximately 20 buses will be converted in this fashion, after successful operation of the new CNG buses proves the viability of the design. These conversions will be performed in Egypt under the direction of the U.S. integrator.

All approaches will use "dedicated" CNG engine, i.e., they will operate only on CNG. Dual fuel conversions (the use of both diesel fuel and CNG) conversions were investigated but were considered unacceptable. Dual fuel engines do not reduce emissions as much as dedicated CNG engines, do not save as much diesel fuel, they lose power, and are less technically certain. The engines used in the Cairo buses have not been converted to dual fuel operation to date.

Other activities associated with the pilot test are briefly described below.

- **Overall program planning, coordination, and evaluation.** OECP will act as lead agency to manage the CNG vehicle program. The CAIP will provide Local Support, training, and TA. An important function within this role will be development of an overall strategy for expansion of the CNG vehicle fleet.
- **Fleet coordination.** Each bus fleet will have a lead CNG vehicle supervisor who will receive extensive training. The fleet operators will receive TA as well.
- **Connection to natural gas supply system.** The Ministry of Petroleum has committed to provide all natural gas needed for the program to the fleet sites.

- **Supply of CNG stations.** Amoco has indicated its willingness to furnish and operate CNG fueling stations for the pilot test. Agreements will be finalized early in the project.
- **Establishment of safety standards, regulations, licensing and certification procedures.** CAIP will provide TA to support the development of this critical component of the overall program.
- **Emissions testing.** Accurate measurement of diesel vehicle emissions requires a chassis dynamometer and certain types of test equipment currently not available in Egypt. Misrlab is within the Ministry of Petroleum and is now the best equipped and positioned to perform such work. This facility, when upgraded, will be an important part of the overall plan for demonstrating project impact and also for establishing emissions standards in Egypt. Equipment, training, and TA will be provided under CAIP.
- **Implementation of a broad training program.** Training will be provided to all participants, including technicians, engineers, bus drivers, planners, and fleet managers. Training will include the introduction to CNG technology and safety issues, equipment operation, CNG vehicle economic analysis, detailed engineering/manufacturing issues, and observational tours of other fleets.
- **Conduct of CNG vehicle feasibility studies.** OECP will be trained to conduct detailed assessments of CNG operations by other potential fleets.
- **Coordination and support of industries for local manufacture and assembly.** The expanded use of CNG technology in Egypt will require extensive participation by local industry. The project is intended to provide maximum local participation consistent with other project objectives. The U.S. participants will be required to form partnerships with local organizations.

The main objective of the activity is to introduce a method of conversion to CNG powered vehicles that is technologically and economically viable in the Egyptian context. If CNG proves a workable substitute for diesel fuel, its use and replication throughout the bus fleets should become self-sustaining. CAIP could assist the bus companies in developing a "master plan" for large-scale CNG conversion of their fleets to contribute to sustainability.

b. Policy Dialogue on Industrial and Municipal Sources

The Helwan, Tourah and National Cement Companies in Helwan, all parastatals, have electrostatic precipitators and bag houses to reduce pollutant emissions. These systems are, however, not usually in use as the plants' management does not have an incentive to expend the considerable funds required to maintain and operate them. If operated incorrectly, the precipitators and bag houses can put an explosive mixture of dust into the plant. If operated well, the plant would require a fleet of trucks to carry the tons of silicate dust to a disposal site, adding significantly to operating expenses.

Airborne cement dust from these facilities is a highly visible element of Cairo's air pollution and, according to the preliminary findings of the source apportionment analysis, a major ingredient in the mix of particulate matter. Correcting the problem will begin with establishing the operational, financial and regulatory basis for dust emissions control. At a minimum, this effort will require considerable policy dialogue with GOE regulatory bodies and cement plant management, supported by relevant technical analyses and subsequent training personnel to assure reliable O&M.

Other major polluters in the Helwan area are General Metals (covered in the section on lead pollution) and Egypt Iron and Steel. The latter emits an estimated 27,000-34,000 tons of sulphur dioxide into the air as well as large amounts of chlorine, zinc and other contaminants. Here also, large capital investments to mitigate pollution would not be effective if the parastatal itself did not have the will to improve. As the World Bank tactfully noted in its study of pollution in the Helwan area, "The strong ties between government and industry do not promote the abatement of pollution."

The situation with the public sector cement plants and other major polluters in Helwan is complex, institutionally and technically, and has been unsuccessfully dealt with by other donors. Under the CAIP, USAID will proceed to address this problem without exaggerated expectations of quick success. This component will provide technical assistance and studies to reinforce ongoing policy reform aimed at reducing TSP emissions and other pollutants.

