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Egyptian Environmental Policy Program
Program Support Unit

CONSIDERATIONS FOR REVISING AIR QUALITY STANDARDS IN EGYPT

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and
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Indefinite Quantity Contract (EPIQ)

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Fact Sheet

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Foreword

Through competitive bidding, the United States Agency for International Development (USAID) awarded a multi-year contract to a team managed by International Resources Group, Ltd. (IRG) to support the development and implementation of environmentally sound strategic planning, and strengthening of environmental policies and institutions, in countries where USAID is active. Under this contract, termed the Environmental Policy and Institutional Strengthening Indefinite Quantity Contract (EPIQ), IRG is assisting USAID/Egypt with implementing a large part of the Egyptian Environmental Policy Program (EEPP).

This program was agreed to following negotiations between the governments of the United States, acting through USAID, and the Arab Republic of Egypt, acting through the Egyptian Environmental Affairs Agency (EEAA) of the Ministry of State for Environmental Affairs, the Ministry of Petroleum's Organization for Energy Planning, and the Ministry of Tourism's Tourism Development Authority. These negotiations culminated with the signing of a Memorandum of Understanding in 1999, whereby the Government of Egypt (GOE) would seek to implement a set of environmental policy measures, using technical support and other assistance provided by USAID. EEPP is a multi-year activity to support policy, institutional, and regulatory reforms in the environmental sector, focusing on economic and institutional constraints, cleaner and more efficient energy use, reduced air pollution, improved solid waste management, and natural resources managed for environmental sustainability.

USAID has engaged the EPIQ contractor to provide Program Support Unit (PSU) services to EEPP. The PSU has key responsibilities for providing overall coordination of EEPP technical assistance, limited cross-cutting expertise and technical assistance to the three Egyptian agencies, and most of the technical assistance that EEAA may seek when achieving its policy measures.

The EPIQ team includes the following organizations:

- Prime Contractor: International Resources Group
- Partner Organization: Winrock International
- Core Group:
  - Management Systems International, Inc.
  - PADCO
  - Development Alternatives, Inc.
- Collaborating Organizations:
  - The Tellus Institute
  - KBN Engineering & Applied Sciences, Inc.
  - Keller-Bliesner Engineering
  - Conservation International
  - Resource Management International, Inc.
  - World Resources Institute's Center For International Development Management
  - The Urban Institute
  - The CNA Corporation.

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Acronyms and Abbreviations

ADB	Asian Development Bank
AfDB	African Development Bank
Amer.	America *or* American
As	arsenic
Assns.	associations
BACT	best available control technology
BAT	best available technology
BS	black smoke
C	carbon
C.F.R.	Code of Federal Regulations
CAAA	Clean Air Act Amendments of 1990
CAIP	Cairo Air Improvement Project
CASAC	Clean Air Science Advisory Committee
Cd	cadmium
Cl	chlorine
CNG	compressed natural gas
CO	carbon monoxide
CO_2	carbon dioxide
Cu	copper
D.C. Cir.	Federal Circuit Court for Washington, D.C.
D.C.	District of Columbia (Washington, D.C., U.S.)
D.D.C.	Federal District Court for Washington, D.C.
D.O.E.	U.S. Department of Energy
Dec.	December
EA	environmental assessment
EBRD	European Bank for Reconstruction and Development
EC	European Community
EEAA	Egyptian Environmental Affairs Agency
EIA	Environmental Impact Assessment
EMS	Environmental Management System
EPAP	Egyptian Pollution Abatement Project
EPIQ	Environmental Policy and Institutional Strengthening Indefinite Quantity Contract
et al.	*et alii* (and others)
et seq.	*et sequens* (and the following one or ones)
EU	European Union
F	fluorine
F. Supp.	Federal Supplement
FCC	fluid catalytic cracker
Fed. Reg.	Federal Register
FGD	flue gas desulfurization
g/hr	grams per hour
g/km	grams per kilometer
g/m	grams per mile
g/MJ	grams per mega joule
GHG	greenhouse gases
GJ/hour	Giga Jjoules per hour
GOE	Government of Egypt
gpl	grams per liter
gpm	grams per mile
GVWR	gross vehicle weight rating
H_2SO_4	sulfuric acid
HAP	hazardous air pollutant
HC	hydrocarbon
HCl	hydrochloric acid
HEW	U.S. Department of Health, Education, and Welfare
HF	hydrogen fluoride
Hg	mercury
HLDT1	heavy light-duty truck category 1
HLDT2	heavy light-duty truck category 2
hr	hour
IDB	Inter-American Development Bank
IFC	International Finance Corporation
ILO	International Labor Organization
IQ	intelligence quotient
ISO	International Organization for Standardization
Jan.	January
Jul.	July
kg	kilogram
kg/t	kilogram per ton
km	kilometer
LAER	lowest achievable emission rate
lb	pound
LDT1	light duty truck category 1
LDT2	light duty truck category 2
LDV	light duty vehicle (passenger cars)
LEV	low emission vehicle
LEV2	phase 2 LEV
LRTAP	Long-range Transport of Air Pollutants (treaty)
LT	long ton (2,240 lbs.)
LVW	loaded vehicle weight
m, m^3	meter, cubic meter
MACT	maximum achievable control technology
Mar.	March
max	maximum
MCW	municipal waste combustor
mg	milligram
mg/dscm	milligram per dry cubic meter at standard conditions
mg/Nm^3	milligram per normal cubic meter
mgms	milligrams
MIGA	Multilateral Investment Guarantee Agency
ML/gallon	mililiter per gallon?

mmBtu	million British thermal unit
MT	Montana
MW	megawatts
MWe	megawatts of electricity
MY	(vehicle) model year
NAAQS Standards	National Ambient Air Quality
NESHAPS	national emission standards for hazardous air pollutants
Ni	nickel
NMHC	non-methane hydrocarbons
No.	number
NO_2	nitrogen dioxide
NO_x	nitrogen oxides
NSPS	New Source Performance Standards
NSR	New Source Review
NTE	not to exceed
O_3	ozone
OPIC	Overseas Private Investment Corporation
PAH	poly-aromatic hydrocarbons
Pb	lead
PM, PM_{10}, $PM_{2.5}$	particulate matter; particulates with an aerodynamic diameter of 10 (or 2.5) microns or less
ppb	parts per billion
ppm	parts per million
ppmv	parts per million by volume
PRIDE	Project in Development and the Environment
PSD	prevention of significant deterioration
Pub.L.	public law
reg-neg	regulatory negotiation process
RFG	reformulated gasoline
SD	South Dakota
SIP	State Implementation Plan
SO_2	sulfur dioxide
SO_3	sulfur trioxide
SO_x	sulfur oxides
Stat.	U.S. Statutes at Large
SULEV	Sports utility LEV
TOC	total organic compounds
TSP	total suspended particulates
TW	test weight
U.S.	United States
U.S.C.	United States Code
UK	United Kingdom
ULEV, ULEV 2	Ultra-low emission vehicle
UN ECE	United Nations Economic Commission for Europe
UN	United Nations
USAID	United States Agency for International Development
U.S. EPA	United States Environmental Protection Agncy
v.	versus
VOCs	volatile organic compounds
vol.	volume
WHO	World Health Organization
wt.	weight
WTO	World Trade Organization
yr	year
Zn	zinc

_g/dl	microgram per deciliter
_g/m^3	microgram per cubic meter
_m	micron
§	section
>	is greater than
<	is less than
≥	is greater than or equal to

Summary

The United States Agency for International Development (USAID) has a long-standing interest in environmental issues in Egypt. From the 1980s to the mid-1990s its undertakings were primarily building and rehabilitating infrastructure such as water and wastewater treatment plants and networks. Concern shifted in the early 1990s to areas of the country outside the two urban centers of Cairo and Alexandria**.** In Greater Cairo, efforts shifted from building infrastructure to institutional development so the utilities could operate in a more business-like manner, in line with the Government of Egypt's (GOE) efforts to de-control the economy.

At the same time, both the GOE and USAID were becoming increasingly aware that urban Cairo was suffering from ever-increasing pollution, especially air pollution. USAID funded several short-term efforts to assess the situation, including a study in 1994, the Project in Development and the Environment (PRIDE), which identified the seriousness of public health impacts from air pollution. USAID and the GOE then laid plans for a massive project to address air pollution—the Cairo Air Improvement Project (CAIP). CAIP contains a number of discrete projects targeted to specific local needs.

Given the serious nature of the air quality problems, USAID has instituted a new project under the Environmental Policy and Institutional Strengthening Indefinite Quantity Contract Program (EPIQ) to provide resources to address air quality problems in Egypt. USAID is currently funding the Egyptian Environmental Policy Program (EEPP), which operates at a level aiming to address policies that affect Egypt's environment over the long term. The Program Support Unit (PSU) of the EEPP is charged with completing 14 tasks during its first tranche of operation—among them to assess the air quality standards set by Egypt in its "Environmental Law" (Law 4 of Year 1994 and Executive Regulations). As an important step, USAID is providing funding to establish a system for periodic review and modification of air emission standards, in conjunction with the Egyptian Environmental Affairs Agency (EEAA).

As part of its efforts, the PSU has prepared an analysis to compare Egypt's standards with other leading air quality programs. The analysis surveyed all the significant national and international programs, focusing on those standards used by the United States of America (U.S.), by the European Union (EU), and by the World Health Organization (WHO). In addition, a series of meetings was held in Egypt with key stakeholders (listed in Appendix E) to identify priorities for EEAA's assessment.

Air pollution standards can be divided into two different categories: air quality standards, and emission control standards. Because of their fundamental differences there are usually distinct programs for control of stationary source and mobile source emissions. All these categories of Egyptian standards were evaluated in light of world standards.

Air quality standards in Egypt were compared with those of the U.S., EU, and WHO. Analysis showed that Egypt's ambient air quality standards (i.e., the free air outside of buildings) are not out of line with these standards overall, but that several changes should be made. First, because the standards for nitrogen dioxide (NO_2) and lead (Pb) are significantly less stringent than acceptable elsewhere in the world, this report recommends that Egypt set stricter standards for these. Second, this report also recommends that Egypt reexamine the averaging times for all standards. Third, this report recommends that Egypt consider de-listing two pollutants: black smoke (BS), because it is obsolete and duplicates the category for particulate matter with a diameter of 10 microns or less (PM_{10}), and total suspended solids (TSP), because they are solids that are too large to be inhaled deeply into the lungs and cause health problems. Fourth, this report recommends that Egypt consider adding a standard for $PM_{2.5}$, which are small enough to be inhaled deeply into the lungs, and for volatile organic compounds (VOCs), which will reduce ambient ozone (O_3) formation.

In addition, at least 11 hazardous air pollutants (HAPs), which cause health damage from low exposure, should be considered for addition to Egypt's air quality standards. Some of these are currently listed as substances subject to *emission* or *workplace* standards.

Emission standards for stationary sources in Egypt are organized by pollutant first, then by category of industry to which the standards apply. By contrast, the three world programs are all organized by source—with the U.S. standards going to the extreme of specifying type of equipment rather than industry. Because of these basic differences, it is not possible to make a straight comparison between Egypt's stationary source emission standards and those of the U.S., EU, or WHO. Nevertheless, some useful observations are possible. First, the Egyptian law is unspecific, listing pollutants in several categories with different limits. Second, the emission standards are written as absolutes, without averaging times, so that while they alleviate nuisances they do not necessarily reduce air pollution. Third, the list is not comprehensive—many HAPs are missing altogether. The organizing principle—by pollutant rather than by source—makes equitable application of the rules impossible and is extremely difficult to administer effectively.

Egyptian stakeholders expressed the opinion that many of the emission standards—such as that for sulfur dioxide (SO_2)—are not stringent enough, and raised issues of controlling the sulfur content of fuels as the best way to control emissions.

In addition, the standard for emissions from combustion sources is obsolete in method, using the outdated Ringelmann method to measure the opacity of the smoke produced rather than a quantitative analytical approach to measuring the volume, chemical composition, and size of particles composing such emissions.

Mobile source emission standards were compared with those of the U.S. and EU (WHO does not publish standards for mobile sources). This comparison revealed basic differences: First, Egypt is measuring tailpipe emissions as percentage of pollutant in volume of emissions, while the other two are denominated in grams of pollutant per distance traveled. Second, Egypt's test protocol does not compare easily with either that used in the U.S. or the EU; Egypt measures only CO, hydrocarbons (HC), and BS, and does not measure non-methane hydrocarbons (NMHC), nitrogen oxides (NO), or PM—which, as discussed earlier, would be a more useful measurement than BS. While there is no methodology that would allow direct comparison of the standards, some observations are possible.

First, testing tailpipe emissions at a single moment fails to capture a more representative sample of real driving conditions. In addition, testing a vehicle at idle (as the Egyptian standards do) is the moment when emissions are at their lowest. The standards apply to all vehicles—gasoline-, diesel-, and compressed natural gas-fueled; motorcycles, passenger cars, buses, and trucks. Large vehicles are not likely to be able to meet the standards, while the same standards are too lenient for small vehicles, meaning that Egypt loses an easy opportunity to make reductions in emissions.

Egypt's mobile emission standards need to be rewritten in line with either the U.S. or EU standards. The technologies to achieve such standards are available, costs have been reduced to acceptable levels, and integration of such technology into vehicle design yields concurrent improvements in fuel economy.

The other aspect of mobile emissions standards is fuel standards. Egypt already has unleaded fuel available and should move quickly to prohibit the use of the remaining leaded fuel. Given the warm temperatures and absence of onboard vehicle evaporative controls, it is also recommended that volatility controls for fuel sold in urban areas be added to control formation of O_3. Egypt has a decided advantage in its vast reservoirs of natural gas and its progress toward encouraging the use of CNG as a motor fuel. Incentives have been shown to be effective in facilitating conversion to CNG.

General considerations: Finally, there appears to be an underlying problem in Egypt that goes far beyond the air quality standards: the lack of a widespread understanding of the connection between air pollution and human health. Egypt is subject to an annual cycle of sand and dust storms that simply blow away, reinforcing the concept that bad air goes away by itself. There has been little public education concerning air pollution until very recently. However, several years with periods of inversions that have trapped pollutants over Cairo (known locally as "the black cloud") have increased public awareness. Still, emitters don't see themselves as polluters; they don't understand the reasoning behind the standards nor why they should be burdened with the cost or effort it takes to comply with them.

Studying the development of the U.S. air quality program, it is possible to see what is missing from the Egyptian program: a clear understanding of the link between air quality and protection of human health, with regulations used to achieve emission reductions to levels that provide adequate air quality.

Stakeholders from EEAA expressed the lack of this obvious link in many ways, ranging from historical and cultural methods of avoiding compliance to the absence in Law 4/1994 or its Executive Regulations of guidance about penalties for those not in compliance.

Any program that has a cost or involves perceived sacrifice—and air quality control meets those two criteria—can only go as far as public opinion will allow. There must be political will, resources for enforcement, commitment on the part of both the government and industry, and a high degree of acceptance among the professional and scientific communities.

It is recommended, therefore, that any process to revise the air quality standards use two central premises as its starting point:

- Air quality standards should be set at levels that achieve protection of human health primarily, as well as the environment, and
- Emission standards should be set at levels that bring pollutant concentrations within the air quality standards.

In order to begin the process of setting new standards, it will be necessary to answer the main questions key stakeholders raised. One was whether the standards should be the same throughout Egypt, or should they vary by location. International experience argues that the standards for ambient air should be the same everywhere. Allowing industry to relocate to areas that are not now polluted removes incentives for modernization and introduces a number of inequities.

Systematic review of new standards is necessary on a regular basis. In the U.S., there is a requirement for review of standards at least every 5 years, or whenever new information appears. Even with the resources available in that country, that schedule is less than rigorously followed. For Egypt, a review every 5–10 years seems reasonable to keep it abreast of international developments and scientific advances.

As new standards are developed, lawmakers must also consider administration of regulations. According to EEAA stakeholders, current procedures are not clear and enforcement authority is inadequate. Not only do the standards conflict as now written, but methodologies for measuring emissions are lacking as well, as is adequate administrative organization and responsibility.

A frequent complaint was that enforcement programs are understaffed and that the staff lacks resources to do their jobs. Equipment, instruments, spare parts, vehicles, and trained staff are badly needed. One EEAA staff member commented that although the law regulates more than 300 chemicals in indoor concentrations, his staff couldn't measure more than two or three of these, rendering this portion of the law meaningless.

Another regular criticism concerned the recognition that the standards did not have a solid scientific or medical basis—quantitative methods are essential to standard setting and standard enforcement, and more science could be used to link the emission standards with the ambient standards. Development of rigorous protocols must be part of the revision process, but must not become a means of postponing implementation of the standards.

It is clear, too, that the program needs to develop specific standardized procedures and sampling methods that have approved quality assurance or quality control practices. It will be useful to rely on the standard methodologies that have already been adopted and are in use by international financial organizations or the International Standards Organization (ISO). These are available, and their use simplifies the implementation of methodologies. These will be critical for success of any standard Egypt adopts.

Two conclusions seem clear: First, the relationship of emissions to air quality should be stressed as part of a new approach. Second, although attainment of the health-based standards is unrealistic in the near term, it is not appropriate to ignore the air quality standards. There has to be a way of working toward them in a reasonable and appropriate way.

It would be appropriate to issue new emission standards without waiting for signals from ambient standards. Various technologies and the source categories that use them should be targeted for application of new emission standards without regard to their specific impacts on ambient loadings. The most appropriate approach will be to issue emission standards one industry at a time, focusing on bringing technologies in that industry up to world standards.

The first task would be to look at all the source categories and set up a scoring of various industries in order to prioritize them into a schedule: industries emitting the problem pollutants (PM and its precursors) in the largest amounts; industries with obsolete facilities that would make good targets for renovation; industries that are capital-intensive and high profile. Overall emissions would decline as the process works through the list, industry by industry.

The overriding concern will be the health and life potential of the Egyptian people. This report concludes that it is possible to start making positive steps now.

1. Introduction

The United States Agency for International Development (USAID) has a long-standing interest in environmental issues in Egypt. From the 1980s to the mid-1990s its undertakings were primarily building and rehabilitating infrastructure such as water and wastewater treatment plants and networks. Concern shifted in the early 1990s to areas of the country outside the two urban centers of Cairo and Alexandria, and has extended to the east to the cities of Suez, Ismailia, and Port Said, throughout the Nile Delta region, and to Upper and Middle Egypt. In Greater Cairo, efforts shifted from building infrastructure to institutional development so the utilities could operate in a more business-like manner, in line with the Government of Egypt's (GOE) efforts to de-control the economy.

At the same time, both the GOE and USAID were becoming increasingly aware that urban Cairo was suffering from ever-increasing pollution: noise pollution, uncollected rubbish, and especially air pollution. USAID funded several short-term efforts to assess the situation, including a study in 1994, the Project in Development and the Environment (PRIDE), discussed in more detail below, which clarified the seriousness of the air pollution problem.

USAID and the GOE then laid plans for a massive project to address air pollution—the Cairo Air Improvement Project (CAIP). CAIP is charged with implementing a vehicle emissions testing pilot program, assisting the two major public transit companies to put test fleets of compressed natural gas (CNG)-fueled buses on the streets, helping the Egyptian Environmental Affairs Agency (EEAA) implement the National Lead Abatement Plan through providing technical expertise to private lead smelter owners as they upgrade their facilities, and compiling data on components of Greater Cairo's ambient air with special emphasis on lead (Pb) and particulate matter with a diameter of 10 microns or less (PM_{10}).

Given the serious nature of the air quality problems, USAID has instituted a new project under the Environmental Policy and Institutional Strengthening Indefinite Quantity Contract Program (EPIQ) to provide resources to address air quality problems in Egypt. As an important step, USAID is providing funding to establish a system for periodic review and modification of air emission standards, in conjunction with the Egyptian Environmental Affairs Agency (EEAA).

1.1 Tasks Covered

Under EPIQ, USAID and the Government of Egypt (GOE) have agreed to 14 policy objectives designed to improve environmental conditions in Egypt.[1] These objectives are to be completed within 18 months, starting June 1999.

This task is designed to complete Objective 4, Tranche I, which calls for conducting an assessment of the existing air standards in Egypt.[2] The goal of this exercise is to provide analysis for the EEAA to use in establishing a system of periodic review of emission regulations.

A team of two consultants was assigned to conduct research and prepare materials for the required assessment. Dr. Mahmoud Nasralla, professor of environmental sciences and author of the existing Egyptian air quality regulations, was assigned the role of team leader and consultant. The author, Mr. Alan P. Loeb, Esq., an American attorney specializing in environmental standards and regulations, was assigned the role of international consultant. Under his Terms of Reference, Mr. Loeb was tasked to:

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[1] The source document for EPIQ in Egypt is the Memorandum of Understanding Between the Arab Republic of Egypt and The United States Agency for International Development, Egyptian Environmental Policy Program.

[2] The outline does not set out a specific measure for the tranche, but footnote 1 indicates what steps to undertake and tools to use. It has been determined that the task calls for an assessment of the existing air pollution standards.