3. Vehicle Emissions Testing and Tune-ups (VETT)

This component applies the lessons learned from a successful pilot effort discussed below. Its objective is to develop a vehicle emissions inspection and maintenance network of economical, private sector testing and tune-up stations across Cairo that allow the GOE to certify vehicles to assure that emission standards are met.

Motor vehicles are the major source of air pollution problems in most cities. They are the primary source of carbon monoxide, and a direct source of hydrocarbons, nitrogen oxides, sulfur oxides and particulates. Vehicles currently in use have consistently been found to emit pollutants well in excess of their design capabilities. Reasons for this include poor maintenance and poor vehicle durability. Experience gained worldwide further demonstrates that vehicles perform better after being maintained and adjusted properly. A vehicle emission testing and tune-up program is one of the best ways to ensure that high-emitting vehicles are identified and correct maintenance or adjustments are performed.

Based on a recent USAID pilot program, there is strong evidence that the market for tune-ups should be self-sustaining given the improvements in fuel efficiency that would result in cost savings for individual drivers. The economic benefits greatly facilitate the public's willingness and ability to comply with the newly-formulated vehicle emissions standards.

The USAID pilot study was designed to determine the impact of tune-ups on fuel economy and pollution. Through the ECEP project, the pilot program involved four private sector gasoline stations that had emissions testing and electronic tune-up machines. Station personnel were trained in the machines' proper usage and the activity was publicized locally, with a target of testing a minimum of 1,000 gasoline-powered cars. The cycle comprised three visits, including before and after readings of fuel use and emissions. The test was both a technical and public relations success. On the average, there was a 62 percent reduction in CO, a 34 percent reduction in HC and a 14 percent increase in fuel mileage.

If this fuel saving could be brought about for Cairo's approximately 700,000 cars, it would convert into a savings of some \$25 million a year. During the pilot effort, both the garage owners and the drivers were content as they realized, respectively, that tune-ups generated income and resulted in fuel savings. It is this economic impact that can help assure sustainability of the larger CAIP component, even in the absence of strict enforcement of the GOE emission regulations.

This project component will promote the economic and environmental benefits of maintaining properly tuned vehicles among gasoline service stations and private motorists. Most significantly, it enables the GOE to begin to institute a Cairo-wide system of vehicle emission testing and certification. Egyptian environmental law now includes emission standards for gasoline vehicles. Through the VETT component, motorists will be able to have their vehicle tested for its compliance with emission standards. If the vehicle's emissions are within the permissible range, the motorist will be issued a certification that can be presented to the appropriate authorities upon registration of the vehicle. If the emissions exceed GOE

standards, the motorist may have a vehicle tuned at that facility and re-tested, or may find another tune-up operator.

Under this component of CAIP, USAID will work with the EEAA to establish from 150 to 250 stations in Greater Cairo which would be equipped and trained to conduct modern, computerized emissions testing and certification and, if so desired by the gas station operator, electronic tune-ups. Stations may opt to offer testing and electronic tuning or just tuning. Several options are available for providing the test analyzers to participating stations: through a local distributor identified by the contractor on a grant basis; purchase by stations from a local distributor; or distribution to stations on grant, lease or purchase from EEAA which would receive the machines as a grant from CAIP. There are advantages and disadvantages with each option, presenting different financial and general management issues. After further discussions with relevant CAIP partners, a final decision will be made prior to implementation on the most efficient means to distribute the emission testing devices.

The overall supervision of the VETT program, including the licensing of gas stations to participate in the emission testing/tune-up program, and the oversight of their performance, will be handled by the EEAA. For this activity, the EEAA will establish a separate unit, with an estimated staff of 37 employees.

Through CAIP, USAID will provide computerized emissions test equipment, appropriate management, and technical and enforcement training to the staff of participating gasoline and inspection stations and GOE personnel. CAIP will also work with EEAA to develop a detailed program design for the creation, oversight and evaluation of the decentralized inspection and maintenance system. During the initial year of the VETT program, the GOE may only require commercial taxis to meet emission regulations and undergo mandatory testing, while urging the general motoring public to become familiar with the benefits of emissions testing and tuning prior to the full-scale implementation of the emissions standards decree.

The CAIP will also assist the EEAA to establish a central technical center. Operation of decentralized inspection and maintenance (I/M) programs in the U.S. and other countries has demonstrated that for an enforceable program, it is necessary to provide technical assistance at a centralized facility for motorist having trouble passing the emission standards. Additionally, technical assistance to the testing and repair industry becomes more important once such a program is mandatory.

An important task of a technical center is the measurement of vehicle emissions in volume or mass to determine the air quality impacts of any automotive emission control program. Regular vehicle testing is in percent of concentration, not in total volume. The equipping of a technical center with appropriate

emissions testing gear can provide the EEAA with this sort of basic monitoring data.