- Review existing air emissions standards established under Law 4, Year 1994 ("the Egyptian Environmental Law")and prepare a brief analysis comparing the Egyptian standards with comparable U.S. and selected international air emissions standards such as those used by the World Health Organization (WHO) and the European Union (EU).
- Work with the local consultant and use the above analysis to conduct a series of interviews with key stakeholders to identify—based on criteria agreed to with Dr. Ahmed Gamal, Environmental Advisor to the USAID-funded Cairo Air Improvement Project (CAIP) and the Egyptian Environmental Affairs Agency (EEAA)—specific air emissions standards that should be the focus of the EEAA assessment.
- Assist in the preparation of a detailed questionnaire, using the above analysis and interviews, and test it with a small roundtable of key stakeholder/advocates. The questionnaire was to be distributed to relevant stakeholders before the stakeholder consultation.
- Following the stakeholder consultation, assist the local consultant in preparing an assessment of the effectiveness of existing air emissions standards in controlling priority air pollutants, and recommend appropriate modifications and procedures for periodic review and modification.

This report gives an account of the first two tasks. The method used involved two phases: first, it was necessary to survey the standards adopted by leading national programs, including the U.S. and the EU, international organizations, and others to identify air quality standards for comparison. This was a necessary prerequisite for the analysis. A key factor was to discover if there are world norms in air pollution control that the Egyptian air pollution control system must meet in order to be at general parity with other countries. While the survey conducted was intended to be comprehensive, so that all important programs could be identified, it was not exhaustive. Programs were summarized and some inessential aspects were not covered at all. The result, even after selective coverage, has produced an extensive collection of materials, which are set out in appendices to this report.

Once the survey materials were assembled there followed a second phase, which was to evaluate the existing Egyptian program to identify flaws or weaknesses in the regulations and make recommendations for addressing those deficiencies. The evaluation has taken account of both the written standards themselves as well as considerations relating to the Egyptian administrative system and the emission sources. Because the analysis naturally falls into two distinct processes, this step has been accomplished in two parts:

1. The analysis first compares the air quality standards that apply in Egypt with the standards that are applied by selected countries and international organizations. The report examines the strengths and weaknesses of the Egyptian program relative to these other programs to the extent such are possible given their incompatibilities. The examination focuses on the pollutants of greatest concern in Egypt so that public health priorities can be addressed. The analysis identifies problem areas and offers some preliminary observations and recommendations.[3]
2. The analysis also evaluates other concerns about the functioning of the Egyptian air quality program, focusing on the administration and other relevant technical or policy considerations. This relies principally upon interviews in which I have participated, supplemented by a reading of

[3] In order to complete the assignments within time and budget allocated, the analysis presented here includes secondary materials where they could be obtained. In some cases I have drawn from copyrighted materials, including my own, which remain subject to the proprietary protections they originally held. Material drawn from others has been referenced; not all of my own material has been referenced herein. Nothing in this document waives any right or claim in intellectual property held by any author whose material appears here.

a translation of the Egyptian environmental law with its Executive Regulations and experience in solving similar problems in other countries.

While this report represents completion of the research part of this project, the analysis is more preliminary and should be taken as a platform for discussion rather than as final conclusions. Refinement of the analysis and the recommendations that come from it will result from the remaining tasks in the project.

1.2 Target Air Pollution Problems in Egypt

Most concern with air pollution in Egypt centers on Greater Cairo—an area that encompasses the cities of Cairo, Giza, and Qaliobiya—where air pollution levels rank among the highest in the world.

Before 1994 it was believed that mobile sources were the biggest air pollution problem in Cairo. In September of that year, USAID released the report, *Comparing Environmental Health Risks in Cairo, Egypt*, prepared by the Project in Development and the Environment, which became known as the PRIDE study. This report provided a much more refined view of the problem, identifying two primary public health concerns regarding air pollution in Cairo.

First, it determined that lead pollution was the single greatest single source of pollution damage to the Cairo population. It found the average blood lead levels among Cairo residents to be at 30, 27.5, and 22.5 micrograms per deciliter (μg/dl) of blood for men, women, and children respectively—among the highest ever recorded for a major city.

Based on these levels, it found that every year lead pollution in Cairo alone causes 6,500–100,000 heart attacks, and 840–1,400 strokes, resulting in a total of 6,300–11,100 cardiovascular deaths, and an average IQ loss of 4.25 points for every person raised in Cairo. The cost associated with the IQ loss is estimated to be billions of dollars annually.

Virtually all of the lead in the environment starts in the air, at that time principally from leaded gasoline. Thus, the PRIDE study did not disturb the belief that mobile sources were the source of the most significant air pollution problem, but it did change the sense in which that initial hypothesis was true. As a result of this information, and with advice that antiknock substitutes could be implemented quickly at reasonable cost, in 1996 the GOE acted quickly to remove the lead from the gasoline sold in Greater Cairo. Nevertheless, because of the dry climate, the lead that was used previously continues to contaminate Egyptian urban environments and reenters the air through reentrainment. In addition, the current lead loading is increased by emissions from lead smelters that continue to operate in and around Cairo.

Second, it found that particulate matter (PM) levels in air pollution in Cairo exceeded health-based standards by a factor of 5 to 10, with levels in Cairo higher than in any of the world's largest cities. It found that industrial emissions were the principal source of PM, though it had no inventory of emission sources. It predicted that reducing PM concentrations to natural background levels might prevent 3,000–16,000 deaths and 90–270 million days of restricted activity per year

Among the other environmental health risks, it also noted high ozone levels, though its assessment was based on incomplete monitoring data. In addition, it found high levels of the conventional pollutants nitrogen oxides (NO_x) and carbon monoxide (CO), as well as the probability of high concentrations of toxic air pollutants such as benzene, formaldehyde, cadmium, nickel, and benzo-a-pyrene. Even without time series monitoring data, it can be assumed that increases in road traffic since 1994 have also increased emissions of ozone precursors, resulting in corresponding increases in ambient ozone levels, as well as many of these other pollutants.

While new data, when it becomes available, will inform decision-makers better about current conditions, information that is now available indicates the presence of very high levels of air pollution in urban areas, especially in Cairo. These conditions create a significant public health problem that has high personal and economic costs. This analysis is intended to identify institutional means of reducing human exposure to such substances through revision of the air pollution standards and changes in administrative mechanisms.

2. Comparison of Pollutant Standards

This section compares air quality standards used throughout the world with Egypt's established under the Executive Regulations of Law 4/1994. The materials used for the comparison, along with additional information on the programs, are contained in the appendices. Of course, a standard can only be compared with like standards. The survey indicated that the programs have fundamental differences that, in some cases, make absolute quantitative comparisons difficult or impossible. Nevertheless, even in these cases the exercise provides useful information and insight about the Egyptian program.

2.1 *Survey of World Air Pollution Standards*

A first step in carrying out the assigned task was to identify the various world standards and determine the kinds of standards found in their programs. The results of a preliminary survey of Egypt, the U.S., the EU, WHO, the World Bank, other financial organizations, and the International Organization for Standardization (ISO) are summarized in table 1.

Table 1. Summary of World Air Pollution Standards

Standard or Guideline	Egypt	U.S.	EU	WHO	World Bank	Other Financial	ISO14000
Ambient	*	* (Federal)	*	*			
Emissions							
Stationary Sources	*		(Not pursued)		*		
-Existing		* (States)[a]					
-New		* (Federal)				*	
Mobile Sources	*	* (Federal)[a]	*				
Technical Methods		*		*		*	*
Management Practices			*		*	*	*

* Indicates existence
[a] Regarding the U.S. program, this characterizes programs that are most developed and actively enforced. The exceptions that exist for stationary sources are in programs that have only recently been pursued vigorously, such as for visibility protection, where federal authority to regulate existing sources exists. The exceptions that exist for mobile sources are the longstanding exception for California and the ability of other states to 'opt-into' participation in the California standards.

2.2 *Survey of World Ambient Air Quality Standards*

Analysis of world air pollution standards begins with a survey of the standards that define air quality goals. Egypt, WHO, the U.S., and the EU have programs that approach air quality in conceptually different ways. As noted in the appendices, the U.S. program classifies air pollutants (other than global air pollutants) into two fundamental categories: conventional pollutants and hazardous air pollutants (HAPs). The U.S. program is the anomaly. Other world programs do not make that formal distinction, providing instead for the differences in toxicity by assigning lower maximum ambient concentrations. Despite differences in organization, the programs are compatible enough to be compared, but the distinction of ambient pollutants and hazardous air pollutants is maintained here.

2.2.1 Conventional Pollutants: Health-based Ambient Air Quality, Visibility, and Acidification

Table 2 compares health-based ambient pollutant standards in Egypt with those issued by the WHO, U.S. and EU. The list excludes pollutants that are toxic at low thresholds and which may be considered HAPs.

Table 2. Comparison of Health-based Ambient Air Quality Standards

Pollutant	Averaging Time	Maximum Limit Value			
		Egypt	WHO	U.S.	EU
Black Smoke (BS)	24-hour	150 μg/m^3	—	—	250 μg/m^3
	Annual	60 μg/m^3	—	—	80 μg/m^3
Total Suspended Particles (TSP)	24-hour	230 μg/m^3	—	[260 μg/m^3, rescinded]	[rescinded]
	Annual	90 μg/m^3	—	[75 μg/m^3, rescinded]	[rescinded]
Particulate Matter (PM_{10})	Annual	—	—	50 μg/m^3	40 μg/m^3
	24-hour	70 μg/m^3	—	150 μg/m^3	50 μg/m^3
$PM_{2.5}$	Annual	—	—	15 μg/m^3	—
	24-hour	—	—	65 μg/m^3	—
Sulfur Dioxide (SO_2)	Annual	60 μg/m^3	50 μg/m^3	80 μg/m^3	20 μg/m^3
	24-hour	150 μg/m^3	125 μg/m^3	365 μg/m^3	125 μg/m^3
	1-hour	350 μg/m^3	—	—	350 μg/m^3
	10-minute	—	500 μg/m^3	—	—
Carbon Monoxide (CO)	8-hour	10 mg/m^3	10 mg/m^3	10 mg/m^3	[proposed]
	1-hour	30 mg/m^3	30 mg/m^3	40 mg/m^3	
	30-minute	—	60 mg/m^3	—	
	15-minute	—	100 mg/m^3	—	
Nitrogen Dioxide (NO_2)	Annual	—	40 μg/m^3	100 μg/m^3	40 μg/m^3
	24-hour	150 μg/m^3	—	—	—
	1-hour	400 μg/m^3	200 μg/m^3	—	200 μg/m^3
Nitrogen Oxides (NO_x)	Annual	—	—	—	30 μg/m^3
Ozone (O_3)	8-hour	120 μg/m^3	120 μg/m^3	157 μg/m^3	[proposed]
	1-hour	200 μg/m^3	—	235 μg/m^3	
Lead (Pb)	Annual	1 μg/m^3	0.5 μg/m^3	—	0.5 μg/m^3
	Quarterly	—	—	1.5 μg/m^3	—

A number of observations about the Egyptian standards can be made on the standards compared in table 2.

Standard Level Concentrations

First, ambient levels that are specified in the Egyptian standards listed in the Executive Regulations of Law 4/1994 in Annex 5 are not out of line with world standards overall. However, when taken individually, two of the pollutants, NO_2 and Pb, are assigned standards that are significantly less stringent the levels considered acceptable elsewhere in the world. Specific observations on the comparisons are as follows:

- **PM_{10}**. Annex 5 (of the Executive Regulations of Law 4/1994) specifies a PM_{10} 24-hour standard of 70 μg/m^3, while the U.S. and EU standards are 150 and 50, respectively. Thus, the Egyptian standard falls within the range of other standards. However, Dr. Nasralla points out that the background level of PM_{10} from natural sources is already in excess of 70.
- **SO_2**. Annex 5 specifies a SO_2 annual standard of 60 μg/m^3, while the WHO, U.S., and EU standards are 50, 80, and 20, respectively. Thus, while higher than the WHO and EU standards, this Egyptian standard is actually lower than the U.S. standard.
- **CO**. Annex 5 specifies a CO 8-hour standard of 10 mg/m^3, the same as the WHO and U.S. standards. The 1-hour standard of 30 mg/m^3 is the same as the WHO standard and less than the U.S. standard of 40 mg/m^3. Thus, it is at or below the world standard.
- **NO_2**. Annex 5 specifies a NO_2 1-hour standard of 400 μg/m^3, twice that of the WHO and U.S. standards, which are at 200 μg/m^3. Egypt should consider revising this standard to bring it within the world norm.
- **O_3**. Annex 5 specifies an O_3 1-hour standard of 200 μg/m^3, slightly below the U.S. standard of 235 mg/m^3. It also specifies an 8-hour standard of 120 μg/m^3, which is the same as the WHO standard and slightly below the U.S. standard. Thus, the O_3 standard is on a par with the world standards.
- **Pb.** Annex 5 specifies a Pb annual standard of 1 μg/m^3, twice that of the WHO and EU standards, which are both set at .5 μg/m^3. The U.S. standard is not comparable, as it applies only quarterly. Because the Egyptian standard is set at twice comparable standards, Egypt should consider revising this standard and bringing it within the world norm.

Averaging Times

Among the six pollutants listed by Annex 5 that are also listed by the U.S., EU, or WHO, there are a number of pollutants that have multiple standards for distinct averaging times. While all of the averaging times used in Annex 5 (with the single exception of the 24-hour NO_2 standard) are used in one or more of these other programs, the question arises whether it is really necessary to maintain all of these standards, especially in the case of SO_2, where Annex 5 gives three separate standards. But even where there are two standards, it remains an open question whether both are required, or whether those that exist now are the most appropriate averaging times for these pollutants. New knowledge may change not only the level considered to be toxic but also the temporal exposure scenario in which toxicity will arise.

Given the high particulate levels in Cairo, it is advisable to consider adopting a 24-hour standard for PM_{10} to control for episodes resulting from temporary conditions such as inversions because of mortality potential from acute exposures; high concentration episodes get washed out in the annual average.

As part of any review, Egypt should consider reexamining the averaging times for the ambient pollutants to determine whether current averaging times remain appropriate. Maintenance of more standards than is necessary costs resources that could be used for other purposes. Obviously, one can observe from table 2 that there is no single approach that has been adopted by all. On the other hand, it may be that certain factors that are indigenous to Egypt should be taken into consideration and would affect the determination of the standards that are most appropriate.

Considerations for De-listing Two Pollutants

In addition to the listed pollutants that correspond to pollutants now listed by other regulatory agencies, Annex 5 includes two pollutants, both related to particulates, that are no longer commonly in use elsewhere. Egypt should consider deleting at least one of these:

- **BS.** The standard for black smoke has been made obsolete by the adoption of PM_{10} standards and has been dropped in other programs internationally. A strong argument can be made for dropping it in Egypt, as it duplicates the existing PM_{10} standard, and its administration and enforcement would drain scarce resources. Moreover, control of smoke emissions as nuisances can be accomplished more efficiently through the use of Ringelmann charts. If another health-based particulate standard is needed, it should be a $PM_{2.5}$ standard, which has become the other conventional form. The counter-argument raised by Dr. Nasralla is that a standard for black smoke should remain because incomplete combustion is a problem in Egypt.
- **TSP.** The TSP ambient standard has been dropped from most programs because of the growing understanding of the relationship between particle size and health effects. As indicated in the appendices, beginning in the early 1990s researchers, using time series analyses, began to see a strong association of health effects with smaller particles and to recognize that the larger particles found in ordinary airborne dust do not constitute a significant health concern. While the large particles create a nuisance, they do not enter the deep parts of the lungs. Moreover, while the TSP standard ostensibly measures *total* suspended particulates, in practice only the largest particles get measured and controlled, leaving the smaller particles that affect health adversely uncontrolled. Thus, use of a standard that includes the larger, benign particles results in lack of control of the smaller, harmful particles. As with black smoke, it may be advisable to delete TSP as obsolete. However, Egypt may pose a special case because of the significant natural background levels of larger particles. It is at least debatable whether it is desirable to retain the TSP standard in Egypt as a means of tracking the large particles because of the public interest in that information, even if it is not a measure of health effects.[4] Thus, indigenous circumstances in Egypt may warrant that use of resources.

Additions to the List

To come up to the state-of-the-art, Egypt should also consider some additions to the lists. Two suggestions are considered here:

- **Particulates**. The pollutant that is of greatest political visibility in Egypt is the PM standard. The aforementioned studies carried out in the 1990s identified the nature of health hazards from fine particulates as a much more significant health threat than previously realized. Studies have also pointed to fine particles, particularly $PM_{2.5}$, which is inhaled deep into the lungs, as the greatest source of human health risk. Currently, Egypt has a standard for PM_{10} but not for $PM_{2.5}$. Any reconsideration of the standards should, in addition to examining the level of the PM_{10} standard, evaluate the costs and benefits of establishment of a separate $PM_{2.5}$ standard. The health concerns are not in doubt; the only question is whether attainment of the standard is economically feasible, assuming that the standard will be implemented if adopted.

[4] To make a determination a better inventory of sources is called for. Limited data used in the PRIDE study suggests that only about one-third of the TSP measured in Cairo results from natural sources. Thus PM_{10}, which excludes the larger fraction most likely to be from natural sources, is most likely to result from anthropogenic causes. These issues will need to be sorted out in order to make a decision on the form of PM standards to retain.

- **Volatile Organic Compounds (VOCs)**. In an interview, Cairo environmental lab manager Nader Shehata Doas suggested the addition of a standard for VOCs. These are pollutants that chemically combine in the ambient air to form ozone and other photochemical pollutants. While control of VOCs is important to reduce ambient ozone formation, VOCs as a class are not necessarily significant as health detriments. As discussed in Appendix B.3.1, the United States Environmental Protection Agency (U.S. EPA) initially had an ambient standard for hydrocarbon (HC) but dropped it for this reason. The proper regulatory approach for HC and VOCs is to control them with emission standards, rather than through the ambient standard mechanism. Thus, the addition of a VOC ambient standard is not recommended.

Visibility Impacts

While human health is universal, making consideration of ambient pollutant concentrations essential, it is also important to take into account the impact of ambient pollutants on other air quality factors in Egypt, such as visibility. Visibility is particularly important in Egypt for two reasons:

- **Value Relating to Tourism**. Visibility has a high economic value. Tourism is a major industry in Egypt, and tourists come to experience the antiquities visually. Because of their grandeur, they must be viewed from great distances. The impact of these monuments is substantially reduced by visibility impairment. In addition, to the extent Egypt is seen as dirty and polluted, tourists may choose other options and stay away. Visibility has a cash value.
- **Value Relating to Public Awareness of Air Pollution**. By the same token, visibility is a condition that is, by definition, obvious to the public in Egypt, and any changes in air quality will be noticed. Since visibility impairment is caused by particulates and ozone, which are also ambient pollutants of great concern in Egypt, visibility acts as an indicator to the public of the level health hazards in the ambient air.[5]

Because of these two values, it may be important in any consideration of conventional pollutants to take account of not only their health effects as ambient pollutants but also their impacts on visibility and other air quality values. Control of ambient pollutants for health reasons would not always reduce visibility-impairing pollutants to acceptable levels. For example, since TSP is more of a nuisance pollutant than a health threat, it could be de-listed as an ambient pollutant but still be subject to controls under a separate visibility program. Visibility impacts are worth consideration as part of a complete examination of the air quality program.

Acidification

Because of the significant impact of acid deposition upon historic monuments and archaeological sites, acidification from conventional air pollutants is a significant problem in Egypt. Like visibility, acidification has not been addressed in the Executive Regulations to Law 4/1994.

2.2.2 Hazardous Air Pollutants; Other Air Pollutants

In addition to the traditional ambient pollutants, there is a second class of air pollutants that are toxic at lower thresholds, which the various programs have treated differently. In most programs, including that of the EU, these are grouped with the ambient pollutants but controlled to much lower concentrations. By contrast, in the U.S. program these are treated as a distinct class of pollutants and controlled under a separate regulatory program.

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[5] Visibility degradation is caused in large part by precursor emissions that result, which are notoriously high in Egypt, especially in Cairo.

Table 3 provides a sample of substances that may be considered for control in Egypt as hazardous air pollutants, but which are not currently listed in Law 4's Executive Regulations Annex 5 as air pollutants. These include the eight substances listed as hazardous air pollutants by the U.S prior to 1990 and the eleven substances listed (or under consideration for listing) as ambient pollutants by either the WHO or the EU. Some of these are listed in the Egyptian program under Annex 6 as substances subject to emission standards. A more complete list would include the 188 substances currently listed by the U.S. under section 112(b)(1) of the Clean Air Act.

The absence of a program that recognizes the exposure concerns of these pollutants, either as part of Annex 5 of the Executive Regulations of Law 4/1994 or in a separate program, creates a gap in coverage. For most of these substances there is no control other than by the occupational standards listed in Annex 8, "Maximum Limits of Air Pollutants inside the Work Place According to Type of Industry."[6] Regulation by occupational standards alone would raise the theoretical scenario that firms using the 11 substances—or any of the substances listed in Annex 8—could control occupational exposure levels by venting these substances to the exterior of the building where no regulatory controls apply, rather than control them by pollution prevention (i.e., by substituting non-toxic materials). Venting is one of the classic mistakes—it was the remedy adopted in the U.S. for controlling worker exposure to organo-metallic compounds of lead from the 1920s on, but which resulted in diverting attention from the exposure of the public to the lead emissions or accumulation of lead in the ambient environment. All these considerations argue for additional standards.