An additional activity being considered is the installation of a number of diesel testing machines. Tune-ups of diesels would have a direct impact on TSP. The machines and dynamometer cost an estimated \$65,000 as opposed to \$12,000 for gasoline testers. A tester could be installed at the two major bus companies and a commercial truck fleet. Once its impact on mileage and pollution is proven, this program could be replicated as well. Both types of tune-ups have substantial environmental impact: tuning gasoline vehicles reduces HC, CO, CO₂ and lead, while tuning diesels reduces TSP.

4. Monitoring and Analysis

Originally conceived as a project component to develop an ambient air quality monitoring network for Greater Cairo, this intervention has evolved to become more directly supportive of the monitoring requirements needed to evaluate the impacts of the Cairo Air Improvement Project. The principal reason is that the GOE and DANIDA have designed a project to establish a comprehensive ambient air quality monitoring network for all of Egypt and will begin implementation early in 1996. (Details of the GOE/DANIDA effort are provided in Annex D.5.) Thus, the monitoring efforts under CAIP will complement those of the GOE, but be more directly intended for on-going monitoring and evaluation of CAIP project impacts (see Section III.C, Monitoring of Indicators).

This activity will be cross-cutting in nature, i.e., a necessary complement to all of CAIP's interventions. As discussed in detail in Annex D.5, the monitoring program will provide data of known reliability on the ambient concentrations of air pollutants in support of the overall objectives of CAIP. Since the intent of CAIP is to reduce the concentrations of ambient particulate matter and lead, as well as other high risk emissions, through reducing emissions from lead smelters, replacing buses powered by diesel with buses powered with CNG, and instituting a vehicle maintenance program to reduce emissions from automobiles, the monitoring and analysis will support these activities by (1) providing a baseline for current ambient air quality and emissions and (2) tracking the trend of ambient air quality and emissions over some period of time.

In order to determine the impacts of CAIP on Cairo air quality, the air quality measurement program will focus on:

- ambient monitoring to detect changes in lead concentration near the lead smelters as a result of project intervention;
- emissions testing from either stationary (e.g., lead smelters) or mobile (e.g., automobiles) sources; and

- monitoring to support project analyses, such as changes in the contributions of various sources to ambient particulates.

In addition, the project will include an analysis component which will provide the means to develop greater technical understanding of air pollution problems in Cairo, perhaps leading to the identification of new, additional avenues for further interventions by USAID through this project, or activities financed by other donors or the GOE. An example of the kind of analysis to be undertaken is the recent efforts by USAID, in conjunction with the National Research Center, to apportion ambient particulates in Cairo among the various possible sources. Other possible analyses could include emission inventories, a dust re-entrainment assessment, health cost investigations, and a study of the polluting role of motorbikes. Additional possibilities for analyses will be suggested during project implementation.

5. Public awareness and communications

The direction of resources toward environmental goals is contingent upon a correct perception of the problem. Awareness of environmental issues is thus a pivotal consideration. Environmental problems, however, are by definition difficult to relate to their cause because they are not immediately visible, but are remote in time and/or consequence. It is fundamentally the absence of a visible tie between the effect and its cause that underlies environmental problems. Damage that cannot be demonstrated to be attributable to a cause goes unaddressed. This is true in any society, but in Cairo there is a specific context to consider.

As perceived by Cairenes, most environmental issues occur on a global scale rather than in local activities. Other than the great number of cars, most environmental problems in Cairo are not sufficiently appreciated for their hazards. As the local population increases and resources decline, associated environmental problems are more likely to be perceived by the public as economic issues rather than environmental. The perception of environmental problems as global and local problems as economic will be absorbed into the common sense of decision makers at all levels.

Building up environmental awareness and with it widespread acceptability and personal responsibility for environmental consequences requires strengthening the common understanding of these principles. To have an impact on reducing emissions, the Cairo population must perceive that air pollution poses health risks to them and their children, and that there are specific actions that can be taken and tangible benefits that will result (e.g., tune ups save money, cleaner air means fewer sick days).

While the decision-makers in the private and public sector do now seem more concerned about environmental problems, an informed and concerned public can help motivate prompt, more substantive actions. Only with the understanding and support of the GOE, the Egyptian public, the private sector and the media will the Cairo Air Improvement Project achieve its objectives.

Fortunately, there is experience in social marketing in Egypt as well as a variety of media available to disseminate the project's messages, providing at least a good base from which to start public relations and communications activities. Cairo is the region's largest publishing and broadcasting center. There are two national TV channels and five regional channels as well as "Nile TV," a new channel offering French and English programming. There are seven daily newspapers (5 Arabic, 1 English, 1 French), a number of weekly newspapers, commercial radio stations and more than fifty magazines. The media is demonstrating a growing interest in environmental issues. Topics covered in the newspapers have included such diverse issues as Egypt's water supply, water pollution, air pollution, overuse of chemicals in agriculture and noise pollution.