In addition to the conventional pollutants and the hazardous air pollutants, there are two additional categories of air pollutants that should be covered to make a comprehensive program. First, in addition to contamination of the open air, an air management program may also incorporate provisions to address indoor air quality. While in other systems a formal distinction is made between ambient (environmental) contamination and work place (occupational) contamination, in Egypt the contamination of indoor air quality is treated as air pollution and included within the environmental program under Law 4, for which standards are written under the Executive Regulations. Global air pollutants are those which are only manageable at the worldwide level. These include stratospheric ozone depletors and greenhouse gases, "GHGs". It is useful to think of them as as impacting the atmosphere rather than the ambient air. A comprehensive air quality management program must also take into account such additional classes of air contamination phenomena.

2.3 Survey of World Stationary Source Emission Standards

Emission standards are direct controls on emissions into the ambient air. Various stationary source emissions control programs were reviewed in the survey. While the stationary source emission control programs are so fundamentally different that no quantitative comparison can be made, some useful qualitative observations are still possible.

Table 3. Comparison of Hazardous Air Pollutant Standards

Pollutant	Maximum Limit Value			
	Egypt	WHO	U.S.	EU
Benzene	—	5.0-20.0 μg/m^3 [Table 3.3]	[regulated as NESHAP]	[proposed]
Arsenic	[Annex 6, Table 2]	(1-30)10^3 μg/m^3 [Table 3.3]	[regulated as NESHAP]	[proposed]
Mercury	[Annex 6,	—	[regulated as	[in research]

[6] An exception is found in Article 19, which addresses radioactive substances, which corresponds to radionuclides on the HAPs list. Additional exceptions are found in Annex 6, Table (2), for listed HAPs.

	Table 2]		NESHAP]	
Asbestos	—	—	[regulated as NESHAP]	—
Beryllium	—	—	[regulated as NESHAP]	—
Vinyl Chloride	—	—	[regulated as NESHAP]	—
Radio Nuclides	—	—	[regulated as NESHAP]	—
Coke Oven Emissions	—	—	[regulated as NESHAP]	—
Cadmium	[Annex 6, Table 2]	(0.1-20) 10^{-3} µg/m^3 [Table 3.2]	[Cd compounds regulated as HAP]	[in research]
Nickel	[Annex 6, Table 2]	1-180 µg/m^3 [Table 3.3]	[Ni compounds regulated as HAP]	[in research]
PAH	—	(1-10) 10^{-3} µg/m^3 [Table 3.3]	---	[in research]

2.3.1 Comparison of Programs

The stationary source programs reviewed start with three very different organizing principles.

The Egyptian standards, set out in Annex 6 of the Executive Regulations of Law 4/1994, is organized by the following logic: first, the categories of pollutants emitted are set out in two separate tables—one for particulates only, the other for other types of emissions. Then the categories of industries to which the standards apply are listed. Finally, if there is a further distinction between new sources and existing sources, that is listed. Thus, the primary organizing principle for the standards is the pollutant emitted, rather than the category of source from which it is emitted.

By contrast, others have used the source category, rather than the pollutant, as the organizing principle. There are two variations on this approach. First, in its *Industry Sector Guidelines* (Appendix D), the World Bank recommends a set of performance standards for control of emissions at specific categories of industrial sources. Since these are enforced as a precondition of financing a project, they are, in effect, sector-specific emission standards applied in a pre-construction review process. In addition to the *Guidelines*, the World Bank also provides a review of generic control technologies for specific pollutants.

Second, and at the far extreme, the U.S. standards are organized by type of equipment, rather than by industry. The program considers an individual piece of equipment in use at a facility (rather than the facility as a whole) to be the emission source that is the subject of regulation, and thus the rules apply to (and are arranged by) category of equipment. Within a given facility or plant there will be numerous emission sources that are regulated individually, each with its own set of standards for emissions of each pollutant.

Because each of the programs is written around a different organizing principle it is impossible to make direct quantitative comparisons of the emission standards, since one cannot know in advance the equivalences that would allow translation from one set of standards to another. For a quantitative comparison to be made, standards for each industry would have to be analyzed individually using engineering judgment to determine those equivalences. Such a comparison far exceeds the resources contemplated in this task. In consequence, this report offers no opinion as to whether the Egyptian stationary source standards are more or less stringent than other world standards.

2.3.2 Qualitative Observations on the Egyptian Stationary Source Emission Standards

While direct quantitative comparisons are impossible, some useful observations on the Egyptian emission standards can be made.

First, there are many specific flaws in the standards as they are now written. For example:

- Annex 6 of the Executive Regulations of Law 4/1994, "Permissible Limits of Air Pollutants in Emissions," contains two tables, "Overall Particles" and "Maximum Limits of Gas and Fume Emissions from Industrial Establishments." It appears that the Regulations are designed to distinguish particulate emissions from gaseous emissions. However, the second table contains numerous substances that normally would be in particulate form, so there is not a clean and logical distinction. As a result it is possible that both tables—and more than one standard—could apply simultaneously. In such an instance the owner of the source cannot ascertain which standard would apply. This ought to be clarified by revisions in the Executive Regulations.
- The second table lists categories for *heavy elements (total)* and for *organic compounds*. These are very unspecific and probably too arbitrary to be enforceable.
- That table also combines conventional and hazardous air pollutants. If it is intended to be comprehensive, incorporating all air pollutants, there are numerous additional HAPs that should be considered for addition to the list.
- The standards are denominated as mass per volume, but since no averaging periods are specified it is implicit that they apply as absolute standards. That is, emissions at no time may exceed the maximum. While that does provide a constraint on emissions of high concentrations at every moment, it does not limit the aggregate amount of emissions over a period of time. In other words, under these rules a facility is prohibited from emitting highly concentrated emissions at any instant, but a large volume of emissions within the standard that continues for a long period and results in many times more emissions to the environment is perfectly legal. The standards are written to prohibit nuisances, rather than air pollution generally.

Second, organizing the standards by pollutant, rather than by source category, is undoubtedly very difficult to administer. Since different industries have different equipment and varied emissions, the use of a single, uniform standard to apply to a number of industries would be arbitrary. For some industries the standard would be easy to meet and present no burden; for others it would severely constrain operations and cause great financial hardship if it were enforced. As a result, equitable application would be impossible, and it would probably not be enforced. The result is that the emission reductions that are the purpose of the standards are unlikely to be achieved. In the distant future, when stringent levels of control for every industry become the norm, it may be economically feasible to have equal standards for all industries, but under present conditions this is not something that achieves the program goals.

Third, organizing by pollutant, rather than by source category, can lead to extraordinary inefficiency if the rules are enforced as written. For most pollutants, the rules assign all sources the same standard. But it is well known that typically the cost of control varies widely across industries and even across types of equipment in the same industry. While the application of a single standard to all sources is, in a sense, equitable since it places an equal responsibility on all parties, the burden of meeting the same standard is greater for some than for others, since the costs of control are higher.

Finally, and most importantly, organizing the standards by pollutant, rather than by industry, makes these rules extremely general. But any revision of these standards to achieve a reduction in emissions would have to be targeted toward the specific industries or source categories that emit them. Once the process of targeting industries for emission reductions is started, the organizing principle for the rules would quickly become the industry, rather than the pollutant. It is something that occurs naturally. Since these are *emission* standards, the controls would be on emissions by a source and would include all the emissions from that source. By contrast, organizing an emission control effort by pollutant, so that dozens of source categories have separate standards under each listed pollutant would be an extremely unwieldy approach.

Even without a direct and quantitative comparison with other stationary source control programs, it is possible to conclude that the Egyptian stationary source emission standards are outmoded and unsuited to the task. The foregoing discussion suggests two improvements: (1) any program to amend the rules should start from the principle of assigning appropriate emission limitations to emission sources for each pollutant that source emits; and (2) the standards contained in Annex 6 of the Executive Regulations to Law 4/1994 may remain while the process of replacement goes on so that regulatory oversight can continue, but ultimately they would be supplanted by the new process.

2.3.3 Views about the Egyptian Emission Standards

In addition to the analysis, some opinions about the standards were obtained through interviews.

Stringency of the Standards

Several individuals interviewed noted that the emission standards are not stringent enough. Dr. Ahmed Hamza, Senior Technical Advisor, Environmental Compliance Unit, Industrial Sources, EEAA, observed that industry is complying with the standards, but the air is still polluted. “We can feel the pollution, we get complaints from all over, but we can do nothing about it,” said Dr. Hamza.

According to Nader Shehata Doas, the emission limits specified by Law 4 and its Executive Regulations are very lax. Some emission limits such as the SO_2 standard are so lenient that no facility will exceed them; these need to be more stringent. He noted complaints from individuals around the cement plants, smelters, and foundries. He also noted that one can see the emissions from facilities that use heavy fuel oil, called *mazout*, but when it is measured it is within the limit. Doas suggested that it would be better to limit the high sulfur content of the fuel that gives high emissions rather than to measure it as emissions. He also noted that uncontrolled incineration of solid waste in the streets needs to be addressed.

Article 42(C)

A number of specific comments were directed at Article 42(C) of the Executive Regulations of Law 4/1994, which covers emissions from combustion sources. According to Dr. Ahmed Hamza, among the standards that are too lax are those that provide limits for fuel-burning sources under Article 42(C). EEAA has already commissioned a study to revise these. Significant emission reductions are possible.

As a general matter, one can observe that Article 42(C) is obsolete in method. One obvious flaw is that it measures pollution from combustion sources visually using the outdated Ringelmann method. This measures the opacity of smoke, but it tells nothing about its volume, the chemical composition of the gaseous combustion products (such as SO_2, NO_x, or CO) or the size of particles composing it. Thus, the Ringelmann method is a crude and ineffective regulatory tool that should remain in the law only for the purpose of measuring the traditional smoke nuisance to downwind receptors, but not as a metric by which modern air pollution problems are measured. There is no substitute for a quantitative analytical approach.

Standards for Hospital Waste Incinerators

It was suggested above that standards be adopted by classification of facility, as is the practice in the World Bank guidelines. There seems to be a natural tendency toward that approach. Already, without adopting this practice as a systematic approach, some in EEAA are developing standards for specific source categories. One example is the standards for hospital waste incinerators.

According to Dr. Nefisa S. Abo El-Seoud, Director of Environmental Engineering, Hazardous Substances and Waste Management, EEAA, the Executive Regulations are not clear about standards controlling emissions from hospital waste incinerators. Moreover, the standards are for emissions from industrial establishments that are assumed to be located in industrialized areas, while in Egypt hospitals are often located within residential areas. For this reason, the standards for emissions have to be very strict. EEAA has developed its own air emission standards for these specific treatment units, guided by EU materials, U.S. standards, and others. These apply technical specifications to incinerators, though details were not made available. Dr. El-Seoud considers this change very important and has recommended that these standards be included in the Executive Regulations.

The approach taken with respect to hospital waste incinerators appears to have all the correct elements: it is developed based on a class of like-kind facilities, the standards are drawn from precedents established by advanced air quality programs, and the level of the standards is driven by air quality impacts.

2.4 Survey of World Mobile Source Emission Standards

Emissions from vehicles are affected by both emission controls and by fuels. Though each affects the other, they are considered separately here.

2.4.1 Vehicle Emission Standards

Given the great number of standards for different classes of vehicles, direct comparison of emission standards for mobile sources is difficult. For comparison purposes, the standards for the largest segment of the vehicle fleet—the gasoline-fueled passenger car—have been assembled in table 4. This should be taken as representative of other classes of vehicles.

Analysis

Several observations can be made on the information provided in the table.

Comparability of the standards. From the outset it is clear that a direct comparison of the Egyptian standards with the U.S. and EU standards is impossible for several reasons:

- *Denomination of pollutant.* The Egyptian standards are written in percentage of pollutant in volume of emissions, while the U.S. and EU are denominated in grams of pollutant per vehicle distance traveled (either mile or km, respectively).
- *Test protocol*. Each regulation uses a different test procedure to measure emissions from the vehicles, so that the design of the driving cycle used in measuring emissions affects the quantity of pollutants actually emitted.
- *Emission warranty*. The regulations may apply to different lengths of warranties. That is, a vehicle required to meet the emission standard for only 50,000 miles has much greater emissions in its lifetime than a vehicle required to meet its standard for 100,000 miles. EU-certified vehicles have no emission warranty.

Table 4. Comparison of Standards for Gasoline-fueled Passenger Cars

Pollutant	Egypt		U.S.		EU
	Existing Vehicles	New Vehicles	Pre-1994 g/mi [g/km]	Tier 1 (1994) g/mi [g/km]	2000 g/km
CO	7% volume at idle speed (600-900 rotations/ minute)	4.5% volume at idle speed (600-900 rotations/ minute)	7.0 [4.3498]	3.4 [2.1128]	2.3
HC	1000 ppm at idle speed (600-900 rotations/ minute)	900 ppm at idle speed (600-900 rotations/ minute)	1.5 [.9321]	—	0.20
NMHC	—	—	—	0.25 [.15535]	—
NO_x	—	—	1.0 [.6214]	0.4 [.24856]	0.15
Smoke	65% darkness (opacity) or equivalent at maximum acceleration	50% darkness (opacity) or equivalent at maximum acceleration	—	—	—
PM	—	—	—	0.08 [.49712]	—

Sources: The Egyptian standards are those established under Article 37 of the Executive Regulations of Law 4/1994. The U.S. standards are those issued for gasoline-powered light-duty vehicles under section 202 of the Clean Air Act (1977) for emissions prior to 1994, and under the 1990 Amendments (tier 1) effective 1994. The EU standards are those applicable beginning 2000, as compiled in Michael P. Walsh, *Motor Vehicle Standards and Regulations Around the World*, June 3, 1999, as revised.

- *Date of applicability.* Of the two U.S. standards presented here, the more stringent are those applicable to model year 1994, while the EU standards presented here are those from model year 2000. Both sets of standards are soon to be superseded with much more stringent standards in model years 2004 and 2005, respectively. However, presentation of these two future standards was impossible to accomplish in a simple table because the U.S. tier 2 standards are impossible to describe except by listing numerous conditions that apply with them. Thus, it should be understood in making the comparison that the table compares the old U.S. standards with the new EU standards, and while these are comparable now that condition will not pertain for long.

To make a comparison, one would have to test individual vehicles certified to one standard on the test protocols applicable to the other; for example, by testing the emissions of a car certified with the U.S. test protocols under the Egyptian idle test.

Accordingly, one has to read table 4 with the recognition that the absolute numbers stated there may not represent absolute comparisons of the relative stringency of the various rules. One acknowledges that because of these factors an absolute comparison is impossible and a more precise comparison than this would require considerable engineering judgment.

Since there is no standard methodology that would allow the extrapolation of the emissions performance of one test procedure to the other, there is no way to know with precision how the Egyptian vehicle emission standards compare with the U.S. or EU standards. However, it can be reasonably assumed that the Egyptian standards do not require vehicles to control emissions to the world standard. Indeed, in the absence of a standard, NO_x emissions are not controlled at all and may indeed be increased by designs implemented for control of HC and CO.

Other Observations

Despite the lack of direct comparability, there are some observations that can be made about the mobile source emission standards.

The use of a concentration-per-volume standard makes the Egyptian program suitable for tailpipe testing for an in-use vehicle. Measuring emissions at a single moment simplifies the approach by eliminating the need for a more complicated testing protocol. But by the same token, this testing procedure fails to capture a more representative sample of real driving conditions as part of the vehicle certification, making it unlikely that vehicles in driving conditions actually have the emissions they are certified to. Emissions vary dramatically with cold start, road conditions, acceleration, etc. The certification protocols used in the U.S. and EU for new vehicles attempt (some would say without true success) to be representative of the whole driving cycle. By contrast, the emissions tested in the Egyptian standard are from a vehicle at idle, when emissions are lowest. The Egyptian standards should be changed to be in the same measures as other standards to conform to the world norm, which is written to capture the emissions during the whole driving cycle.

Even without a direct and quantitative comparison of the Egyptian vehicle emission standards with other standards, it is still reasonable to conclude that the Egyptian standards are obsolete and ought to be replaced. For example, the vehicle emissions standards apply to any vehicle, including buses, motorcycles, tractors, etc. For larger vehicles, this imposes heavy burdens that are not likely to be met; for smaller vehicles the standards are too lenient, losing the opportunity to make reductions that could be made easily. For other categories, such as diesel smoke, the standard is possibly too lenient and may need to be reconsidered given the high ambient particulate levels in Cairo. Given these problems, the rules come to be treated as unenforceable as a whole. At a minimum, it is appropriate to rewrite the Executive Regulations of Law 4/1994 to make clarifications and tighten up the language.

Given the air quality problems that currently exist, vehicle emission standards should be significantly tightened. Since vehicles are built to meet one set of standards or another, the only effective way to accomplish this is to adopt one of the sets of U.S. or EU standards, which would harmonize Egyptian standards with one or another of the world standards.[7] First, all the technologies to achieve such standards are available, and thus such a mandate would be technology-forcing only in the sense of forced utilization rather than forced advancement of the state of the art. Second, for some standards the technologies have been in use long enough that costs have been reduced to acceptable levels, and integration of the technologies for emission control into total vehicle design has made possible the concurrent improvement of other amenities such as fuel economy. Third, the elimination of gasoline lead additives, which is the predicate for use of catalyst-equipped vehicles, has already been accomplished in many urban centers in Egypt. Elimination of the remaining leaded gasoline would remove the last technical obstacle to tightening the Egyptian mobile source standards. It would also allow the introduction of more sophisticated vehicle technologies generally.

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[7] According to David Fratt, Home Office Project Officer at Chemonics International, contractor to USAID for the Cairo Air Improvement Project, the Egyptian vehicle emissions standard from the Executive Regulations of Law 4/1994 is the standard that is used as the pass/fail test for in-use vehicles. As such, it has a large impact on the ultimate success of the in-use vehicle testing program. Fratt expressed concern that tightening the regulations would cause many cars to fail their inspections. Since the median age of the cars in Cairo is around 18–20 years old (and possibly older in other areas of Egypt), and even recent vintage cars don't show better emissions because they don't have emission control systems on them, we don't see the decline in emissions that occurs elsewhere with turnover of the fleet. For social acceptability, the rate of failure of in-use testing is around 20 percent in Egypt; the fail rate is higher than that now. Currently Egypt is not testing the general public's cars, but only testing captive fleets. These circumstances suggest that in the future there must be a separate test for in-use vehicles, apart from the standard to which vehicles are certified. In addition, waiver provisions are appropriate.

2.4.2 Fuel Standards

Comparison of the world fuel standards is much easier than a comparison of the vehicle emission standards. Fuel standards are product quality standards, directing refiners to produce fuels having certain characteristics that affect emissions. Table 5 compares Egyptian standards with those in place in the U.S. and EU.

Table 5. Comparison of Fuel Standards for Gasoline-fueled Passenger Cars

Fuel Requirement	Egypt	U.S.	EU
Unleaded Availability	yes	yes	yes
Prohibition on Leaded	yes	yes	yes
Volatility Controls	—	yes	—
Reformulated Gasoline	—	yes	—
Oxygenated Fuel	—	yes	—

Since 1973, the U.S. has had controls on gasoline quality, both to protect catalytic converters installed to reduce emissions and to reduce the lead itself. In the 1990 Amendments to the Clean Air Act, Congress banned leaded gasoline effective January 1, 1996, required the use of reformulated gasoline in certain ozone non-attainment areas beginning 1995, and required the use of oxygenated fuels in certain CO non-attainment areas. In 2000, the U.S. EPA mandated significant reductions in the sulfur content of fuel, both to reduce sulfur emissions and to allow the tier 2 emission control devices to function as designed.

The EU’s standards for gasoline quality trailed the U.S. by many years. The EU rules that existed did not consolidate into specific requirements until 1989, when a mandate to supply unleaded gasoline was first implemented. Recent actions have moved the EU toward the use of all unleaded gasoline. However, there is no indication that further controls on fuel quality, such as volatility controls, reformulated gasoline, or oxygenates have been required.

In gasoline quality controls Egypt does not lag as far behind as it does in vehicle emission controls. Unleaded is widely available in Egypt, though leaded gasoline is still used universally in upper Egypt and some locations in lower Egypt outside main urban areas. Leaded gasoline should be completely eliminated so that programs on mobile source emission control can introduce vehicles that use catalytic converters to reduce tailpipe emissions. However, because changes in fuel quality can reduce emissions immediately, while requirement of vehicle emission controls on new cars relies on vehicle turnover and can take many years to have an impact, changes in fuel quality are an expedient way to achieve mobile source emission reductions. Two advancements in fuel quality seem worthy of further investigation.

First, given the consistent warm temperatures in Egypt, the absence of onboard vehicle evaporative controls, and the persistence of ozone in urban areas, it seems appropriate to consider volatility controls for fuel sold in urban areas. While many engineering and economic considerations would govern the decision to develop such a program, the potential benefits could be large and rapid.

Second, given the development of new natural gas production in Egypt it also seems appropriate to further expand the use of this alternative as a motor fuel. Natural gas consists principally of methane, which does not contribute to ozone formation. It is for this reason that HC is no longer measured in the U.S. as part of HC emissions as a pollutant — the indicator pollutant has been changed to non-methane hydrocarbons (NMHC). While the use of gas would require some changes in vehicles (by contrast with the usual relationship, in which the vehicle imposes requirements on the fuel), the costs of such changes are more than recovered in lower fuel costs.[8] At very little cost, tailpipe emissions could be reduced. This option should be examined as part of any reconsideration of vehicle emission programs.

2.5 General Comments on the Standards

The foregoing discussion focuses on the specifics of the comparative analysis. Next, the discussion turns to considerations pertaining to the standards generally.

2.5.1 Relationship of Emission and Ambient Standards

The development process for air quality regulation in the U.S., which is reviewed in Appendix B.1, provides concrete lessons for diagnosing problems in the Egyptian system. By enabling an observer to look at not only what is there but also at what is not, the account of the U.S. experience provides specific signals about what is missing from the Egyptian program.

EEAA staff who were interviewed complain that there are deficiencies in the Egyptian system that limit its effectiveness. One often-heard complaint was that it will be generally difficult to enforce more stringent emission standards, as owners of emission sources often don't see the justification for costs they will be forced to bear. This reflects deeper problems in the structure of the law. Underlying this perception is the absence of a clear justification for the standards. Why are they set at this level and not some other? Is there any reason why they could not be waived in this specific case, given the burden placed upon an individual business? Why now? The answers are not easily forthcoming from the Egyptian system, for something fundamental is lacking. One turns to the U.S. example to identify what is not there.

The U.S. experience shows that the use of emission standards by themselves is inadequate to address modern environmental problems. The success of the U.S. air quality control program has resulted from the recognition that the primary goal of a program has to be the protection of human health, and that therefore a health-based ambient standard, which measures the quality of the air individuals breathe, must be the anchor of the program. Without an ambient level to act as a reference point, all the emission standards would have remained arbitrary, and there would have been no rationale to justify significant commitments to emission control. While the regulatory mechanisms used to achieve emission reductions should be selected on a pragmatic basis, and can vary considerably within the cultural and legal context, the ambient standard is tied to human health and is universal and completely transferable to any context.

Of course, the use of ambient targets to set emission standards depends upon being able to determine quantitative relationships between emissions and ambient concentrations. If one starts with a desired ambient level, the methods require working backward from effect to cause to determine the level of emission reductions that would be necessary to achieve the ambient standards. The development of such methodologies was a major scientific breakthrough of the 1960s.

Using this analysis only to determine if the existing emission standards in Egypt were quantitatively comparable to world norms would fall short. Such an inquiry would miss the point that for a program of air quality controls to be sustainable the process has to have a core rationale and methodologies implemented to achieve it.

Analysis of the Egyptian standards makes clear that one of the principal deficiencies in the system is the lack of a working linkage between the ambient standards and the emission standards. The adoption

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[8] According to David Fratt, many taxicabs have converted to run on compressed natural gas (CNG) in the past 3 years. There are now approximately 20,000 CNG-fueled taxis running in Cairo. Natural gas prices are low, and after paying the installment loan on the taxi's conversion cost, the owners are saving substantial amounts of money.

of ambient and emission standards meets international expectations that it have standards in place, but even if the standards themselves meet the world norms, the absence of linkage between the ambient and emission standards makes their enforcement very difficult.

This expresses itself in tangible ways. It has been observed that the new industrial areas do not achieve the ambient standard even if the emission standards are met.[9] It would appear that the concept of setting emission standards at levels necessary to achieve ambient standards is not being carried out in practice. But is the reason that the emission standards are not stringent enough, or that facilities that claim to comply with the emission standards are not in fact complying? Both arguments were expressed in interviews. Moreover, the law is not clear on what EEAA officials should do when they find ambient standards violated but emissions from facilities within their standards. Such issues will have to be clarified for a successful program to be carried out.

In order for the Egyptian system to function effectively and provide a rationale to motivate compliance it is necessary to link the ambient standards and emission standards logically and methodologically. Given the goal of this task to recommended a process for reconsidering and replacing the Egyptian standards, it is appropriate to identify the framework within which such standards should be considered. Any process that is designed for revision of the air quality standards should use as its starting points two central premises:

- Ambient standards should be set at levels that achieve protection of human health primarily, as well as the environment.
- Emission standards should be set at levels that bring ambient pollutant concentrations within the ambient standards.

The process—being able to justify the standards as they are—is a critical feature of the final product.

In sum, an essential mission of the new process will be to establish a methodologically valid relationship between the ambient and emission standards. In modern air quality regulation there has to be an inherent link, and the Egyptian process has to be designed to reflect it. This calls for a program with a more scientific approach to link the emission standards with the ambient standards.

2.5.2 Guidance for Formulating New Standards: Targets and Timetables

Defining air pollution as a problem raises the question of remedy. To translate air quality goals into actual improvement, the remedy has to take form of a set of defined responsibilities for emission sources. In the absence of a linkage between ambient levels and emissions, no one is responsible for the ambient air, since no causal connection between emissions and their consequences would be recognized. Once the policy has been clarified to establish functional roles for ambient and emission standards, emissions from one source can be formally considered to be causally related to pollutant levels in the ambient air, and then emission standards can be assigned as legal responsibilities.

The question thus turns to the process and the substance of determining the levels and deadlines for standards. The choice of these critical elements should not be made on an arbitrary basis; it should be pursuant to a consistent policy that has been determined in advance and cleared through a consensus process. A number of considerations were raised in interviews that would affect the design of the system.

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[9] According to Yasser Sherif, General Manager, Environics, interviewed May 2000.

Geographical Distinctions

Eng. Dahlia Lotayeff, Planning Director, Follow-up and Technical Cooperation Department, EEAA, questioned whether the standards should be the same for facilities in the center of Cairo as for in the desert of Aswan. That is, should there be some sort of system that applies different standards for different areas? She suggested that the differences could be the basis for a permitting system.

Experience provides guidance on the potential pitfalls of geographic distinctions. For example, an early version of air quality control in the U.S. enacted in 1967 under the Clean Air Act mandated a system for setting emission standards based on the relationships of emission sources and downwind receptors. The concept was that emission standards from individual sources would be linked to specific receptors.[10] While such a system is logically and economically appealing because it tailors emission reductions to specific needs, it requires too much information. For such a mechanism to be workable, one has to have an amount of information that is much too large and much too costly for a workable administrative system. Lacking information to run such a system, the U.S. Congress turned, 3 years later, to a simpler system of nationwide ambient standards as a compromise. The nationwide approach was based on the conclusion that human health effects are universal and do not correspond significantly to geographic location. The approach for ambient standards in the U.S. adopted under the 1970 Act does not rely on a source-receptor relationship; sources are contemplated only in the physical placement of monitoring devices, and receptors are disregarded completely. While the ambient standards are the same nationwide, local authorities can make the necessary emission reductions in any appropriate way that achieves the standards. This has resulted in a kind of national zoning in which areas that are "in attainment" of the ambient standards operate with very different procedures from those that are not.

Like the approach under the 1967 Clean Air Act, the suggestion of differential standards for Egypt has the appeal of tailoring emission standards to the requirements of different regions. But given the success of the simple approach adopted in the U.S., what are the arguments for differential ambient standards in Egypt? Does Egypt present circumstances that warrant a different mechanism?

The main advantage, which is implied in the arguments made for differential standards, is that differential ambient standards would allow less stringent emission standards for industrial zones or areas that are not inhabited, while populated areas such as cities would have more stringent standards. By not insisting on a single, universal ambient standard, it becomes possible to adopt more stringent standards for the populated areas. If enforced, this would provide an incentive for polluting industries to move from populated areas to industrial or unpopulated areas.

There are many downsides to this design. (1) The argument seems to suggest that industries located in areas that are not meeting ambient standards should not be forced to make additional emission reductions; instead, the ambient standards should be made less stringent so that additional emission reductions by industries will not be necessary. It is a way of conforming the standards to existing emissions. (2) By setting up classifications of air quality the GOE would acquiesce to allowing some individuals to be exposed to harmful levels of air pollution within these zones on a permanent basis. The U.S. and other air quality control systems are organized to provide the means to meet the ambient goals: whatever levels are adopted, air quality that is not completely safe for humans is intended to be eliminated. (3) It takes away incentives for industries to modernize. The current standards are not too stringent, since they are all being met by new technologies that are available internationally. Meeting the standards is now simply a matter of economics and resolve, and many industries may be at the point

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[10] The approach adopted by the 1967 Act has resurfaced in recent years under the Long-range Transport of Air Pollutants (LRTAP) treaty, in which it is called an "effects-based" approach. While it is very attractive as a means of tailoring emission controls to specific critical loads at which environmental damage is thought to begin, it relies on an information-intensive mechanism that has failed in the past. Will it be possible to develop such a mechanism now, given much-improved information? It is difficult to know. Certainly, the kind of information needed to run such a system is not available in Egypt.

where their equipment needs to be replaced anyway. (4) Moreover, if less stringent emission standards are the goal, it might not work as planned. For example, if such a program results in transferring all the lead smelters into one area, this would have the cumulative effect of concentrating their emissions in one place. Then reliance on existing emission standards would not be sufficient to meet even a less stringent ambient standard and a hot spot of concentrated pollution would result.

Given these downsides, a zoning of the country into categories of air quality is not a desirable program design on a permanent basis, though it is worth considering as an interim strategy. One proviso is necessary in the event such are adopted: the ambient target levels that meet health criteria should be separated from the ambient standards, so that if standards for some classes of locations are adopted that do not achieve the ambient targets it will be clear that these are areas that will not meet health targets.

Basis for Emission Standards

One can observe from the appendices that traditionally two classes of emission standards have been applied:

Performance standards are applied when a target rate or mass of emissions is desired, but the means of achieving those levels are not specified in rules. Tailpipe standards for new vehicles have traditionally been in the form of performance standards. The current emission standards in Egypt are all performance standards.

Technology standards are applied when the rules specify a technology to be used. Despite their name, the new source performance standards in the U.S. have operated as technology standards, in that once a technology has been adopted as the best available technology, its specifications become the *de facto* standard.

In the U.S. both kinds of standards are applied, since both have a functional role. First, to meet the ambient standards, performance standards are applied to individual sources. In addition, because the most economical time to make emission reductions is when new sources are being built or major modifications are being made to existing sources, the technology-based standards are applied in these situations, regardless of the ambient air quality into which they will emit. The application of technology standards to new sources is also important for equitable reasons: allowing new sources to avoid the burden of installing best available technology while requiring existing sources to purchase new equipment to reduce emissions would be seen as unfair. In the long run, it has been expected that the regular turnover of equipment would provide an automatic upgrade of emission control equipment over time that would offset the expansion in the economy, though some have taken advantage of loopholes to avoid such upgrades.

Unlike the ambient standards, which are universal, there is no single best formula for determining which among the types of standards will be the most suitable for a program. As a general rule, if one expects to make progress, a guiding principle would be to mandate the more stringent of either the best available technology standard or standards necessary to attain the ambient standards, though that is merely a rule of thumb. More important is to provide a process with a list of alternatives on how to decide that question. We can list criteria.

Form of Performance Standards

For performance standards that are adopted there are two forms that the standards can take:

Rate standards. Rate standards are those in which compliance is measured in terms of concentration per volume or unit of output. This was the form many standards took initially in the U.S. It did not impede economic growth because it allowed emissions at a fixed rate. If a firm doubled the size of a plant the rate of emissions remained the same. Environmental groups began to criticize rate standards because they allowed total emissions to increase with economic growth, so that, over time, standards would have to be rewritten repeatedly so that a lower rate could be applied to compensate for higher volume. In addition, because such standards are measured by concentration they are easy for industry to comply with, since the actual concentration can be diluted with additional air until the standard is met.

Mass emission standards. Mass emissions are those in which compliance is measured in terms of total mass over a period. This approach enables one to measure the total environmental loadings; if the rate of production of a plant increases, the plant must find a way to reduce the emissions per unit of production. By measuring load rather than flow you can overcome the dilution problem. This approach was suggested for Egypt by Nader Shehata Doas.

Of the two approaches, the mass emission approach is more stable over the long term. Setting standards for the total amount of pollutant, rather than the rate of emissions per volume or unit, avoids the necessity of going through successive changes of standards as economic growth increases production with concomitant increases of emissions. An ideal approach that provides flexibility to industry is to set performance standards on a mass/year basis with limits on short-term peaks to assure that acute exposures do not reach hazardous levels. If standards are desired for new sources, a supplementary requirement can mandate that they meet emission levels equivalent to those that would be met if the project were financed through one of the world financial bodies such as the International Finance Corporation (IFC), African Development Bank (AfDB), etc. The principal financial organizations that impact world air quality standards are identified, but not analyzed in any depth, in Appendix D.

In Egypt, Article 10 of the Executive Regulations of Law 4/1994, which applies to numerous facilities listed in Annex 2, requires an Environmental Impact Assessment (EIA).[11] If it works according to design this process would prevent the expansion of industry from increasing total load. This should be taken into account when considering the form of the standards.

Deadlines

Under Article 1 of President Hosni Mubarak's order promulgating Law 4/1994, a final date for compliance with Law 4 was February 2000. This date was fixed by the date of issuance of the Executive Regulations (1995), plus 3 years grace period, plus 2 years of extension, which yields the date February 2000.

2.5.3 Air Quality and Public Opinion

Another reason to examine the general background for designing a new system of standard-setting is the general perception of air quality in Egypt.

The U.S. experience, as reviewed Appendix B.1, shows that public opinion is a significant driver in the development of air quality regulation. In the U.S., an air quality emergency in Donora, Pennsylvania in 1948 and news of a similar emergency in London, England in 1952 provided alarming examples that human health could be harmed by the accumulation of pollutants in the ambient air. Drawing from these examples, individuals began to recognize that they were being exposed to pollutants from sources over which they had no control and considered it an inequity that could not be corrected through voluntary market transactions. They turned to legislation to mandate relief.

While a scientific examination of public opinion was not made as part of this analysis, interviews, discussions of recent events, and observations suggest that public opinion in Egypt currently is in an ambiguous and transitional state.

[11] See Egyptian Environmental Affairs Agency, Environmental Management Sector, *Guidelines for Egyptian Environmental Impact Assessment*, Oct. 1996.

On the one hand, there is the background of traditional views. In the long course of Egyptian history the experience has been, as it was in the U.S., that air pollution just blows away. The annual dust storms, while not welcome, created an expectation that air quality problems are naturally caused and temporary. Accustomed as Egyptians are to seeing dust, they have been traditionally conditioned to look at poor ambient air quality without thinking of it as air pollution.[12] It is not clear how well understood is the relationship of air quality to human health. One can observe a certain degree of acceptance of existing air quality as if conditions are not polluted. With the exception of removing lead from gasoline, there does not seem to be a strong perception that the pollution is medically harmful and has a cost. That is, in a city that has significant public health problems resulting from poor air quality, air pollution is discussed as if it were a hypothetical problem.

On the other hand, consciousness of air pollution as a man-made and unnatural phenomenon may be growing now. In the fall of 1999 an inversion, which has come to be known as "the black cloud," raised public awareness about air pollution. Although an inversion had occurred the previous year, this was the first time the public became politically sensitive to it.[13] It was clear that the phenomenon was anthropogenic, and a concerned public turned to the government for explanations. Surveys of public opinion now report high recognition of air pollution as an issue, and especially of mobile sources as a cause of the pollution problem.[14] While actual ambient pollutant concentrations during the black cloud are subject to debate, it is clear that as a matter of perception the event is analogous to the Donora incident in the U.S. and the London smog.[15] The experience has raised public concern that may cause decision-makers to reevaluate their views of the importance of air pollution control. This could result in elevating consideration of ambient air quality in policy decision making, such that control of emissions to improve ambient air quality becomes an active program.

The final measure of public opinion may depend to a large extent on the availability of air quality data, either that collected from ambient monitoring or that estimated by the USEPA in its evaluation of the black cloud incident. If data are made available to the public that show high ambient concentrations, the demand for air pollution control in Egypt would increase markedly. On the other hand, if such data are not made available, the public would never know and would not be in the position to demand a remedy for the public health risk to which they are exposed.

The reason to consider these possibilities is that in the current state of flux one has to assess the degree of public approval for air quality programs. The program suggested in this task will to some extent shake up the status quo. In general principle, any program that has cost or involves perceived sacrifice—and certainly air quality control meets those two criteria—can only go as far as public opinion will allow. Is there the political will to implement a $PM_{2.5}$ standard? Could emission standards be enforced without being undermined by resistant industries? These outcomes depend upon the degree of concern expressed by the public. If a genuine review of the air quality standards and the implementation of a review process are to take place and be fully implemented, then there will have to be a considerable increase in commitment from both the GOE and industry. For air quality programs to have a tangible impact it is essential that they also attain a higher degree of acceptance among the professional and scientific communities.

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[12] I am given the impression that many in Egypt accept air quality as it is in the belief that the current conditions are not polluted. It appears stationary sources know that they are emitters, but they don't think of themselves as polluters. With the exception of gasoline lead, which was eliminated very quickly, no one in Egypt seems very motivated by the idea that the pollution is medically harmful and has a cost. Without an explicit expression of the connection between emissions and ambient concentrations, they don't make that connection themselves.

[13] According to Lee Pasarew, Director, Middle East Programs, Office of International Activity, U.S. EPA.

[14] Interview with David Fratt.

[15] According to Dr. Nasralla, the ambient pollutant concentrations in Cairo were much less than in either Donora or London, and not much above Egyptian standards.

Thus, public opinion is important to the success of the program, and the consensus-building processes that are planned for subsequent stages of this process will be important as means of developing legitimacy for the processes that are envisioned.

2.6 Process: The Need for Regular Review and Revision of Standards

As indicated in Appendix B, the prevailing notions about air quality standards have changed over time, and one can expect that in the future with the growth of information they will change again. Until world standards converge around a single set of precise norms—which will occur only when long-term exposure/dose relationships have been completely studied—new information will continue to change our perceptions of the ambient hazard.

In the past, the addition of new information has generally caused standards to be made more stringent, as correlations of exposure levels to human health damage have been found at lower and lower levels. This will not necessarily be the rule in the future. As information becomes more precise, uncertainty factors will be reduced, allowing reductions in the margins of safety that now exist to cover uncertainty. Such will offset increases in stringency, potentially even causing the standards to become less stringent. Thus, one should think of the process as yielding more refined and targeted standards, not standards that necessarily become increasingly difficult to achieve.

Currently, the ambient air quality standards used in Egypt suffer from numerous deficiencies, some of them obvious. It is apparent from the review conducted here that enforcement of the standards as presently written could result in a less-than-perfect targeting of scarce air pollution control resources. Recognition of this problem calls upon Egypt to review its ambient standards to make them current with world standards, and to revisit them on a regular basis to stay current as additional changes in world standards are made.

A system of periodic review of the standards was advocated by EEAA's Eng. Dahlia Lotayef as part of a new system of science-based environmental targets. Precedents established in other countries suggest how this may be accomplished. In the U.S., for example, the ambient standards are required to be reviewed as a matter of routine every 5 years and may be reviewed more often as new information appears. This requirement has been less than rigorously applied in practice, resulting in a routine review of each standard every 5 to 10 years, approximately. While a routine review more often than once every 5 years is undoubtedly a greater burden than Egypt will want to shoulder, a review cycle of longer than once every 10 years is probably too great, given the rapid increase of information. In just the last 10 years there has been a total revolution in the understanding of PM's health effects. Thus, a review cycle of 5–10 years, inclusive, would be a reasonable approach in Egypt.

Eng. Dahlia Lotayef was the strongest advocate for a system of periodic review of the standards. She conceptualized it as part of an integrated strategy for air quality control in which decisions are made on a scientific basis, rather than as reaction to pressures. Programmatic goals would be translated into a strategic plan of action, then there would be a feedback system using indicators that measure the parameters used in the regulations. In other words, periodic review would function as part of a whole air quality management system.

3. Observations on Administration of the Air Pollution Program

In addition to comparing the current emission standards, a second phase of the analysis involves examining the administrative system in which the standards are implemented to make them tractable. Thus, the next task of this task will be addressed to correcting deficiencies in the existing administrative and legal framework.

3.1 Administration of the Air Pollution Law

Interviewees identified several problems in the administration of the law or proposed administrative mechanisms that should be considered.

3.1.1 Procedures

EEAA officials consistently mentioned the need for clearer procedures and more authority for enforcement. Interviewees expressed deep conviction that one of the most pressing items is removing the constraints and limitations they confront in doing their jobs.

For example, as discussed above, Article 34 of Law 4/1994, which requires compliance with the ambient standards, is potentially unenforceable if read literally. No administrative mechanism is specified for enforcement and there is no legal tool to apply in cases of noncompliance. The program works if a company volunteers to comply, but if it doesn’t meet the standard no process for addressing that is stated. According to Dr. Ahmed Hamza, the Executive Regulations don’t specify the frequency of sampling or the statistical significance of violation. The Regulations don’t tell when they should start legal action. Other examples include the absence of protocols for testing the emissions of sources, the difficulty in applying the standards to the various emission sources, the lack of definition in inspection procedures, clarity in the administrative decision structure, and training in specific inspection procedures and use of sampling equipment.

To have an enforcement program, the law must specify how to distribute the burden. A goal of an overall administrative review will be to clarify responsibilities. According to Ahmed Ismael, consultant for environmental inspection, EEAA, their work depends on regional branches. The efforts of the branches are not sufficiently coordinated, resulting in duplication. Sometimes they cooperate, sometimes not.

Article 5 of Law 4 describes the functions of EEAA: to develop strategy, action plans, standards, and to operationalize those plans. A summary of relevant powers belonging to EEAA appears in Appendix A. The powers granted under the law are broad. In general principle it appears to be possible to achieve all the administrative changes, including issuance of new regulations, without statutory change. The regulations should be reviewed as a legal document to provide definitions and make sure all the essential elements are present.