USAID and its counterparts have some experience in environmentally-related social marketing, not to mention an excellent family planning social marketing campaign. USAID has financed a successful promotion and communication effort under the Energy Conservation and Environment Project (ECEP). The Project targets Egyptian industry, reaching its audience through publications, seminars and conferences as well as through radio and TV interviews and a series of technical briefs it has published.

EEAA, with USAID assistance, is preparing an awareness campaign to familiarize the public with the Environmental Protection Law, passed in January 1994. The campaign is expected to run from June 1995 to June 1996 and may serve as a base for a longer term environmental awareness program that will be implemented by the Egyptian Environmental Training Program sponsored by DANIDA. The public relations and communications efforts under CAIP will be coordinated closely with EEAA, EETP and DANIDA to maximize mutual impact.

The key to implementation of the Cairo Air Improvement Project's public relations campaign will be the pairing of a research firm and an advertising agency. This pairing is critical because the social research organizations do not have the expertise to design a media campaign, and the advertising agencies are weak in the testing of social marketing messages. The research and advertising firms will work under the close guidance and support of a USAID funded contractor with extensive experience in the field of environmental social marketing campaigns.

As with the air quality monitoring and analysis activity, it is anticipated that the public awareness and communications activities will be cross-cutting in nature, working in conjunction with all of the CAIP's interventions. Research will be carried out with the target audiences (the general public, the GOE, the private sector and/or the media) to identify the most effective messages for each activity. Once the message and media mix is determined the campaign will be initiated. By means of these focussed campaigns, the CAIP hopes to engender understanding, a constituency, and ultimately support for the project's efforts within the GOE and among the Egyptian public.

II. PLAN OF ACTION

The CAIP is structured to conform with the concept of a "results package" contained in the proposed revised USAID operations system. While some specific project interventions will be fully analyzed and ready to be implemented upon obligation, other interventions which require more study or analysis may be implemented later. However, all project interventions that are implemented must have a demonstrable causal linkage to the achievement of the strategic objective. While the project structure will be sufficiently flexible to accommodate a variety of discrete interventions, the number of actions will be constrained by the management capacity of USAID/Cairo as well as anticipated weaknesses in many of the partner agencies that will be involved in the project. Therefore it is likely that, as new activities are added to the project, less significant activities or activities in which insufficient progress is being made will be phased out.

USAID-financed inputs will include: (1) technical assistance; (2) commodities; (3) training; and, (4) local support. These inputs will provide USAID the flexibility to respond quickly to remedy air pollution problems as they are identified by the project's analyses and monitoring or by other sources.

A. USAID Actions

1. Technical Assistance

To assist in carrying out the various interventions identified, a prime contractor will provide a core team of long-term TA, including U.S. and local subcontractors, as well as a mechanism through which additional long- and short-term TA can be accessed to carry out studies, assessments, monitoring, or other activities, as needed. The prime contractor will be procured through a USAID direct contract.

2. Commodities

Direct USAID procurement of testing, monitoring and other environmentally related equipment will be financed under CAIP as needs arise during project implementation. Filtration devices and other pollution prevention equipment for the lead smelters, and equipment for the CNG component may be among the commodities procured. As noted earlier, the Private Sector CIP will be used for procurement when deemed feasible.

3. Training

This will be a flexible mechanism for providing training, primarily short-term, for selected individuals. The primary criterion is that the training enables the participant to more effectively implement the proposed environmental activities. Study tours abroad for the relevant managerial and technical staff members of cooperating Egyptian entities will be conducted. Workshops and seminars will also be funded.

4. Local Support

The Vehicle Emissions Testing and Tune-up and the CNG Conversion activities are expected to require most of the local support for the project. Financial assessments will be made of the GOE organizations anticipated to be USAID's primary implementation counterparts, i.e., EEAA for the VETT program, and OECP for the CNG component. USAID has successful experience implementing projects with the assistance of self-contained secretariats established within cooperating GOE partner organizations. Typically, local implementation units receive support in the form of salaries, office equipment and supplies, office space and project-related travel expenses. Project funds are allocated to local support units through Project Implementation Letters which are amended annually.

Local support for the implementing units, in particular support for salaries, will be for those costs related solely to project implementation and will be terminated upon project completion. The CAIP will not finance any recurrent costs needed to continue activities beyond the life of the project.

5. Policy Dialogue

USAID will initiate a policy dialogue with GOE entities in regard to pollution prevention activities. When prudent, the dialogue will be supported with resources from the CAIP, primarily for TA to carry out analyses and studies.

USAID does not propose to condition the project, at least initially, on implementation of policy reforms; however, there are two fundamental policy dialogue considerations which must be continuously borne in mind during project implementation.

First, significant reduction in air pollution must rely fundamentally on market rather than command and control mechanisms. The GOE's Environmental Action Plan explicitly notes this fact. This will require adoption by the GOE of the use of economic prices for petroleum products and electricity. (The Environmental Action Plan identifies a total phase out of energy subsidies as the first policy reform required to reduce air pollution.) Other elements of the USAID program, eg., Power

Sector Support II and future Sector Policy Reform programs will address these energy pricing concerns more directly.

Second, a major portion of industrial air pollution and a significant percentage of transport-related air pollution is generated by public sector firms. To make an impact on the air pollution problem the project must deal with these firms. However, the project generally should not provide assistance which makes public sector firms more viable and less subject to privatization. There are two proposed interventions which will be monitored especially carefully in this regard. The first is the replacement of the lead line at General Metals. This major source of lead pollution is believed to account for a relatively small percentage of General Metals revenues. Replacement of the lead line should remove a very significant source of lead pollution (which would be a major liability for any potential private sector investor at such time this firm might be privatized) without significantly improving its profitability. The second is the proposed introduction of a pilot CNG program for the Cairo bus companies. These companies are known to have significant management problems; however, if the GOE is going to abandon its subsidy on diesel fuel, there must be strong evidence that the introduction of alternative CNG technology is viable over the short term.

B. CAIP Partners

Air pollution prevention in Cairo involves numerous GOE agencies and private entities. USAID's principal partner under CAIP will be the Egyptian Environmental Affairs Agency (EEAA), which is the GOE organization mandated to set and enforce environmental standards. USAID has successfully collaborated with EEAA on previous and ongoing projects. EEAA representatives will participate on the project Advisory Committee which will provide overall direction to CAIP implementation. EEAA will also work directly with CAIP to implement the VETT component (see Subsection 3 below). During the course of the project, other partners will be identified for particular activities. See Annex E, Institutional Analysis, for further discussion of EEAA and other partners.

1. Potential Partners for Lead Smelter Activities

a. General Metals Lead Smelting

A likely partner for this activity will be the Holding Company for Metallurgical Industries, which includes General Metals. This would be the project's initial and primary contact point and would act as liaison with General Metals and the Public Enterprise Office (PEO). To assure a consistent policy *vis a vis* parastatals, USAID's Trade and Investment Office will be involved in CAIP's contacts with the PEO and the Holding

Company. CAIP will deal with General Metals directly regarding maintenance, sustainability, spare parts, and installation and operation of the lead processing line.

b. Private Sector Lead Smelters

EEAA will be a principal partner in working with the private sector lead smelters and will be active in designing activities and perhaps monitoring. The private sector operators themselves, especially the firm that owns and operates a complex of five smelters, will, of course, be the focus of this component. The Governor of the Cairo will also be an important partner.

2. Conversion of Vehicles to CNG

The Ministry of Petroleum's Office of Energy Conservation and Planning (OECF) will be the project's primary counterpart for the CNG component. USAID has had successful project implementation experience with OECF and has collaborated closely with this office during the past two years in developing concepts for CNG use. OECF will facilitate the project's interaction with the Cairo Transit Authority and the Greater Cairo Bus Company which will be the project's technical implementors.

OECF will also have a key role as liaison between the public and private sector participants and in the actual planning of the conversion. The MOP will provide compressed gas at a competitive price. It will also work with AMOCO/Egypt to facilitate the construction of CNG filling stations.

Another important partner will be the bus manufacturer, NASCO (the current supplier of buses to CTA and GCBC.) It is possible that they will change some of their production line to produce CNG buses. Finally, Misr Laboratory will receive equipment, training and technical assistance to develop its capability to conduct emissions testing in support of the CNG pilot conversion.

3. Vehicle Emissions Testing and Tune-Up Services

Private and public sector gasoline stations will operate the emissions testing equipment to be provided under the project. Participating stations will be licensed by the EEAA to offer this service. Therefore, both the EEAA and through it the participating stations will be important partners in implementing this activity. The EEAA will also manage the technical center which will be developed through the CAIP.

4. Policy Dialogue

This activity will involve a wide variety of GOE and private sector entities, depending on the item being discussed. CAIP's key partners will be EEAA, the Ministry of International Cooperation (MIC), and other donors.

5. Monitoring and Analysis System

The Danish International Development Agency (DANIDA), is planning to implement an air monitoring network with EEAA. CAIP will coordinate closely with them to avoid duplication and assure that the project's monitoring needs are met.

III. DEFINITION OF SUCCESS

While the goal of the Cairo Air Improvement Project is to reduce morbidity and mortality associated with air pollution, indicators at this level are difficult to define for a number of reasons:

- many health outcomes, such as acute or chronic respiratory disease, have additional contributing factors, such as diet and smoking habits;
- typical latency periods for chronic health outcomes are longer than the duration of this project; and
- impact on acute health outcomes for the general population may be limited within the resource constraints of the project.