3.1.2 Staff and Resources

A frequent complaint was that the programs are understaffed and the staff lack resources for the job.

According to Nader Shehata Doas, the staff assigned to monitor air emissions is too small; he has three people, and while they are well trained, he needs at least two more. He complained he does not have enough equipment or spare parts, and often lacks the cars to get people to their work. Due to these limitations, inspections are not made by routine; they take measurements only when there is a complaint against a facility. Dr. Ahmed Hamza says he lacks personnel, instruments, and political commitment to enforce against a violation. He notes that in Annex 8 there are more than 300 limits for indoor concentration of chemicals; he complains his staff cannot measure more than two or three of these. As a result, that rule is useless and has no meaning.

Any program that is developed to provide a more scientific, quantitative approach will have to rely on the resources needed to run such a program. At present, that is a clear deficiency.

3.1.3 Proposal for a Permit System

Esko Meloni, Senior Advisor to the FINIDA-funded Egyptian Pollution Abatement Project (EPAP), is a strong advocate for establishment of a system of emission permits to implement the ambient standards. In 1999 he delivered a conference paper that recounted the success of Finish authorities in use of a permitting system to reduce emissions from the pulp and paper industry there.[16] In Finland permits are granted for 7 years, and at the end of that period they negotiate a plan to go on when the permit is renewed. In the future the permit system will come under new EU legislation that integrates water and air permits.

The system he advocates is to have quantitative standards implemented by an operating permit system that states the amount of emissions from a specific facility. Such a permit system would consolidate all emission requirements for a facility into one document, so that distinctions such as type of equipment or geographical distinctions are clarified. The question is whether industry in Egypt is ready for that. While a permit system works well in an advanced environmental culture, especially one in which reliable data are the norm and expertise is generally available, it may be difficult to get industries to agree to such a system in Egypt. Another problem is that a permitting system is appropriate for major industries but does not cover emissions from sources such as trash burning, which are a large contributor to particulate emissions in Cairo. The better argument is that a permit system in Egypt should wait until a better air quality system as a whole has been adopted.

3.2 Development of Sound Methodologies

Following closely from the previous discussion, a second complaint heard in interviews was that the methodologies for air pollution control are not on a sound technical basis.

3.2.1 Basis for the Standards

Interviewees consistently voiced recognition that the current standards do not have a solid scientific or medical basis and that what would make them meaningful would be to put them on a sound basis. As a matter of process, clearly there should be more science in the regulations and more planning in the policy.

Eng. Dahlia Lotayef emphasized that targets should be on a scientific basis to achieve air quality, and that these should be translated into a plan of action, standards, and a prioritized strategy. She suggested that it would be appropriate to have a standing group to adopt the standards. She argued that Article 5 under Law 4 provides authority, although there needs to be appropriate linkage. Dr. Ahmed Hamza also suggested a standing technical committee to review and put a long-term plan in place, based on scientific considerations and representing various communities that should work together.

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[16] Esko Meloni, *Development of Water Pollution Control in the Finnish Pulp and Paper Industry—A Case Study: Are There Lessons to Be Learned?*

Quantitative methods are essential to standard setting and standard enforcement, and more science could be used to link the emission standards with the ambient standards. Developing rigorous protocols must be part of the revision process. However, there is a risk that more methodologies will erect barriers, and that in consequence progress will be slowed. The requirement of too much information, or information obtained with excessive precision, can become a means of postponing implementation of the standards.

3.2.2 Methods for Testing and Compliance

Interviewees had many complaints about the lack of clear methodologies for ascertaining compliance. In general, they argued that nothing in the regulations indicates how compliance is to be measured or how testing protocols are to be conducted. The regulations lack procedures that set out the parameters for monitoring, the frequency of inspection, or other details.

For example, there were many complaints about implementing Article 42 of the Executive Regulations (regarding combustion emissions). Several deficiencies were identified:

- Article 42(B) prescribes the use of chimneys for combustion sources that have total waste of 7,000 kg/hour or more. However, many emission sources do not have a chimney to take emission measurements from, making it impossible to enforce the emission standards. The problem occurs mostly in small, unregistered factories that do not have adequate technology or facilities.
- The lack of specific testing protocols enables industries to produce compliance by changing the engineering parameters at the time of measurement. Given the fact that inspections are announced in advance, the absence of specific protocols gives companies the chance to prepare stacks for inspections. One way the industries can create compliance is to open stack vents to dilute the emissions to meet the standard.

The program needs to develop specific standardized procedures and sampling methods that have approved quality assurance or quality control practices. Any such program will find it useful to rely on the standard methodologies that have already been adopted and are in use by international financial organizations or the International Standards Organization (ISO). These are available, and their use simplifies the implementation of methodologies. As summarized in Appendix D, the world community is attempting to develop standardized methodologies. These will be critical for success of any standard Egypt adopts.

4. Conclusions and Recommendations

This analysis has great potential to stimulate fundamental change. It provides an uncontroversial mechanism to develop the air quality programs and move them forward. A number of suggestions have been made in this report that could provide a basis for progress. The next step would be to establish a process that rewrites the Executive Regulations to Law 4/1994 and updates them on a regular basis. Two questions remain open: what sort of program will it be, and how fast should it proceed?

4.1 The Cautious Approach

Interviewees typically recommended a cautious approach. Eng. Dahlia Lotayef suggested that developing the system would take time: Each new system of regulation needs some time in the field to be tested. Then any deficiencies or gaps can be seen. Unless there is a system to support regulation it is not possible to know whether the deficiency comes from the regulation or the implementation.

However, from the view of an outsider there is really nothing that is required in Egypt that has not already been worked out elsewhere, and no obstacle that has not already been encountered and overcome. Given the resources and the commitment, the obstacles are actually very few.

As important as it will be to establish a relationship between the emission standards and the ambient standards, the prospect for developing a reliable quantitative relationship of the two program elements is currently a long way off. Such a relationship on a quantitative basis would require obtaining high quality measurement of ambient concentrations, measuring emissions from all the significant categories of sources, and developing an inventory from these measurements of the relative contribution of the various source categories. From that exercise the appropriate emission reductions can be decided for each category of sources and emission standards can be written.

4.2 Practical Steps

One readily sees that delaying action until all these steps are completed would take far too long, and that the benefits of precision would be outweighed by the costs of delay. An interim strategy containing two elements seems appropriate.

First, the relationship of emissions to ambient air quality should be stressed as part of a new approach. As mentioned above, it is crucial that sources recognize that their emissions contribute to pollution, that pollution is a public health problem with economic consequences, and that every increment in emissions is an increment in ambient loadings. The historical example shows that the understanding of the relationship does not have to wait for complete information. While it will not be possible to quantify this relationship immediately, at least an Egyptian monitoring and enforcement program could be organized in this way so that there will be a tie between ambient and emission standards that can be made more quantitative as data becomes available.

Second, attainment of the health-based standards is unrealistic in the near term. Interviewees identified a number of constraints—lack of resources, competition with other priorities, lack of expertise and institutional capabilities, and lack of political will—that make attainment unlikely in any short-term scenario. At the same time, it is not appropriate to go to the other extreme and ignore the health-based ambient standards. There has to be a way of working toward them in a reasonable and appropriate way.

Since most emissions in Egypt are at high to uncontrolled levels, resulting in ambient pollutant levels that cause significant damage to public health, it would be appropriate as an interim step to issue new emission standards without waiting for signals from ambient standards. Given the state of generally uncontrolled sources at present, one can assume that emission reductions in the short term will not result in a condition of wasteful over control. Various technologies and the source categories that use them should be targeted for application of new emission standards without regard to their specific impacts on ambient loadings. That will have to wait until later.

Two approaches for such a program suggest themselves. The first is a schedule of emission reduction targets for industries generally. This approach would apply a percentage reduction to all industries on an annual basis, for example, "reduce SO_2 emissions by 30 percent in 3 years, 50 percent in 5 years, and 70 percent in 7 years." It sounds reasonable and moderate. However, such a program is indifferent to the relative costs of SO_2 reductions to the various industries. More significantly, for many capital-intensive industries a phased approach is anything but reasonable. Emission reduction equipment used to meet the 3-year target might have to be scrapped to meet the 7-year target, long before its useful life is exhausted. Moreover, adding emission controls to old equipment also does not make economic sense. Given the advances that have been made in other programs, there is no technological obstacle in most industries that would require an interim step. The first suggestion is not viable.

A second approach would be to rewrite the emission standards one industry at a time, and at the effective date require that industry to move up to the world norm in a single step. Instead of reducing emissions from all facilities by a specific percent in a given year, this alternative would make large reductions in specific industries in given years. That way, instead of asking a company to reduce emissions in multiple small increments it would be required to reduce emissions by replacing major equipment with new equipment. The efficiencies will offset the cost of emission controls, and they will get better products. Moreover, focusing on one industry at a time would avoid adverse competitive effects on any one firm. It would be a rolling process, moving from one industry to the next as years pass.

The first task would be to look at all the source categories and set up a scoring of various industries in order to prioritize them into a schedule: industries emitting the problem pollutants (PM and its precursors) in the largest amounts; industries with obsolete facilities that would make good targets for renovation; industries that are capital-intensive and high profile. Emissions would fall as the process works through the list, industry by industry. Targeting the resources to move one industry at a time is a much more viable option.

The overriding concern will be the health and life potential of the Egyptian people. This report concludes that it is possible to start making positive steps now.

Appendix A: The Egyptian Air Quality Program

The review begins with an assessment of the existing Egyptian air quality program, including background information and the existing standards.

A.1 Background: Egyptian Environmental Laws

Like most law, the Egyptian environmental law grew out of experience with prior legislation.

A.1.1 Prior Efforts to Address Environmental Issues

Prior to the early 1990s, a variety of laws governed air pollution control in Egypt. This collection of mandates resulted in a widely dispersed approach to environmental programs. Earlier studies found authorities scattered among 17 ministries responsible for 81 laws, 34 Presidential Decrees, 17 Prime Ministerial Decrees, 287 Ministerial Decrees, and 34 international environmental convention protocols. This system was ineffective because of:

- Lack of awareness of the seriousness of environmental pollution by policy makers
- Outdated regulatory requirements (as of 1993, nearly 65 percent of the laws were at least 15 years old)
- Penalties set at rates that are trivial today
- Lack of a system to monitor, sample, and detect pollution
- Statement of standards for pollutants under existing laws as narrative rather than quantitative.[17]

On May 8, 1992, the GOE issued the National Environmental Action Plan (also referred to as the Egyptian Environmental Action Plan) calling for a comprehensive, long-term program to reverse the trend toward deterioration of Egypt's environment. Developed by EEAA with contributions from international experts, the plan was designed along the lines of a World Bank document. It identified several major environmental problems, including salinization of land, pollution of the Nile, and air pollution.

A.1.2 The 1994 Environmental Law

Law 4 of 1994, known as the Environmental Law, superseded many provisions of law that had been adopted before.

EEAA Powers

Under Law 4 of 1994 (Article 5), EEAA is given the powers to:

- Prepare draft laws and treaties
- Prepare studies and formulate a national plan for environmental protection

[17] See Energy Conservation and Environment Project, "Re-design Report," May 13, 1993. Prepared for USAID by Datex, Inc., at IV-7 to IV-9.

- Set criteria and conditions that owners of facilities must meet before establishing their projects and during operation
- Survey national organizations and institutes in preparing plans for environmental programs
- Conduct field follow-up implementing the criteria and conditions and take action against violators
- Set rates and percentages to guarantee that the permitted limits for pollutants are not exceeded
- Gather data on the environmental situation in cooperation with data centers of other authorities and use them in planning
- Set the bases and procedures for evaluating the environmental effect of projects
- Plan for environmental emergencies
- Conduct environmental training
- Conduct a national environmental survey and benefit by its data
- Prepare and publish periodic reports
- Conduct environmental education programs for citizens
- Propose economic mechanisms to encourage activities to prevent pollution
- Implement experimental projects
- Coordinate with the Ministry of International Cooperation
- Participate in preparing the plan to secure the country against leakage of dangerous materials.

A.2 Air Pollution Standards under Law 4/1994

Three kinds of standards are being applied under Law 4 and its Executive Regulations—ambient air quality, stationary source emissions (including hazardous air pollutants), and mobile source emissions.

A.2.1 Health-based Ambient Air Quality Standards

Under Article 34 of the Executive Regulations, “The total amount of pollution emitted by all the establishments in any one area must be within the permissible levels as indicated in Annex (5) of these Executive Regulations.” Annex 5 sets out quantitative values for ambient air quality standards, as set out in table A.1.

It should be noted, however, that Article 34 does not directly require the attainment of the ambient air quality standards set out in Annex 5. By stating that “the total amount of pollution emitted by all the establishments in any one area must be within the permissible levels,” it literally requires that the emissions in an area meet the standards. A requirement that ambient air quality meet the ambient standard would not have been stated in terms of emissions. Probably it can be inferred that what was intended was that the ambient air meet the ambient standard, but as stated it is possibly unenforceable if taken literally.

Table A.1. Law 4/1994 Executive Regulations, Annex No. 5: Maximum Limits of Ambient Air Pollutants

(Standards expressed as _g/m[3] except for CO, which is stated in mg/m[3])

Pollutant	Period of Exposure [a]	Maximum Limit (Ceiling)
SO_2	1 hour	350 μg/m[3]
	24 hours	150 μg/m[3]
	1 year	60 μg/m[3]
CO	1 hour	30 milligrams/m[3]
	8 hours	10 milligrams/m[3]
NO_2	1 hour	400 μg/m[3]
	24 hours	150 μg/m[3]
O_3	1 hour	200 μg/m[3]
	8 hours	120 μg/m[3]
Suspended Particles (measured as black smoke [b])	24 hours	150 μg/m[3]
	1 year	60 μg/m[3]
TSP	24 hours	230 μg/m[3]
	1 year	90 μg/m[3]
Respirable Particles (PM_{10})	24 hours	70 μg/m[3]
Pb	1 year	1 μg/m[3]

Source: Annex 5, Executive Regulations of Law 4/1994, p. 53; footnotes to the table are original to this report.

[a] The averaging time is expressed as "period of exposure." It is assumed that these are calculated in arithmetic mean. The U.S. rule is that for any period other than an annual period, the applicable maximum allowable increase may be exceeded during one such period per year at any one location. It is not specified if such a rule applies in Egypt.

[b] The term "black smoke" as used in Annex No. 5 is not defined therein. However, it is described in the World Bank Handbook, at III-10, where it is stated: "Black Smoke (BS) is a particulate measure that typically includes respirable particles smaller than 4.5 μm in aerodynamic diameter, sampled by the British smokeshade method . . . . Its use is recommended in areas where coal smoke from domestic fires is the dominant component of ambient particulates since this method is based on reflectance from carbon in elemental form . . . . BS is roughly equivalent to PM_{10} . . . . . The BS measure is most widely used in Britain and elsewhere in Europe."

The Executive Regulations also include standards for occupational air quality within the section on air pollution. While these are interesting for comparison, they are not addressed in this report.

A.2.2 Stationary Source Emission Standards

The Executive Regulations prescribe both generally applicable standards and standards applicable to fuel combustion sources.

Generally Applicable Standards

Article 36 of the Executive Regulations requires that stationary sources for which emission standards in Annex No. 6 are applicable meet those standards.

Annex 6 expresses permissible limits of air pollutants in emissions in two separate tables, one for particulates, and the second for other types of emissions. They are set out here in the same format.

Table A.2. Law 4/1994 Executive Regulations, Annex 6, Table 1: Overall Particles
(Expressed in mg/m3 of exhaust, unless otherwise stated)

Pollutant	Industry	Vintage	Maximum Limit (Ceiling) of Emission
Particulate Matter	Carbon industry		50 mg/m^3
	Coke industry		50 mg/m^3
	Phosphates industry		50 mg/m^3
	Casting and extraction of lead, zinc, copper and other non-ferrous metals		100 mg/m^3
	Ferrous industries	existing	200 mg/m^3
		new	100 mg/m^3
	Cement industry	existing	500 mg/m^3
		new	200 mg/m^3
	Synthetic woods and fibers		150 mg/m^3
	Petroleum and oil refining industries		100 mg/m^3
	Other industries		200 mg/m^3

Source: Law 4/1994 Executive Regulations, Annex 6, Table 1; footnotes to the table are original to this report.
Note: No averaging periods are specified in the regulations.

Table A.3. Law 4/1994 Executive Regulations, Annex 6, Table 2: Maximum Limits of Gas and Fume Emissions from Industrial Establishments
(Expressed as mg/m3 unless otherwise stated)

Pollutant	Industry	Vintage	Maximum Limit (Ceiling) of Emission
Aldehydes (measured as formaldehyde)	All		20 mg/m^3
Antimony	All		20 mg/m^3
Carbon Monoxide	All	Existing	500 mg/m^3
		New	250 mg/m^3
Sulfur Dioxide	Burning coke and petroleum	Existing	4000 mg/m^3
		New	2500 mg/m^3
	Non-ferrous industries		3000 mg/m^3
	Sulfuric acid industry and other sources		1500 mg/m^3
$SO_3 + H_2SO_4$	All		150 mg/m^3
Nitric Acid	Nitric acid industry		2000 mg/m^3
Hydrochloric Acid (Hydrogen Chloride)	All		100 mg/m^3
Hydrofluoric Acid (Hydrogen Fluoride)	All		15 mg/m^3
Lead	All		20 mg/m^3
Mercury	All		15 mg/m^3
Arsenic	All		20 mg/m^3
Heavy Elements (total)	All		25 mg/m^3
Silicon Fluoride	All		10 mg/m^3
Fluorine	All		20 mg/m^3

Pollutant	Industry	Vintage	Maximum Limit (Ceiling) of Emission
Tar	Graphic electrodes industry		50 mg/m^3
Cadmium	All		10 mg/m^3
Hydrogen Sulfide	All		10 mg/m^3
Chlorine	All		20 mg/m^3
Carbon	Garbage burning		50 mg/m^3
	Electrodes industry		250 mg/m^3
Organic Compounds	Burning organic liquids	Details unclear	50 mg/m^3 0.04% of crude (oil refining)
Copper	All		20 mg/m^3
Nickel	All		20 mg/m^3
Nitrogen Oxides	Nitric acid industry	Existing	3000 mg/m^3
		New	400 mg/m^3
	Other sources		300 mg/m^3

Source: Law 4/1994, Executive Regulations, Annex 6, Table 2; footnotes to the table are original to this report.

Note: No averaging periods are specified in the regulations. These standards were derived from standards adopted by USEPA, WHO, and ILO; there is no indication of the method used to adopt them. Some details of the standards remain unclear in the unofficially translated version; they should be checked with the official Arabic text.

Standards Applicable to Fuel Combustion Sources

In addition to the general provisions, specific provisions apply to fuel combustion sources under Article 42 of the Executive Regulations:

(A) Precautions to minimize pollutants. Article 42(A) sets out several mandates to use sound engineering practices in combustion, to not burn coal or *mazout* in populated or residential areas, to limit sulfur content in fuel used near residential areas to 1.5 percent, and to dilute CO_2 emissions by use of smokestacks.

(B) Chimney heights. Article 42(B) specifies heights of various classes of chimneys.

(C) *Limits on Emissions.* Article 42(C) specifies emission limits from fuel-burning sources.

Table A.4. Maximum Limits on Emission from Fuel-burning Sources

Pollutant	Maximum Permissible Limit
Smoke	1 Using Ringelmann Card
Dispersed Ashes	1 Ringelmann - sources existing in urban regions, or close to residential areas 2 Ringelmann - sources far from habitation 2 Ringelmann - burning of wastes
SO_2	Existing, 4000 mgms/m^3 New, 2500 mgms/m^3
Aldehydes	Burning of waste, 20 mgms/m^3
CO	Existing, 4000 mgms/m^3 New 2500, mgms/m^3

Source: Law 4/1994 Executive Regulations, Article 42(C).

A.2.3 Mobile Source Emission Standards

Law 4/1994 superseded Law 66/1973, which dealt with traffic and vehicle exhaust regulations. It previously set out vehicle emission standards. As part of its new environmental regulations, Egypt adopted the standards for passenger cars given in table A.5a.

Table A.5a. Egyptian Vehicle Emission Standards

Pollutant	Existing Vehicles	New Vehicles
CO	7% volume at idle speed (600–900 rotations/minute)	4.5% volume at idle speed (600–900 rotations/minute)
HC	1000 ppm at idle speed (600–900 rotations/minute)	900 ppm at idle speed (600–900 rotations/minute)
Smoke	65% darkness (opacity) or equivalent at maximum acceleration	50% darkness (opacity) or equivalent at maximum acceleration

Source: Law 4/1994 Executive Regulations, Article 37.

However, these standards may soon be revised. The following have been proposed as new standards pending implementation of the Euro2 standards in Egypt for new cars:

Table A.5a. Egyptian Vehicle Emission Standards

Pollutant	Private cars, taxis, light trucks	Heavy duty vehicles
CO	1.2% volume at idle speed (600–900 rotations/minute)	2% volume at idle speed (600–900 rotations/minute)
HC	220 ppm at idle speed (600–900 rotations/minute)	400 ppm at idle speed (600–900 rotations/minute)
Smoke	20% darkness (opacity) or equivalent at maximum load for diesel engines	20% darkness (opacity) or equivalent without loading (diesel engines)

Sources: Dr. Samir Mourad; Mahmoud Nasralla.

There are two important features listed in Article 37 regarding the applicability of the vehicle emission standards:

- The standards do not necessarily apply throughout all of Egypt. The rules specify their applicability is to be determined by a decree from the Minister of the Interior that will specify the governorates in which these standards are applicable. The rules then become effective 1 year following that decree.
- The EEAA may reconsider the standards in coordination with the Ministries of Interior, Industry, Health, and Petroleum 3 years after their issuance.

Overall, these provide that for the next 3 years Egypt will have emission control standards that are not technology forcing. In fact, they are described as being at a level that late-1960s control technologies would meet.

Appendix B: U.S. Air Quality Standards

The U.S. has been a leader in establishing air quality standards, policies, and programs. The U.S. program is a well-developed articulation of mechanisms for combating air pollution problems, and represents a set of approaches that must be considered in any comparative study.

The U.S. program is important for a second reason as well. Because many of the world's air quality conventions were first adopted in the U.S., the development of the U.S. program occurred on a blank slate. By contrast, other countries that have adopted the conventions already established do not need to consider the underlying fundamentals to the same extent. Such countries can simply adopt conventional program elements in order to comply with international pollution norms without going through the process of fundamental exploration and discovery that had taken place before. Thus, it is prudent, if one wants to reexamine an air pollution program thoroughly, to look at not only the quantitative standards in the U.S. program but also the policies and decision processes from which those standards were derived, since these provide a window into the complex dimensions of decision-making.

B.1 Development of U.S. Air Quality Regulation

Because of the current structure of Egyptian environmental regulations, it is relevant to examine selected aspects of the development of the U.S. air pollution program.[18] The American experience provides useful comparisons with perceived obstacles to progress in the Egyptian program.

Traditionally, in the Anglo-U.S. legal tradition, common-law rules governed responsibility for air quality. These were principally liability rules for private legal action, supplemented with public nuisance ordinances of local governments. Generally, these were designed to reduce emissions that affected adjacent and downwind individuals. By contrast, no one gave serious thought to establishing standards for the *ambient* air, that is, the unrestricted open air outside buildings. Beyond the immediate proximity to a source, or a plume emitted from it, air pollution was assumed to disperse and not concentrate to levels of any concern.[19]

In the late 19th Century, with the growth of emissions from new combustion sources such as steam engines and electric power plants, especially those using soft coal, the incidence of urban smoke increased to new dimensions.[20] Many municipalities adopted anti-pollution laws to combat the problems.[21] These legal programs recognized the accumulation of emissions into an aggregate that created an ambient pollution phenomenon, and early advocates for such laws even drove their publicity campaigns on health and beauty. But the health considerations they recognized were limited in two ways. First, they were limited to those that concerned sanitary health (cleanliness), rather than toxicological health (disease caused by exposure to harmful or toxic chemicals). Second, while they recognized the unsanitary effects of ordinary smoke, they did not yet recognize the true extent of hazard resulting from exposure to it. To a large extent, they were concerned only with dense smoke,

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[18] This section is derived from Loeb, Alan, "Paradigms Lost: A Case Study Analysis of Models of Corporate Responsibility for the Environment," *Business and Economic History*, Vol. 28, No. 2, Winter 1999, at 95, as revised.

[19] The 19th Century municipal smoke laws did not consider air pollution both toxicological and ambient. They might be considered toxic to receptors that are immediately adjacent to the source or within a plume, but not to unrelated individuals in the open air. Or they might be ambient in the recognition that smoke accumulates, but only as a nuisance in the sense that it is dirty or unhygienic and not chemically toxic. To show that this works I would have to show the absence in those laws of provisions for chemical toxicity in the open air.

[20] Stradling, David, *Smokestacks and Progressives: Environmentalists, Engineers and Air Quality in America, 1881-1951*. Johns Hopkins, Baltimore, 1999.

[21] Loeb, A. P. and T. J. Elliott, "Looking Backward and Forward: A Review of Particulate Emission Control in the U.S.," presented at the meeting of the Fine Particle Society, Chicago, Illinois, August 24, 1995

and it was considered to be mostly a contributing factor in other diseases.[22] Thus, they recognized that in some circumstances smoke could accumulate sufficiently to become ambient, and they recognized that it was unsightly and unhealthful, but they had very limited awareness of pollution toxicology, certainly not enough to drive public demand for controls.

The first modern air pollution controversy in the U.S. was the introduction of lead additive for gasoline in the 1920s. Leaded gasoline introduced the novel scenario that individuals could be harmed, *toxicologically* harmed, by inhaling pollutants in the ambient air. While concerns for lead emissions from vehicles forced the U.S. Surgeon General to consider the possibility of an ambient hazard, the concept was too novel to be readily accepted as real, and in the absence of a concrete finding of imminent harm the concern for ambient hazards was put aside.

The notion that the public health could be harmed in the ambient environment was reawakened a generation later in Donora, Pennsylvania. On October 25, 1948, a temperature inversion settled over the valley, trapping emissions from local industry. Over 6 days the inversion caused approximately 18 deaths out of a total population of 13,839; in addition, 26 percent of the population over age 55 suffered disabling illness. A second episode, an inversion in London in December 1952 that caused 4,000 deaths, reinforced the lesson from Donora that emissions don't just blow away and disperse, they accumulate in the ambient air. These two episodes were a turning point in U.S. public opinion.

By the mid-1960s, the concept of an ambient level had become accepted as a regulatory construct. It was decided that ambient standards should be set at levels deemed necessary to protect the public health, and emissions would be reduced to levels that would achieve the ambient standards. It was not until 1970 that this could be achieved scientifically, but the development of a model for linking emissions to ambient concentrations cleared the way for establishing the regulatory structure that forms the basis for the modern Clean Air Act. Thus, Congress established the Act with the belief that safe air quality levels could be established and that these levels would drive the emission standards with mathematical precision. Since the entire system would be mathematical in nature there was no room for exception.

It would be very easy to overlook the lessons that produced modern air pollution control. Clearly, the modern programs result from the recognition that ambient air pollution presents hazards to the public health, and that emissions must be limited to those that achieve ambient levels that are consistent with public health. This is a fundamental lesson has still not taken firm hold in Egypt but must if progress is to be made.

B.2 Structure of U.S. Air Quality Regulation

The program for control of air pollutants in the U.S. originated in the 1960s under the Clean Air Act and took its modern form in the 1970 Clean Air Act Amendments. It originally consisted of a simple structure based on two fundamental distinctions:

- Regarding *types of sources*, it distinguished stationary sources from mobile sources; and
- Regarding types of pollutants, it distinguished between ambient air pollutants and hazardous air pollutants.[23]

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[22] Stradling, supra, at 51.

[23] The separation of air quality standards into two classes, conventional air pollutants and hazardous air pollutants, derives from the historical experience in the U.S. of distinguishing between pollutants that cause damage from indirect exposure to a pollutant concentration in the open air and those that cause damage from direct exposure to a pollutant concentrated at its source or in a plume of emissions. The distinction is not essential to air pollution control programs—indeed, it is not generally followed in other programs—but simply reflects the American experience in developing air pollution programs. It is worth noting that in making the distinction of the classes categorical, the Act assumed that no pollutant could be both emitted by numerous or diverse sources and highly toxic. Subsequent experience has proved this assumption to be invalid.

Within those fundamental categories further distinctions were made between state and federal responsibilities, between new sources and existing sources, and so on. It is to be noted that the 1970 Act did not create a program for hazardous substances for mobile sources. Since hazardous air pollutants from mobile sources were not contemplated under the 1970 Act, it is shown in table B.1 as an empty cell.

Based on these distinctions, air pollutants covered by the Clean Air Act can be organized into a conceptual matrix, shown in the table. It is obvious from the matrix that the Act is an ambitious attempt to control a variety of air pollution problems with numerous programs.

Table B.1. Conceptual Organization of the Clean Air Act (as amended 1970)

Pollutant Type [a]	Stationary Sources	Mobile Sources
Conventional Pollutants - primary and secondary ambient air pollutants (based on criteria pollutants identified by HEW) -Toxic potency - harmful to human health after prolonged exposure, possible secondary impacts to the environment -Sources - results from numerous or diverse sources whose emissions are widely dispersed; exposure measured in open air	States - attainment of NAAQS left to states, which must adopt State Implementation Plans (SIPs) to show plan for attainment; federal government enforces SIP process Federal - new source performance standards	Strictly federal (states preempted except California) -Auto emission standards (tailpipe and evaporative) and automotive fuels -Aircraft emission standards and fuels
Hazardous Air Pollutants - -Toxic potency - hazardous to human health in small quantities or brief exposure -Sources - relatively few, risk is greatest at point of emission or in path of plume; maximum exposure traditionally measured at the fenceline of emission source	-National emission standards for hazardous air pollutants (NESHAPs)	[none]

[a] Copyright, 1997, A. Loeb.

The structure of the Act has become far more complex over time, mostly due to amendments to the Act in 1977 and 1990. First, regarding types of pollutants, new categories of pollutants were added (i.e., additional sub-categories of conventional pollutants and the category of global pollutants). As a result, the Act now distinguishes three major categories of pollutants: conventional pollutants (including health-based ambient pollutants, acidification, and visibility), hazardous air pollutants, and global air pollutants (stratospheric ozone depletors, and greenhouse gases). Second, programs to control these pollutants were variously added, amended, and replaced, but for the most part greatly expanded. With these changes, the structure of the Act can be described as in table B.2.

Table B.2. Conceptual Organization of the Clean Air Act (as amended 1990)

Pollutant Type [a]	Stationary Sources	Mobile Sources
Conventional Pollutants- primary and secondary pollutants *1- Criteria Pollutants* -Toxic potency - harmful to human health after prolonged exposure, possible secondary impacts to the environment -Sources - results from numerous or	States - attainment of NAAQS left to states, which must adopt SIPs to show plan for attainment; federal government enforces SIP process Federal - -New source performance standards -Prevention of significant deterioration (PSD), added 1977	Principally federal (with exceptions for California and other states under conditions) -Auto emission standards (tailpipe and evaporative) and automotive fuels -Aircraft emission standards and fuels

diverse sources whose emissions are widely dispersed; exposure measured in open air -Includes CO, NO_2, SO_2, Pb, O_3, PM_{10}, and $PM_{2.5}$	deterioration (PSD), added 1977	-Standards for consumer products such as lawn mowers and chain saws
2- Visibility and Other Air Quality-related Values	Prevention of deterioration of air quality in Class I areas	No provisions
3- Acidification- secondary effects of two criteria pollutants	Acid rain program (Title IV) -SO_2- mandated reductions via market-based program -NO_x- technology-based standards	-Parallel provisions for sulfur reduction in fuels under Title II
Hazardous Air Pollutants -Toxic potency - hazardous to human health in small quantities or brief exposure, listed in 112(b)(1) -Sources - relatively few, risk is greatest at point of emission or in path of plume; maximum exposure traditionally measured at the fenceline of emission source	-National emission standards for hazardous air pollutants (NESHAPs) -Maximum achievable conrol technology (MACT) standards for HAPs -Accidental release program for extremely hazardous substances -Special program for municipal solid waste	-Vehicle emission standards - provisions under § 202(l) -Fuels standards - specifications of reformulated gasoline (RFG) designed to reduce toxics
Global Air Pollutants -Impacts - harmful to global resources, the degradation of human health, and the environment -Sources - results from numerous or diverse sources whose emissions are widely dispersed; exposure measured in open air	*1-Stratospheric ozone depletors* - ban on production of ozone depleting substances; restrictions on use of existing supplies *2-Greenhouse gases (GHGs)* - CO_2 and equivalents [by treaty]	

[a] Copyright, 1997, A. Loeb.

This is a highly developed approach, with different programs tailored to fit different pollutants, and its resource requirements are well beyond the means of many other countries. In light of this, this report will only closely examine three types of pollution control programs—ambient air quality standards, stationary source emission control standards, and mobile source emission control standards, which are the same three types of standards found in the Egyptian law.

B.3 Air Quality Standards

As noted above, the Clean Air Act prescribes three categories of air quality standards—for conventional pollutants, hazardous air pollutants, and global pollutants. Three programs that have relevance to Egyptian air quality are examined here.

B.3.1 Health-based Ambient Air Quality Standards

The Clean Air Act prescribes very specific procedures for establishing and attaining the health-based ambient standards.

Process for Establishment and Periodic Review of Ambient Standards

Since 1963, the federal government has been tasked with producing studies of ambient air pollution levels for health effects. Currently these studies, known as "criteria documents," are produced by the research office at EPA. After 1970, in addition to the health-based primary standards, criteria were also set for secondary standards.

Each standard represents three components:

- *Level*–a quantity representing the concentration in parts per million (ppm) in the ambient air.
- Averaging Time–a period of time in which the measurements are taken, set according to the temporal nature of the pollutant hazard, and for which the standard level is the average.[24]
- *Form*–the number of exceedances, traditionally one per averaging period, that will be accepted as compliance with the standard.

EPA is required to reconsider the ambient standards in a 5-year review cycle. The criteria document is reviewed by the Clean Air Science Advisory Committee (CASAC) and others in a public forum and revised if necessary. A Staff Paper is prepared by the EPA Office of Air and Radiation based on the criteria document to determine what are the factors the Administrator should consider in setting the standard. The staff paper is open to CASAC and public comment.

After review there is closure on the Staff Paper, and it is presented to the Administrator with recommendations. The Administrator makes a decision to reaffirm or change the standard and formally proposes that decision. Public hearings are held and a final decision issued, along with the reference method and other implementation rules.

Once the EPA Administrator has issued a standard and reference method, it goes to the states, which have the responsibility for making emission reductions from individual sources to meet the standard. Federal emission control requirements, which apply only in specific circumstances (see below), may also contribute to emission reductions. It is the responsibility of states to make sure that the emission reductions in total are sufficient to attain the ambient standards.

National Ambient Air Quality Standards

The Clean Air Act of 1970 ordered EPA to issue ambient standards for the five pollutants—carbon monoxide (CO), sulfur dioxide (SO_2), hydrocarbons (HC), total suspended particulates (TSP), and photochemical oxidants—for which NAPCA had already written criteria documents. At the time these were issued EPA added one more pollutant, nitrogen dioxide (NO_2), making it six in total. Prior to 1990, EPA dropped HC,[25] added Pb.[26] and changed the indicator pollutants for two pollutants—photochemical oxidants was changed to ozone (O_3), and TSP was changed to particulates with an aerodynamic diameter of 10 microns or less (PM_{10}). After these changes the number of standards remained at six.

In 1997, EPA amended the standards for PM_{10} and ozone, and added a new particulate standard, $PM_{2.5}$, because of evidence that these finer particles cause the most significant health effects. Thus, the current primary and secondary ambient standards consist of seven standards, five gaseous pollutants (CO, O_3, SO_2, Pb, NO_2) and two particulates (PM_{10} and $PM_{2.5}$). These are set out in table B.3.

However, on judicial review of EPA's 1997 action, the Washington D.C. Circuit Court in *American Trucking Assns. v. EPA* (No. 97-1440, opinion issued May 14, 1999), vacated the PM_{10} standard entirely and remanded the $PM_{2.5}$ standard to EPA for reconsideration. On rehearing, issued October 29, 1999, the court reaffirmed its prior PM findings. Thus, the future of the new standards remains

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[24] Different averaging times may be needed for a pollutant because the time pattern of concentrations can be a determining factor in whether the pollutant causes an adverse effect. For example, total dose of a pollutant over a relatively long period may be more important for one adverse effect, whereas dose rate over a relatively short period may be more important for another adverse effect of the same pollutant. In such a case two different averaging times may be needed.

[25] 48 Fed. Reg. 628 (1983). Although HC was dropped as an ambient pollutant, it continued as an auto tailpipe standard because of its role as a precursor to ozone.

[26] 43 Fed.Reg. 46246 (Oct. 5, 1978).

uncertain at this time. While it is expected that EPA will continue to support the existence of standards for O_3, PM_{10} and $PM_{2.5}$, their standard level concentrations or averaging times may be changed somewhat in the near future.

Implementation of Ambient Standards

Under Section 110 of the Act, states are required to adopt State Implementation Plans (SIPs), which are in effect commitments by them to implement controls that will bring ambient air quality levels in the air quality control regions under their jurisdictions within the national ambient air quality standards.[27]

B.3.2 Visibility Standards

A second U.S. program for conventional pollutants that has implications for Egypt is the visibility program. The program for attainment of the health-based ambient standards under the 1970 Act was designed to reduce emissions in areas where they were most concentrated, but it did not explicitly set out a program to deal with already-clean areas. If stringent regulations were applied to polluted areas, that would give industries the incentive to relocate plants to areas that were not already polluted. But that would result only in moving the pollution around, to the detriment of clean areas. To comply with a court order,[28] EPA established a program for prevention of significant deterioration (PSD) in 1974.[29] Congress formally adopted a PSD program in amendments to the Act in 1977, which was to be implemented as a permitting system. As part of these amendments, Congress adopted two programs for visibility regulation.

New sources and major modifications. As part of the PSD program, visibility was identified as an "air quality related value" to be considered in the permitting of new sources and major modifications to existing emission sources.

Existing sources. The Amendments mandated a program to protect visibility in certain areas, affecting even existing pollution sources.

Table B.3. National Ambient Air Quality Standards (as amended 1997)

Pollutant	Primary Standards		Secondary Standards	
	Averaging Time	Standard Level Concentration [a]	Averaging Time	Standard Level Concentration [a]
PM_{10}	Annual Arithmetic Mean [b]	50 µg/m^3	Same as Primary	
	24-hour[b]	150 µg/m^3	Same as Primary	
$PM_{2.5}$	Annual Arithmetic Mean [b]	15 µg/m^3	Same as Primary	
	24-hour[b]	65 µg/m^3	Same as Primary	
SO_2	Annual Arithmetic Mean	(0.03 ppm) 80µg/m^3	3-hour[c]	1300 µg/m^3 (0.50 ppm)

[27] The states were required to provide a schedule in their SIPs for attainment of NAAQS no later than 3 years from date of SIP approval by EPA. If the schedule were strictly kept, that would have been approximately June 1974, although most commentators will say that the requirement was for compliance in 1975. The 1977 Amendments extended the compliance deadlines to December 31, 1982 for NAAQS, but in the case of CO and photochemical oxidants where a state demonstrates that attainment is impossible despite its use of all reasonably available measures the deadline was extended to December 31, 1987. However, further postponements were made. The Steel Industry Compliance Extension Act of 1981 provided an extension of compliance dates for steel companies. In the Clean Air Act Amendments of 1990 Congress established many specific new provisions for attainment programs.

[28] Sierra Club v. Ruckelshaus, 344 F.Supp. 253 (D.D.C. 1972), aff'd per curiam without opinion (D.C. Cir. 1972), aff'd by an equally divided Court without opinion sub nom. Fri v. Sierra Club, 412 U.S. 541 (1973). Visibility, particularly in Western national parks such as the Grand Canyon, was the primary concern of the Sierra Club. R. Melnick, Regulation and the Courts: The Case of the Clean Air Act (Brookings, 1983) 81. See T. Disselhorst, Sierra Club v. Ruckelshaus: "On A Clear Day ...", 4 Ecol. L. Quart. 739 (1975).

[29] 39 Fed.Reg. 42,510 (1974), codified at 40 C.F.R. Part 51.

	24-hour[c]	(0.14 ppm) 365 $\mu g/m^3$	
CO	8-hour[c]	9 ppm (10 mg/m^3)	None
	1-hour[c]	35 ppm (40 mg/m^3)	None
NO_2	Annual Arithmetic Mean	0.053 ppm (100 $\mu g/m^3$)	Same as Primary
O_3	8-hour[d]	0.08 ppm (157 $\mu g/m^3$)	Same as Primary
	1-hour[d]	0.12 ppm (235 $\mu g/m^3$)	Same as Primary
Pb	Maximum Quarterly Average	1.5 $\mu g/m^3$	Same as Primary

Source: U.S. EPA, "National Air Quality and Emission Trends Report," 62 Fed.Reg. 38652-38896 (Jul. 18, 1997).
a Parenthetical value is an approximately equivalent concentration used by EPA.
b TSP was the original indicator pollutant for PM standards. The primary standards were 260 µg/m3 for 24-hour average and 75 µg/m3 for annual average, and the secondary standard was 150 µg/m3 for 24-hour average; the secondary standard was not to be exceeded more than once per year. This standard was replaced with the PM_{10} standard in 1987 (particles less than 10µm in diameter, which are inhalable) as the new indicator pollutant. The TSP standard is no longer in effect. In 1997 EPA added a $PM_{2.5}$ standard because of evidence that those particles cause the most significant health effects. The annual standard for PM10 is attained when the 3-year average annual arithmetic mean concentration is less than or equal to 50 µg/m3; the 24-hour standard is attained when the expected number of days per calendar year above 150 µg/m3 is equal to or less than 1. The annual standard for $PM_{2.5}$ is spatially averaged over designated monitors; for the 24-hour standard the form is the 98th percentile.
c Not to be exceeded more than once per year.
d The 8-hour standard is attained when the 3-year average of the fourth-highest daily maximum 8-hour concentrations is less than or equal to the standard. The 1-hour standard is attained when the maximum hourly average concentration is less than or equal to the standard, with one exceedance allowed per year.