At the next level, namely the impact of the project on ambient air concentrations of particulates and lead, results on a region-wide basis will also be difficult to demonstrate. Within the limited resources and time frame of the project, CAIP successes in emissions reductions may be overwhelmed by increases in population, vehicle fleets, and economic activity. Nevertheless, CAIP will have an impact on certain well-defined targets, in terms of both ambient concentrations and emissions to the environment. This section discusses these in more detail.

A. Intended Results

In this section, the End of Project Status (EOPS) to which CAIP can be reasonably expected to make a contribution are outlined.

1. Project Purpose Achievements

- Lead emissions from smelters will be reduced by 90 percent;
- TSP emissions from CNG converted buses will be reduced by 90 percent;
- Eighty percent of randomly sampled vehicles will be in compliance with GOE emissions standards.

2. Project Level Progress

a. Reduced Concentrations of Airborne Lead In and Near Lead Smelters

There will be a measurable reduction in airborne lead concentrations both in areas within one kilometer downwind and in workplace areas within the smelters. In general, the target reduction will be 50 percent of current concentrations. Larger reductions in ambient lead concentrations, up to 80 percent, can be expected near and within the largest smelters.

b. Expanded Use of CNG as a Fuel for Public Municipal Bus Fleets

Through its CNG conversion activity, CAIP will test the technical and financial feasibility of substituting natural gas for diesel as a fuel for municipal bus fleets as a means of reducing particulate emissions, starting with a demonstration activity involving 100 buses.

c. Improved Fuel Efficiency of the Motor Vehicle Fleet

By the PACD, 200,000 vehicles will be tuned up on an annual basis. Through the increased use of tune-up services by gasoline-fueled taxis and private cars, the average fuel efficiency of the tuned up automobile population will increase by at least 10 percent.

B. Indicators of Progress Toward Results

1. Reduced Lead Emissions

- Within one year, agreement has been reached with one public (General Metals) and one private smelter operator on a detailed design for retooling the plants with less polluting technology.
- Within three years, these facilities will have been re-equipped.

2. Reduced Concentrations of Airborne Lead In and Near Lead Smelters

Within three years:

- a reduction of 90 percent in workplace airborne lead concentrations will be observed at retooled lead smelters.
- a reduction of 80 percent in concentrations one km downwind of the General Metals smelter will be observed.

- a reduction of 50 percent in concentrations downwind of the other (i.e., private) retooled smelters will be observed. This is less because they are located in more densely populated areas where the contributions of other sources to near-smelter lead concentration may be significant.

3. Expanded Use of CNG as a Fuel for Public Municipal Bus Fleets

- Within one year, agreements on the design and mechanism for conversion to CNG will be established.
- Within two years, at least two prototype CNG-fueled buses will be in operation.
- Within three years, the conversion and CNG fueling operations will have moved beyond the prototype phase, and fifty CNG buses will be in operation.
- Within five years, 100 CNG buses will be in operation.

4. Improved Fuel Efficiency of the Motor Vehicle Fleet

- Within three years, there will be 150 facilities providing tune-up services.
- By year five, 80 percent of a 1000 vehicle sample will be in compliance with GOE emissions standards.

C. Monitoring of Indicators

There will be several levels of monitoring in this project. As a new project activity is identified, it will be necessary to determine interim indicators and the desired end-of-activity indicators to assure progress and successful completion. These indicators will then become part of the project's dynamic monitoring plan. The plan will be flexible, as the project will identify and undertake new activities throughout its implementation.

A key component to determine impact of CAIP air pollution activities will be the air quality monitoring system being developed by DANIDA. While this activity will focus on the "macro level" of pollution, CAIP will develop a monitoring capability to measure emissions from individual sources to help determine the impact of project activities. This on-going monitoring will be supplemented by planned evaluations and site visits by experts in appropriate fields.

The cross-cutting Monitoring and Analysis component of the CAIP (see Section I.C) will play a key role in both monitoring progress towards achieving the results specified in the project indicators and EOPS, as well as in building in-country capacity for such analysis. The monitoring tasks to be undertaken associated with each EOPS and its interim indicators include:

1. Reduced Lead and Particulate Emissions

- A baseline inventory of all secondary lead smelters in Greater Cairo completed, including an emissions estimate and inventory.
- Emissions monitoring capability will be put in place and used to measure emissions from lead smelters.
- Emissions reduction at individual plants will be translated into an industry-wide reduction as this activity proceeds.

2. Reduced Concentrations of Airborne Lead In and Near Lead Smelters

- A baseline database of airborne lead concentrations both near (within 1 km) and within the lead smelters will be established for those facilities identified for retooling.
- These concentrations will be monitored during and after retooling of each plant.

3. Expanded Use of CNG as a Fuel for Public Municipal Bus Fleets

- The financial and technical performance of the CNG buses will be closely monitored and compared with conventionally-fueled counterparts.

4. Improved Fuel Efficiency of the Motor Vehicle Fleet

- A baseline survey of the availability and advertising of tune-up services will be established shortly after CAIP start-up. This survey will be repeated two and four years into the project.
- Representative samples of the vehicle fleet (approximately 1000 vehicles) will be monitored for emissions of hydrocarbons and carbon monoxide.

IV. KEY ASSUMPTIONS AND RELATED RISKS

A. Assumptions and Risks

1. Purpose Level

Assumption: Proposed activities have intended effect on air pollution.

Risk management: The decision to select specific activities will be made only after sufficient analyses have convinced USAID and its partners that the activity will be effective. Ongoing monitoring will ensure that the activity is meeting its predetermined indicators.

2. Output Level

a. Lead Reduction

Assumption: The public and private sector lead smelters are willing to make the necessary investments to install and maintain the filtration equipment.

Risk management: As CAIP input into this activity is small, the risk is minimal. USAID's contribution to General Metals would be limited to the plans and materials specifications for a modern lead line. TA may also be provided to help supervise the installation of the equipment. General Metals, however, would have to finance the equipment and its ancillary civil works. With regards to the private sector smelters, CAIP will help design the new filters and facilitate their financing through the private sector CIP if deemed appropriate. At this point, however, the filters will not be purchased with project funds.

b. CNG Conversion

Assumption: Ministry of Petroleum provides ample CNG at a competitive price.

Risk Management: The MOP is interested in the introduction of CNG powered vehicles and has volunteered to USAID and to the American Ambassador to provide CNG at a competitive price. An MOU will be signed with them prior to the initiation of this activity.

Assumption: The private sector petroleum companies will construct the CNG filling stations needed for our pilot project.

Risk Management: The companies volunteered to construct these stations before this project was conceived. They have continued to express their interest. USAID will not disburse funds for vehicle conversions until the stations are constructed.

Assumption: Targeted bus fleet is willing to cooperate with conversion.

Risk Management: The Cairo Transit Authority and the Greater Cairo Bus Company have both stated that they would cooperate fully with CAIP's proposed installation/conversion to CNG of 100 buses.

c. Vehicle Testing and Tune-ups

Assumption: The private sector stations will purchase tune up machines and participate in the program because of the profitability of testing and tune ups.

Assumption: Vehicle operators will make use of the testing and tune up stations because of the increased mileage.

Risk Management: The USAID-financed pilot project demonstrated a positive economic impact for both the vehicle owners and the tune up station operators. The activity generated great enthusiasm, which continues to this day, months after the pilot activity ended. One station reported that since the pilot project, tune-ups have increased from three a day to 25.

B. **Cutoff Point**

As this is a project that will respond to problems and opportunities as they arise, it is not possible to give specifics as to a particular cutoff point aside from the activities discussed below. When an activity is identified for USAID support, the project team will clearly determine its goal and indicators towards progress. If problems arise that prevent a particular activity from meeting its indicators and an adjustment is not feasible, the activity will be cut off.

Similarly, if there were a major change in US or GOE policy that would impede progress toward the project's goals, the team would consider cutting off project activities.

Lead Reduction Activities: If the public and private sector lead smelters are not willing to cooperate with the clean up activities, those activities will be terminated.

Air Quality Monitoring and Analysis: As noted, CAIP plans to use and complement the air monitoring network planned by DANIDA. If DANIDA cancels or substantively alters their plans, CAIP will have to provide the necessary air monitoring devices. At the very least, the project will provide equipment and training to assure monitoring of CAIP activities.

CNG Conversion: This activity will be cut off if the CNG filling stations are not built or if GOE policy were significantly changed against this activity.

Vehicle Testing and Tune Up Activities: If the project is unable to interest sufficient filling stations in participating in the tune up program, or if it cannot generate enough interest on the part of the vehicle owners, this activity will be terminated.

V. FINANCIAL PLAN

A. Resource Requirements

The CAIP is a seven-year, \$60 million project. The complete financial plan is included in Annex B. USAID inputs to the project are provided under five components: technical assistance; training; commodities; local support; and, audits and evaluations.

The CAIP is envisioned as an umbrella project that will support a range of activities directed toward the improvement of air quality in the Cairo area. The project is designed with significant flexibility to respond with appropriate new activities as problems and opportunities are identified and to refine the originally identified activities as the project progresses. Thus, the budgets on which this financial analysis are based cannot be strictly defined at this time. These budgets can be expected to be modified during project implementation based on information obtained early in the project and improved understanding of activity requirements.