As noted, the visibility standards are implemented principally through the permit process. By contrast, the visibility provisions for existing sources, while important to critical scenic areas, are among the least-enforced provisions of the Act.

B.3.3 Hazardous Air Pollutants

The Act creates a distinct category of national standards for separate treatment.[30] By contrast with the ambient standards, which are measured by their concentration in the open air, the point of exposure to hazardous air pollutants is assumed to be at the fenceline of a plant that contains the source, where the pollutants may be most concentrated. In this way the treatment of hazardous air pollutants reflects the traditional assumptions that (1) pollutants naturally disperse in the open air, and (2) that the cause of damage (and hence the basis for regulation) is the source-receptor relationship.

The hazardous air pollutants are given a distinct approach in their regulatory treatment. Since they are not measured in the ambient air, there is no standard for their concentration in the open air. Instead, they are controlled directly through emission standards. Since these pollutants are much more toxic than the criteria pollutants, and exposure is assumed to be in concentrated form rather than diluted by dispersion, the standards for these pollutants are much more stringent than those for the ambient pollutants.

Regulation of HAPs Before 1990

[30] This section is derived from Loeb, Alan, "Air Toxics Provisions of the Clean Air Act Amendments: Regulatory Issue Analysis," Report to the U.S. Department of Energy, 1992.

Under Section 112 of the 1970 Act, EPA was required to identify and list air toxics, and then apply standards to control them with an adequate margin of safety.[31] These were known as the National Emission Standards for Hazardous Air Pollutants (NESHAPs).

Section 112 established a definition of HAPs and delegated to EPA the task of identifying and listing those pollutants that met the definition. Section 112(a)(1) defined HAPs as those substances that caused air pollution resulting in " . . . an increase in mortality or . . . serious irreversible, or incapacitating reversible, illness." By definition, no HAP could also be a pollutant for which an ambient standard had been established. Over time, EPA developed risk assessment methodologies to identify the substances that met that definition.

The program established under the 1970 Act is generally regarded as a failure. Section 112(b)(1)(B) required that standards for HAPs be set " . . . at the level which . . . provides an ample margin of safety to protect the public health from such hazardous air pollutant." Because of the margin of safety requirement, the only standards that could be set for substances that do not have identifiable health thresholds (i.e., levels below which no health detriments can be detected) was zero. And because the deadlines for issuing controls for a pollutant once EPA listed it were so stringent, EPA simply avoided listing pollutants.

As a result, during the 20 years before the enactment of the 1990 Amendments, EPA listed only eight pollutants. Three of those (asbestos, beryllium, and mercury) were listed within 90 days of enactment of the 1970 Act to comply with its mandate that EPA immediately list HAPs for which it intended to apply standards.[32] The other five were listed sporadically thereafter. The last HAP listed for which emission controls were issued was in 1980. EPA promulgated standards for seven of the eight listed pollutants (see table B.4).[33] At the time of enactment of the Clean Air Act Amendment (CAAA), proceedings to establish standards for the eighth listed HAP, coke oven emissions, were ongoing.

Under the savings provision of the 1990 CAAA, Section 112(q), these standards remain in force.

Table B.4. Hazardous Air Pollutants and Source Categories Established by November 15, 1990

Listed Air Toxics	Citation (date) of Listing [a]	Source Categories Subject to Controls (§ in 40 C.F.R. Part 61)
Asbestos	36 Fed. Reg. 5931 (Mar. 31, 1971)	Asbestos mills (§ 61.142), inactive asbestos mill waste disposal sites and manufacturing and fabricating operations (§ 61.151), active waste disposal sites (§ 61.143), and operations that convert asbestos-containing waste material to asbestos-free material (§ 61.155)
Beryllium	36 Fed. Reg. 5931 (Mar. 31, 1971)	Extraction or processing plants for ore or beryllium compounds, and for machine shops which work with beryllium (§ 61.30), and rocket motor test sites (§ 61.40)
Mercury	36 Fed. Reg. 5931 (Mar. 31, 1971)	Sources which process mercury ore, use mercury chlor-alkali cells to produce chlorine gas and alkali metal hydroxide, and incinerate or dry wastewater treatment plant sludge (§ 61.50)
Vinyl Chloride	40 Fed. Reg. 59532 (Dec. 24, 1975)	Plants that produce ethylene dichloride, vinyl chloride, and/or polymers containing any fraction of polymerized vinyl chloride, but not equipment used in research if the equipment does not have a capacity greater than 50 gallons (§ 61.60); (see also § 61.240)

[31] 42 U.S.C. § 7412.

[32] The Clean Air Act, § 112(b)(1)(A) (1970).

[33] Provisions for air toxics are found generally under 40 C.F.R. Part 61.

Listed Air Toxics	Citation (date) of Listing [a]	Source Categories Subject to Controls (§ in 40 C.F.R. Part 61)
Benzene	42 Fed. Reg. 29332 (June 8, 1977)	Various benzene equipment (fugitive emissions) (§ 61.110), coke by-product recovery plants (§ 61.130), benzene storage vessels (§ 61.270), benzene transfer facilities (§ 61.300), chemical plants, coke by-product plants, petroleum refineries, and hazardous waste treatment, storage and disposal facilities (§ 61.340) (proposed to be stayed, see 56 Fed. Reg. 64217 (Dec. 9, 1991); (see also § 61.240)
Radionuclides	44 Fed. Reg. 7738 (Dec. 27, 1979)	Underground uranium mines (§ 61.20) and uranium mill tailings (§§ 61.250 and 61.220 (partly stayed, see 56 Fed. Reg. 67537)), DOE facilities (§§ 61.90 and 61.190), NRC-licensed facilities and non-DOE federal facilities (§ 61.100), elemental phosphorus plants (§ 61.120) (proposed to be amended, see 56 Fed. Reg. 46252 (Sep. 11, 1991)), and phosphogypsum plants (§ 61.200)
Arsenic	45 Fed. Reg. 37886 (June 5, 1980)	Glass furnaces (§ 61.160), primary copper smelters (§ 61.170), and metallic arsenic and arsenic trioxide plants (§ 61.180)
Coke Oven Emissions	49 Fed. Reg. 36560 (Sep. 18, 1984)	Rulemaking began in EPA Docket No. A-83-33; addressed specifically in CAAA; new proposed rule produced by reg-neg proceedings

Note: In addition to the eight substances listed here, EPA published notice of intent to list an additional 25 substances as air toxics. See 40 C.F.R. § 61.01(b).
a Citation of original listing only; additional citations are found in the relevant C.F.R. subparts.

Regulation of HAPs under the 1990 Amendments

Frustrated with the slow pace of EPA's risk-based listing process, Congress decided to take the listing function away from EPA. In the 1990 Clean Air Act Amendments, Congress replaced the existing program under section 112 with a new program that established a list of pollutants and a rolling regulatory program to set emission limitations for them. Under Section 112(b)(1) (1990), the CAAA established a list of 189 hazardous air pollutants for EPA to control by regulation. Section 112(b)(2) allows EPA to add or delete compounds from the (b)(1) list. EPA granted a petition to de-list the listed substance caprolactam, bringing the list to 188. Given the state of toxicity knowledge, the (b)(1) list represents the legislative judgment that the public should not have to wait for full risk assessments to be done on individual substances, and that erring on the side of over-control is warranted.

Section 112 employs a two-phase control strategy for sources of HAPs. During Phase I, under authority of Section 112(d), technology-based standards are to be set for specific source categories. These must apply the maximum achievable control technology (MACT). Existing sources must meet the standards within 3 years of their issuance. During Phase II, EPA must evaluate the residual risk remaining after the installation of MACT controls and report to Congress, which may determine whether additional controls are necessary.

Section 112 proceeds by a process of rolling issuance of the MACT standards: EPA is required to develop a list of source categories and rank the categories into four priority tiers. EPA will then proceed through the category list category-by-category, in order of priority rank, to set standards for each of the HAPs emitted by each category. Phase II follows this rolling schedule: within 8 years of the promulgation of the original MACT standards (9 years for the first tier regulated), EPA must issue residual risk standards for each of the categories.

The current program for hazardous air pollutants is too complex to list in detail here. With regulations setting emission standards for several hundred source categories covering 188 pollutants, it is far beyond the resources of this task to analyze here. However, the substances listed as NESHAPs prior to 1990 are the same as some of those listed as ambient air pollutants in other programs, making a comparison possible.

B.4 Stationary Source Emission Standards

For regulatory treatment, stationary sources are categorized into new sources and existing sources.

B.4.1 New Sources

The Clean Air Act requires that new sources and major modifications to existing sources install best available technologies. This term refers collectively to the NSPS or the two technology standards under NSR: best available control technology (BACT), and lowest achievable emission rate (LAER). Most new stationary sources are required to meet a BACT, placing much of the burden of improvement on new sources rather than on existing sources to achieve air quality improvements, except where existing sources make major modifications.

While these requirements establish a technology-forcing function upon plant/equipment retirement and renovation, it also grandfathers existing sources into their emission rates—essentially uncontrolled—so long as they do not take the actions that trigger a best available technology review. Thus, as time passes the technologies used and the corresponding emission rates fall into two classes—those that have undergone a best available technology review and those that remain grandfathered. Moreover, with time, as the state of the art advances, the performance of the best technology will improve, so that the difference between emission characteristics of the grandfathered sources and the new sources will grow greater. This could result in very different projections of emissions.

Table B.5. NSPS Issued for Select Source Categories

Source Category	Pollutants and Emission Limitations (Operating Practices, Certification, etc. Omitted)	Implied Control Technologies
Municipal waste combustors (MWCs) with unit capacity > 250 tons/day, constructed before 12/20/89	*PM*: Not to exceed (NTE) 34 milligrams per dry standard cubic meter (0.015 grains per dry standard cubic foot), corrected to 7% oxygen (dry basis) [approx. 97% removal]; 10% opacity standard	
	Dioxin/furan: NTE 30 mg/dry standard cubic meter (12 grains per billion dry standard cubic feet, corrected to 7% oxygen (dry basis)	
	SO_2: NTE 20% of potential emissions rate (i.e., 80% reduction by wt. or vol.), or 30 ppm by vol. corrected to 7% oxygen (dry basis), whichever is less stringent	
	HCl: NTE 180 ppmv, corrected to 7% oxygen (dry basis)	
Sulfuric acid production units	*SO_2*: NTE 2 kg SO_2/metric ton of acid produced (4 lb/ton), production expressed as 100% sulfuric acid	
	Sulfuric acid mist: NOTE 0.075 kg/metric ton of acid produced	
	Opacity: NTE 10%	

Source Category	Pollutants and Emission Limitations (Operating Practices, Certification, etc. Omitted)	Implied Control Technologies
Fossil-fuel fired steam generators (construction begun after 8/17/71)	*PM*: NTE 43 nanogram per joule (ng/J) heat input (0.10/mmBtu); not more than one 6-minute period of > 20% opacity	
	SO_2: -Liquid fuel (or w/wood)- NTE 340 ng/J heat input (.80 lb/mmBtu) -Solid fuel (or w/wood)- 520 ng/J heat input (1.2 lb/mmBtu)	
	No_x: -Gaseous fuel- 86 ng/J heat input (0.20 lb/mmBtu) -Liquid fuel (or w/ wood)- 129 ng/J heat input (0.30 lb/mmBtu) -Solid fuel (or w/wood)- 300 ng/J heat input (0.70 lb/mmBtu) -Lignite fuel (or w/wood)- 260 ng/J heat input (0.60 lb/mmBtu) ->25% lignite fuel (or w/wood) mined in ND, SD or MT and burned in a cyclone fired unit- 340 ng/J heat input (0.80 lb/mmBtu)	
Electric utility steam generating units (construction begun after 9/18/78)	*PM*: -All plants- NTE 13 ng/J heat input (.03 lb/mmBtu) -Liquid fuel- NTE 30% of potential combustion concentration (70% reduction) -Solid fuel- NTE 1% of potential combustion concentration; Not more than one 6-minute period of > 20% opacity	Standard was intended by EPA to be technology-forcing; utilities could only meet the SO_2 standard with FGD (scrubber) systems
	SO_2: -Liquid or gaseous fuel- 340 ng/J heat input (0.80 lb/mmBtu) and 10% of potential combustion concentration, or 100% of potential combustion concentration when emissions < 86 ng/J (0.20 lb/mmBtu heat input); -Solid and solid-derived fuel- 520 ng/J heat input (1.20 lb/mmBtu) and 10% of the potential combustion concentration (90% reduction); when emissions < 260 ng/J (0.60 lb/mmBtu) heat input, facilities may emit 30% of their potential combustion concentration (70% reduction). -Solid solvent refined coal- NTE 520 ng/J heat input (1.20 lb/mmBtu) and 15% of potential concentration	
	NO_x: -Gaseous fuel- from coal: 210 ng/J heat input (0.50 lb/mmBtu); all other fuels: 86 ng/J heat input (0.20 lb/mmBtu) -Liquid fuel- from coal or shale: 210 ng/J heat input (0.50 lb/mmBtu); all others: 130 ng/J heat input (0.30 lb/mmBtu) -Solid fuel- bituminous, anthracite and fuel containing > 25% lignite (w/conditions): 260 ng/J heat input (0.60 lb/mmBtu); subbituminous and coal-derived: 210 ng/J heat input (0.50 lb/mmBtu) ->25% lignite fuel (or w/wood) mined in ND, SD or MT and burned in a slag tap furnace- 340 ng/J heat input (0.80 lb/mmBtu) -Fuel containing >25% coal refuse- no standard	

Source Category	Pollutants and Emission Limitations (Operating Practices, Certification, etc. Omitted)	Implied Control Technologies
Industrial-commercial-institutional steam generating units, applies to units with capacities > 29 MW	*PM*: -Coal- NTE 22 ng/J heat input (.053 lb/mmBtu) -Wood, MSW, mixtures, or oil- NTE 43 ng/J heat input (0.10 lb/mmBtu); Not more than one 6-minute period of > 20% opacity	
	SO_2: NTE 10% of potential SO_2 emission rate (90% emission reduction) or a limitations expressed in the following formula: $E_s = (K_aH_a + K_bH_b)/(H_a + H_b)$, where E_s is the SO_2 emission limit, K_a is 520 ng/J, K_b is 340 ng/J, H_a is the heat input from combustion of coal in J, and H_b is the heat input from combustion of oil in J	
	NO_x: -Natural gas and distillate oil- high heat release rate: 86 ng/J heat input (0.20 lb/mmBtu); low heat release rate: 43 ng/J heat input (0.10 lb/mmBtu) -Residual oil- high heat release rate: 170 ng/J heat input (0.40 lb/mmBtu); low heat release rate: 130 ng/J heat input (0.30 lb/mmBtu) -Coal- mass-feed stoker and coal-derived synthetic fuels: 210 ng/J heat input (0.50 lb/mmBtu); spreader stoker and fluidized bed and lignite: 260 ng/J heat input (0.60 lb/mmBtu); pulverized coal: 300 ng/J heat input (0.70 lb/mmBtu); lignite mined in ND, SD or MT and combusted in slag tap furnace: 340 ng/J heat input (0.80 lb/mmBtu) -Duct burner in combined cycle system- natural gas and distillate: 86 ng/J heat input (0.20 lb/mmBtu); residual: 170 ng/J heat input (0.40 lb/mmBtu)	
Small industrial-commercial-institutional steam generating units, applies to units with capacities from 2.9 MW to 29 MW	*SO_2*: -Oil-fired units- NTE 215ng/J (0.5 lb/mmBtu) -Coal-fired units- NTE 10% of potential SO_2 emissions (90% reduction) or 520 ng/J (1.2 lb./mmBtu) -Coal refuse- NTE 20% of potential SO_2 emissions (80% reduction) or 520 ng/J (1.2 lb./mmBtu) -Emerging technologies- NTE 50% of potential SO_2 emissions (50% reduction) or 260 ng/J (0.6 lb./mmBtu) -Others- 520 ng/J (1.2 lb./mmBtu)	
	PM: for facilities with capacity > 8.7 MW -Coal-fired (< 10% other fuels)- 22 ng/J (0.05 lb/mmBtu) -Coal and other fuels- 43 ng/J (0.10 lb/mmBtu) -Wood or wood and other fuels- for capacity > 8.7 MW, 43 ng/J (0.10 lb/mmBtu); for capacity < 8.7 MW, 130 ng/J (0.30 lb/mmBtu); Not more than one 6-minute period of > 20% opacity	
Nitric acid plants	*NO_2*: NTE 1.5 kg/metric ton of nitric acid produced	
	Opacity: NTE 10%	

Source Category	Pollutants and Emission Limitations (Operating Practices, Certification, etc. Omitted)	Implied Control Technologies
Petroleum refineries	*SO_2:* no refining facility (except when burning to produce sulfur or sulfuric acid) may burn fuel gas containing hydrogen sulfide in excess of 230 mg/dscm except as emergency -FCC unit catalyst regenerators- subject to any of three alternatives: (1) reduce SO_2, averaged over 7 days, or to 50 ppm by volume; (2) SO_2 emissions < 9.8 kg/1000 kg coke burn-off; (3) limit fresh feed to sulfur content of 0.3% by weight, averaged over 7 days. -Claus sulfur recovery plants- NTE 250 ppm by vol. if controlled by oxidation control system or other system followed by incineration; or 300 ppm by vol. of reduced sulfur compounds (hydrogen sulfide, carbonyl sulfide, and carbon disulfide) and 10 ppm hydrogen sulfide if controlled by system not followed by incineration	
	PM: -FCC unit catalyst regenerators- NTE 1.0 kg/1000 kg of coke burnoff; not more than one 6-minute period of > 30% opacity per 24-hour period -FCC emissions that pass through incinerator or waste heat boiler in which auxiliary fuel is burned- NTE 43.0 g/MJ or 0.10 lb/mmBtu.	
	CO: -FCC unit catalyst regenerators- NTE 500 ppm by vol. (dry basis)	
Volatile organic liquid storage vessels (including petroleum liquid storage vessels) (construction, reconstruction or modification commenced after 7/23/84)	*Volatile organic liquids:* -Vessels w/ > 151 m^3 capacity and true vapor pressure > 5.2 kPa but < 76.6 kPa or > 75 m^3 but < 151 m^3 containing VOL with true vapor pressure of 27.6 kPa or more but < 76.6 kPa- must be equipped with any one of the following: (1) fixed roof in combination with internal floating cover equipped with seal between tank wall and edge of the floating roof; (2) external floating roof with double seal system between tank wall and floating roof; (3) closed vent system and a 95% emission control device; any equivalent -Vessels w/ > 75 m^3 containing a VOL w/ true vapor pressure of 76.6 kPa must use 95% percent efficiency control device or equivalent	
Primary copper smelters	*PM:* dryers NTE 50 mg/dscm ro 0.022 grans per stry standard cubic foot	
	SO_2: roasters, smelting furnaces and copper converters NTE 0.065% by vol. (w/ exceptions)	
	Visible emissions: dryers and other facilities using sulfuric acid to comply may not emit gases > 20% capacity	

Source Category	Pollutants and Emission Limitations (Operating Practices, Certification, etc. Omitted)	Implied Control Technologies
Stationary gas turbines	*NO_x:* (1) For electric utility gas turbines with heat input > 107.2 gigajoules/hr (100mmBtu/hr)- NTE 0.0075 (14.4/Y) + F by vol. at 15 % oxygen and on dry basis, where Y = mfr's rated heat rate at mfr's rated load (kj/watt hour) or actual measured heat rate at actual peak load, and where F = NO_x emission allowance for fuel-bound nitrogen (defined by special rules for nitrogen content of fuel); (2) For stationary gas turbines with heat input at peak load $\geq$ 10.7 gigajoules/hr, built after Oct. 3, 1982, and stationary gas turbines with rated base load of 30 MW or less- NTE 0.150 (14.4/Y) + F	
	SO_2: emissions NTE 0.015 % by vol. at 15% oxygen and on dry basis; facilities may not burn any fuel containing sulfur > 0.8 % by wt.	
Bulk gasoline terminals (with throughput of > 75,700 liters/day)	*Total organic compounds:* each loading rack must be equipped with vapor collection system designed to collect TOC vapors displaced from tank truck vapor collection systems during loading; emissions from loading NTE 35 milligrams TOC/liter of gasoline loaded; emissions from unrefurbished vapor processing systems constructed before 12/17/80 NTE 80 mg TOC/liter of gasoline loaded; other equipment specifications.	
New residential wood heaters	*PM:* -Burn rates < 2.82 kg/hr- NTE 3.55 times burn rate + 4.98 g/hr -Burn rates > 2.82 kg/hr- NTE 15 g/hr	
Equipment leaks of VOC from onshore natural gas processing plants	Various equipment standards	
Onshore natural gas processing: SO_2 emissions	*SO_2:* -Facilities w/sulfur feed rates > 5.0 long tons/day (LT/d)- removal efficiency from 90-99.8 % -Facilities w/ sulfur feed rates > 2. LT/d but $\leq$ 5.0 LT/d- initial reductions of 79% and 74% thereafter	
VOC emissions from petroleum refinery wastewater systems	Standards for individual equipment, including individual drains, oil-water separators, closed vent systems, and control devices	

B.4.2 Existing Sources

The philosophy adopted by Congress was that decisions about the control of existing sources was best left to state and local authorities, who had the best information on these and were best equipped to make judgments on how the emission reduction burden should be distributed. In consequence, with very few exceptions, existing sources are regulated by the states. In order to have their SIPs approved, a state must assign standards to the various sources that are not assigned federal standards so that the ambient standards will be attained.