The budget line items have a significant amount allocated to "New Activities" that are yet to be identified (\$7.4 million). An Advisory Committee will review proposed new activities and make recommendations to USAID. After careful consideration of these recommendations and any assessments that are required, including financial management assessments if new organizations are expected to participate, the funds for these activities will be assigned from the "New Activity" budget. In addition, equipment and installation costs for the General Metals lead facilities upgrading, estimated to be \$5.4 million, may come out of the New Activities component. The decision to finance the equipment and installation for this activity will be based on the Lead Smelter Action Plan.

Some activities in the project (e.g., CNG Vehicles and Vehicle Emissions Testing and Tune-Up) can be expected to result in a financial pay-back to some participants. However, these pay-backs are considered secondary to the environmental benefits and thus are not analyzed here. They are, however, discussed in the Technical Analyses.

During the life of this project, non-federal/recipient audits will be performed to determine whether the recipients have properly accounted for and used USAID funds for the purposes intended in accordance with applicable laws and regulations. USAID will ensure that all commitments over \$100,000 under this project are in the Mission's audit universe. The Mission will schedule audits for those commitments over \$100,000 and ensure funds are available for audits in accordance with USAID/W guidance dated 3/31/92 on Audit Management and Resolution Program. Not all of the planned commitments over \$100,000 under this project will require non-federal/recipient audits because of the nature of the activity.

Given the nature of the project, which is designed to initiate appropriate new activities as problems and opportunities are identified and to refine the originally identified activities as the project progresses, it is difficult to identify specific host country contributions at this time. Minimum amounts of cash and in-kind support have been identified for the CNG, VETT, and Lead Smelter components. Once a particular activity to be implemented is finalized, the GOE and USAID will sign Project Implementation Letters that will more fully define host country contributions.

B. Projected Financial Schedules

The following tables provide a summary life of project budget, a projection of expenditures, a projected obligations schedule, the methods of implementation and financing, and estimated management costs.

Exhibit 1

Exhibit 2

Exhibit 3

Exhibit 4

Management Costs
[TO BE REVISED BY FM]

VI. MANAGEMENT PROCEDURES

A. Management Systems and Procedures

This project is designed for simplicity and flexibility. The overall project direction will come from an advisory committee representing USAID and EEAA. Memoranda of Understanding or Project Implementation Letters will lay out the mutual responsibilities and inputs of USAID and the respective partners (e.g., General Metals, Cairo Transit Authority). They will specify any conditions precedent to the disbursement of funds and better describe cash and in-kind inputs.

It is anticipated that overall implementation of CAIP will be carried out by USAID through a prime contractor that will oversee various subcontractors. The prime contract team will be responsible for determining, for each component, whether they will provide the necessary TA, training, and commodities, or subcontract out for one or more of the activities.

New activities will be reviewed by the contractor against a pre-determined set of criteria outlined below. If the contractor determines that the activity meets these criteria, the proposal is passed on to the advisory committee for final approval. The proposals will be judged against the following criteria:

- the proposed activity can be addressed within the project's resources;
- addresses pollutants identified as high health risks in Cairo;
- sustainability;
- cost effectiveness;
- leverages activities of others; and
- involves the private sector.

Once approved, the advisory committee, along with the contractor and the partners involved in the activities, will determine indicators and benchmarks to ensure that progress and results are measured.

B. Conditions Precedent to Disbursement

The CAIP Project Agreement will contain no Conditions Precedent to Disbursement other than those required for all USAID project agreements with the GOE.

C. Procurement Plan

It is anticipated that the primary technical assistance contract will be with a U.S. consulting firm or consortium that will work on a cost reimbursement plus fixed fee, LOE contract. They will be responsible for overall management of the CAIP. When submitting their proposals, the offerors will determine which technical components will be subcontracted out. If the primary contractor chooses to subcontract to other firms, it is anticipated that this will be done on a fixed price, performance basis.

The extent of the lead smelter activities are subject to the results of the Lead Smelter Action Plan, which will be completed by April 1996. Therefore, the Request for Proposals will reserve as an option that the prime contractor carry out the selection and installation of the lead smelters at a later date, once the course of action to be taken is finalized based on the Action Plan.

At the time of each procurement action, every effort will be made to encourage the participation of business concerns that qualify for Gray Amendment status and draw upon their knowledge and expertise.

It is expected that the private sector entities involved in the project activities will purchase the appropriate commodities. For example, the private sector lead smelters would purchase the smelting equipment, although USAID would facilitate their use of the Private Sector CIP and provide TA if appropriate. Commodity procurement for public sector entities will be carried out by the prime contractor.

D. Procurement Schedule

Project Agreement signed	August 1995
Commerce Business Daily notice issued	August 1995
PIO/T submitted to PROC	August 1995
Requests for Proposals Issued	September 1995
Contract awarded	January 1996