With 50 different state plans setting stationary source standards, it is impossible to set out a general picture of the stationary source emission standards that apply to existing sources in the U.S. Thus, while the institutions are described here, no generalizations are made about the quantitative standards that exist.

B.5 Mobile Source Emission Standards

Polluting emissions from new vehicles have been on a downward trajectory in the U.S. since the mid-1960s. As new emission control technologies were added, it became possible to achieve greater control efficiencies.

B.5.1 Vehicle Emission Standards

Mobile sources typically have shorter useful lives than most stationary sources. This is accelerated by automakers' marketing strategies—or planned obsolescence—that encourage motorists to turn over vehicles before the engineering useful life has been reached. With emission standards tagged to specific model years, Congress could count on the relatively quick replacement of high polluting cars with low polluting cars without having to force a consumer to give up a car he had already purchased or install add-on devices to it. As a result, emission controls for vehicles are all directed to new sources, implemented by a blanket prohibition on sale of new cars that are not certified to the federal standards.

Historical Emission Standards

Because the newest standards in the U.S. may be far ahead of the standards that have been adopted in Egypt, it is appropriate to include first a view of the historical standards in the U.S. It should be noted that in addition to the federal standards that apply in 49 states there are also separate standards for California.

The first national vehicle emission control standards in the U.S. were mandated by Congress in 1965.[34] Federal standards virtually identical to the standards already adopted by California for the 1966 model year were promulgated in 1966, which were applicable to 1968 and subsequent model year vehicles.[35] From this beginning the standards have come steadily down. In 1970, Congress enacted new standards reducing emissions by an additional 90 percent, an amount that was believed necessary to reduce emission levels enough to achieve the ambient standards. These were superseded by new standards, enacted as part of the 1977 Amendments. The standards that were adopted then continued in application until superseded by those under the 1990 Amendments, which took effect in the 1994 model year. They are listed in table B.6.

Standards under the 1990 Amendments

The 1990 Amendments added new provisions establishing lower emission standards. There have been three steps in bringing the standards lower.

Table B.6. Tailpipe Standards for Gasoline-Powered Vehicles, 1977-1993

(Standard expressed as grams per mile [grams per kilometer])

Model Year	HC	CO	NO_x
Pre-1968 (uncontrolled)	15 [9.321]	90 [55.926]	6.2 [3.8527]
1970	4.1 [2.548]	34 [21.128]	—
1972	3.0 [1.864]	28 [17.399]	—

[34] Pub.L. 89-272, 79 Stat. 992 (Oct. 20, 1965). See 1965 USCCAN 3608 et seq. Sections 101-103 of the 1965 Act divided the Act into three Titles and created Title II to contain the mobile source provisions. It also required HEW to make biannual progress reports to Congress on various aspects of automotive air pollution control. In 1966, the Act was amended to authorize grants to state and local air pollution control agencies, and to extend such programs. Pub.L. 89-675, 80 Stat. 954 (Oct. 15, 1966).

[35] Proposed at 30 Fed.Reg. 17192 (Dec. 31, 1965), issued in final at 31 Fed.Reg. 5170 (Mar. 30, 1966). The regulations set emission standards for HC and CO for passenger cars and light duty vehicles, but not for NOx. They also set out test procedures for measuring emissions and mileage accumulation, including specifications for the fuels to use under these procedures. HEW specified a lead additive (tetraethyl or tetramethyl) content in the test fuel of as high as 3.25 ML/gallon. See The New York Times, Mar. 30, 1966, at 20.

1973-4	3.0 [1.864]	15 [9.321]	3.1 [1.9263]
1975-6	1.5 [.9321]	15 [9.321]	3.1 [1.9263]
1977-79	1.5 [.9321]	15 [9.321]	2.0 [1.2428]
1980	1.5 [.9321]	7.0 [4.3498]	2.0 [1.2428]
1981 and after	1.5 [.9321]	7.0 [4.3498]	1.0 [.6214]

Source: The Clean Air Act § 202(b)(1)(A) and (B) (1977), 42 U.S.C. § 7521(b)(1)(A) and (B) (1977).
Note: The standards represent only tailpipe emissions for light-duty vehicles (passenger cars). Separate standards for other classes of vehicles (e.g., heavy-duty vehicles and diesel vehicles) and for other types of emissions (e.g., evaporative emissions) are not shown. The standards listed are those listed by the statute. The federal standards remained unchanged from 1981 through 1989.

- *Tier 1 Standards*. The standards for light-duty vehicles and light-duty trucks that became effective by operation of the statute, effective beginning in model phase year 1994 (the "tier 1 standards") are listed in table B.7.
- *NLEV Standards*. Provisions of the 1990 Amendments allow states to voluntarily adopt the vehicle emission standards issued by California. Several of the Northeastern states were very interested in adopting the California standards for vehicles sold there. The product of negotiations that took place is the National Low Emission Vehicle (NLEV) program. Because the states and the automakers agreed to it, what started out as a voluntary program has become a nationwide requirement that EPA memorialized in a regulation. As a result, the current California standards (NO_x = 0.3 gpm) apply to 2001 model year vehicles and are enforceable as a federal regulation.
- *Tier 2 Standards*. On February 10, 2000 the U.S. EPA issued two sets of rules together—the tier 2 auto emission standards and limitations on the sulfur content of gasoline (see below).[36] These were effective April 10, 2000. The tier 2 standards, which automakers will be required to phase in beginning in model year 2004, resulted from a mandated study to determine whether tightening of the motor vehicle emission standards was warranted.[37] The tier 2 standards are the first set of tailpipe standards that apply equally to all passenger cars, light trucks, and larger passenger vehicles operated on any fuel.

Table B.7. Tier 1 Tailpipe Standards for Vehicles Beginning 1994
(Standards expressed as grams per mile)

Vehicle Type	Fuel	Short Useful Life				Long Useful Life			
		NMHC	CO	NO_x	PM	NMHC	CO	NO_x	PM
		5 years/50,000 miles				10 years/100,000 miles			
LDV [a]	gas	0.25 [.15535]	3.4 [2.1128]	0.4 [.24856]	0.08 [.49712]	0.31 [.19263]	4.2 [2.6099]	0.6 [.37284]	0.10 [.06214]
	diesel	0.25 [.15535]	3.4 [2.1128]	1.0 [.6214]	0.08 [.49712]	0.31 [.19263]	4.2 [2.6099]	1.25 [.77675]	0.10 [.06214]

[36] 65 Fed.Reg. 6698 (Feb. 10, 2000).

[37] Under Section 202(i) of the Act, EPA was required to determine whether standards more stringent than tier 1 standards are appropriate beginning between the 2004 and 2006 model years, considering (1) the availability of technology to meet more stringent standards, taking cost, lead time, safety, and energy impacts into consideration; and (2) the need for, and cost effectiveness of, such standards, including consideration of alternative methods of attaining or maintaining the national ambient air quality standards. After the study was completed EPA was required to determine by rulemaking whether: (1) there is a need for further emission reductions; (2) the technology for more stringent emission standards from the affected classes is available; and (3) such standards are needed and cost-effective, taking into account alternatives. If EPA answers "yes" to these questions, then the Agency must issue new, more stringent motor vehicle standards (the tier 2 standards). EPA submitted its report to Congress on July 31, 1998, answering all three questions in the affirmative.

LDT1	gas	0.25[a] [.15535]	3.4[a] [2.1128]	0.4[a] [.24856]	0.08[b] [.49712]	0.31[a] [.19263]	4.2[a] [2.6099]	0.6[a] [.37284]	0.10[b] [.06214]
	diesel	0.25[a] [.15535]	3.4[a] [2.1128]	1.0[a] [.6214]	0.08[b] [.49712]	0.31[a] [.19263]	4.2[a] [2.6099]	1.25[a] [.77675]	0.10[b] [.06214]
LDT2	gas	0.32[a] [.19885]	4.4[a] [2.7342]	0.7[a] [.43498]	0.08[b] [.49712]	0.40[a] [.24856]	5.5[a] [.34177]	0.97[a] [.60276]	0.10[b] [.06214]
	diesel	0.32[a] [.19885]	4.4[a] [2.7342]	—	0.08 [.49712]	0.40[a] [.24856]	5.5[a] [.34177]	0.97[a] [.60276]	0.10[b] [.06214]
		5 years/50,000 miles				11 years/120,000 miles			
HLDT1[c]	gas	0.32 [.19885]	4.4 [2.7342]	0.7 [.43498]	—	0.46 [.28584]	6.4 [3.9769]	0.98 [.60897]	0.10 [.06214]
	diesel	0.32 [.19885]	4.4 [2.7342]	—	—	0.46 [.28584]	6.4 [3.9769]	0.98 [.60897]	0.10 [.06214]
HLDT2[c]	gas	0.39 [.24235]	5.0 [3.7284]	1.1 [.68354]	—	0.56 [.34798]	7.3 [4.5362]	1.53 [.95074]	0.12 [.07457]
	diesel	0.39 [.24235]	5.0 [3.7284]	—	—	0.56 [.34798]	7.3 [4.5362]	1.53 [.95074]	0.12 [.07457]

Source: 1990 Amendments § 203(a), establishing new Clean Air Act § 202(g) - (h), 42 U.S.C. § 7521(g) - (h) and Tables G and H. Summarized in John-Mark Stensvaag, Clean Air Act 1990 Amendments, Law and Practice (Wiley, New York, 1991), at 8-12.
Definitions: LDV- Light-Duty Vehicle (passenger cars); **LDT1**- light-duty truck category 1 (Gross Vehicle Weight Rating (GVWR) of 6,000 lb. or less, and Loaded Vehicle Weight (LVW) of 0-3750 lb.); **LDT2**- light-duty truck category 2 (GVWR of 6,000 lb. or less, and LVW of 3,751-5,750 lb.); **HLDT1**- heavy light-duty truck category 1 (GVWR of over 6,000 lb., and Test Weight (TW) of 3,751-5,750 lb.; **HLDT2**- heavy light-duty truck category 2 (GVWR of over 6,000 lb., and TW of more than 5,750 lb.)
Note: The standards represent only tailpipe emissions for LDVs, LDTs, and HLDTs. Separate standards for other classes of vehicles (e.g., heavy-duty vehicles) and for other types of emissions (e.g., evaporative emissions) are not shown. Standards are stated in grams per mile ("g/m") of pollutant emitted. The standards listed are those listed by the statute.
a Phasing: 40% model year (MY) 1994, 80% MY 1995, 100% thereafter.
b Phasing: 40% MY) 1994, 80% MY 1996, 100% thereafter.
c Phasing: 50% MY) 1996, 100% thereafter.

The new rule is one of the longest and most complicated ever published by EPA. Instead of a single standard, each automaker must meet a corporate sales-weighted average. The average changes during the phase-in periods until ultimately there are 10 different standards below and above the average. Indeed, EPA found the rule it had written so complex that it was unable to condense it to prepare a fact sheet for the public.[38] The only generalization is that the average emissions of the whole fleet will be .07 gpm of NO_x. Under these circumstances, table B.8 is presented as a suggestion of the range of standards that apply. No further analysis will be pursued.

Table B.8. Tier 2 Light-duty Full Useful Life Exhaust Emission Standards

Bin No.	NO_x	NMOG	CO	HCHO	PM
8	0.20	0.125	4.2	0.018	0.02
7	0.15	0.090	4.2	0.018	0.02
6	0.10	0.090	4.2	0.018	0.01
5	0.07	0.090	4.2	0.018	0.01
4	0.04	0.070	2.1	0.011	0.01
3	0.03	0.055	2.1	0.011	0.01
2	0.02	0.010	2.1	0.004	0.01
1	0.00	0.000	0	0.000	0.00

Source: EPA, 65 Fed.Reg. 6698 et seq. (Feb. 10, 2000), Table IV.B.-2A.

[38] EPA staff found it impossible to condense the material.

The tier 2 standards will be phased in beginning in 2004 in order to comply with EPA's declining fleet average NO_x standard. One hundred percent of the passenger car and light truck fleets operating on both diesel and gasoline will be required to comply on average by 2007; 100 percent of heavier trucks up to 10,000 lbs. will comply by 2009. The NLEV standards will be phased in in a few Northeast states starting in 1999; nationally they go into effect in 2001. California's TLEV, LEV, ULEV, LEV2, ULEV 2 and SULEV standards are phased in by each manufacturer in a manner sufficient to comply with the fleet average NMOG standard.

B.5.2 Fuel Standards

EPA is granted authority under Section 211(c) of the Clean Air Act to regulate fuel quality in order to prevent pollution from fuels and additives and to protect emission control devices on vehicles using them. In 1973, EPA issued two sets of regulations: (1) mandating the availability of unleaded gasoline for use in vehicle equipped with catalytic converters; and (2) reducing the average lead content of gasoline ("the lead phasedown"). Substitution of other octane additives for lead additive caused gasoline volatility to rise, creating additional hydrocarbon emissions that contributed to growth in urban ozone pollution.[39] In the late 1980s, EPA issued a set of rules controlling gasoline volatility.

In the 1990 Amendments, Congress banned leaded gasoline effective January 1, 1996. It also enacted two additional provisions: (1) to reduce emissions of ozone-forming VOCs and air toxics, section 211(k) requires the sale of reformulated gasoline (RFG) in certain ozone nonattainment areas. The first phase began January 1, 1995; the second phase began January 1, 2000. The provisions regarding VOCs apply during the high ozone season. The provisions regarding toxic air pollutants apply during the entire year. (2) To reduce CO emissions from vehicles in CO nonattainment areas it required the use of oxygenated fuels.

Most recently, EPA mandated significant reductions in the sulfur content of fuel, both to reduce sulfur emissions and to protect the significant investment to be made in achieving the tier 2 emission standards. EPA determined that while technologies existed to make significant tailpipe emission reductions, such could not be achieved by vehicles in use with the existing fuel quality. The controls reducing the sulfur content of gasoline will enable technologies installed by automakers to meet the standards in use. Like the rules issued in 1973 to make unleaded gasoline available to protect catalysts, the new sulfur rules rely on the fuel as an essential predicate for maintaining performance of emission controls.

It should be noted that while both the vehicle standards and the fuel standards are measured principally at the time of sale, rather than in use, the fuel standards are not emission standards *per se*. Instead, they are product quality standards, directing refiners to produce gasolines having certain characteristics that affect emissions.

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[39] See Loeb, A.P., "The Adolescence of Emissions Trading: A Short History and Analysis of the Lead Phasedown Lead Credit Market," presented as faculty at USAID Technical Leadership Training Workshop: Emissions Trading for Environmental Protection, Energy and Environment, Washington, D.C., May 19, 2000.

Appendix C: European Union Standards

The EU has an elaborate set of policies and standards for air quality.

C.1 Ambient Air Quality Standards

The EU issued new ambient standards in Council Directive 1999/30/EC, April 22, 1999. The object of this directive was to establish limit values and, as appropriate, 'alert thresholds,' for concentrations of SO_2, NO_2 and NO_x, PM, and Pb so as to prevent damage to human health and the environment. 'Alert thresholds' are levels beyond which there is an acute risk to human health and at which immediate steps must be taken. These standards are the minimum limit values that member states must achieve; however, member states can establish their own more stringent limits.

Directive 96/62/EC requires that action plans be developed for zones within which concentrations of pollutants in ambient air exceed limit values, plus any applicable temporary margins of tolerance.

In addition to the ambient standards listed in table C.1, which are either now in force or currently listed to be applicable at definite future dates, proposals have been made to Parliament and the Council for standards for three additional pollutants—carbon monoxide, benzene, and ozone. The Commission is also currently carrying out research to consider proposing standards for five additional pollutants—PAHs, mercury, nickel, cadmium, and arsenic.[40] These would be integrated into the program for ambient standards; by contrast to the U.S., in the EU rules there is no separate air toxics program.

C.2 Stationary Source Emission Standards

Standards for stationary source emissions in the EU have proved to be unavailable, since the annexes containing the limit values for the various sources are not posted on the EU website. Stationary source emission guidelines developed by the World Bank are used here instead.

C.3 Mobile Source Emission Standards

As in the U.S. program, the EU program for mobile sources contains rules for both vehicle emissions and fuel quality.

C.3.1 Vehicle Emission Standards

Until the mid-1980s, vehicle emission standards in Europe were developed by the United Nations Economic Commission for Europe (ECE) and adopted by individual countries. Because of the consensus-based approach to rule-making, which required unanimity among the various states, the European standards lagged behind the U.S. standards. For example, the ECE did not adopt emission standards requiring three-way catalytic converters until 1988 (ECE regulation 83), and then only for vehicles with engine displacement of 2.0 liters or more.

Table C.1. EU Ambient Air Quality Standards

Pollutant	Averaging Time	Limit Value	Allowed Exceedances	Alert Threshold
SO_2	1-hour	350 $\mu g/m^3$	24/yr	350 $\mu g/m^3$ for 3 hrs

[40] Personal correspondence Lynne Edwards, EC, to Alan P. Loeb, May 30, 2000.

Pollutant	Averaging Time	Limit Value	Allowed Exceedances	Alert Threshold
	24-hour	125 μg/m³	3/yr	
	Annual	20 μg/m³	—	
NO_2	1-hour	200 μg/m³	18/yr	400 μg/m³ for 3 hrs
	annual	40 μg/m³	—	
NO_X	annual	30 μg/m³	—	
PM_{10}[a]	24-hour	50 μg/m³	35/yr	
	annual	40 μg/m³	—	
Pb	annual	2 μg/m³	—	
O_3	[]	[proposed]		
Benzene	[]	[proposed]		
Arsenic	[]	[proposed]		
Mercury	[]	[in research]		
Cadmium	[]	[in research]		
Nickel	[]	[in research]		
Poly-aromatic hydrocarbons (PAH)	[]	[in research]		

Source: Annexes to Council Directive 1999/30/EC, Apr. 22, 1999. These Annexes are not available on line. These were obtained by personal correspondence with Lynne Edwards. Some details of European standards are provided in the World Bank Handbook, which lists the EU standards in comparison tables; however, the discussion of European standards in the Handbook is obsolete.
Note: Since the purpose of this study is to look prospectively at opportunities for reductions, the standards listed here are only those that have been established for future compliance. The various dates for compliance with standards for individual pollutants are set out in the Annexes to Council Directive 1999/30/EC but not listed here. Details regarding former standards, as well as currently-applicable standards or parts of standards that are scheduled for repeal, are set out in Article 9 of 1999/30/EC.
a The limit values presented here are from the Stage 1 PM10 program. A stage 2 program, with a 24 hour standard of 50 μg/m3 (not to be exceeded more than 7 times per calendar year) and an annual standard of 20 μg/m3 are currently under consideration.

With the shift recently in the EU to a decision process that allow adoption of standards with less-than-complete unanimity, it has become possible to adopt more stringent emission standards, and they have now begun to catch up with U.S. standards.[41]

Table C.2 summarizes the EU standards that apply to passenger car emissions, measured as limit values in grams per kilometer (g/km).[42]

Table C.2. EU Standards for Passenger Cars

Pollutant	2000		2005	
	Gasoline	Diesel	Gasoline	Diesel
Carbon monoxide	2.3	0.64	1.00	0.50
Mass of hydrocarbons	0.20	—	0.10	—
Mass of oxides of nitrogen	0.15	0.50	0.06	0.25
Combined mass of hydrocarbons and oxides of nitrogen	— (0.5 prior standard)	0.56	— (0.5 prior standard)	0.30
Mass of particulates	—	0.05	—	0.025

Source: Michael P. Walsh (1999); standards represent the final conciliation values agreed on June 30, 1999.

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[41] Faiz, Asif, Christopher S. Weaver, and Michael P. Walsh, Air Pollution from Motor Vehicles, Standards and Technologies for Controlling Emissions (The World Bank, Washington, DC, 1996), at 8.

[42] Faiz, et al., supra, at 8.

It should be noted for comparison purposes, that the EU standards do not assign automakers the responsibility for emission performance of their vehicles once they enter service. That is, they have no emission warranty. Moreover, surveillance testing, recalls, and other features of the U.S. regulatory program do not exist in the EU program. Given the deterioration in performance of emission control devices, in-use emissions of vehicles certified to EU standards are likely to be significantly higher than the standards over their lifetimes.[43]

C.3.2 Fuel Standards

Initially, European nations varied greatly in their adoption of the U.S. model. West Germany unilaterally adopted a maximum lead content of 0.15 grams of lead per liter of gasoline (gpl) in 1975 for regular grade gasoline. The EC followed with a directive in 1978 requiring member countries to set maximum lead content standards between 0.15 and 0.4 gpl.[44] However, this did not occur with universal agreement. Major opposition came from the United Kingdom (UK), which argued that lead additives were important for energy conservation.[45]

Once the U.S. took action to strengthen its lead phase-down regulations in 1982 and 1985, the EC followed suit. The UK reversed its position in 1983 and actually took a leadership role in making lead reductions. The EC issued a second directive in 1985 that formally asked that member states reduce the lead content of leaded to 0.15 gpl “as soon as they consider it appropriate.[46]

In the parallel to lead content rules, European countries adopted requirements for the availability of unleaded gasoline to supply new catalytic converter-equipped vehicles. The 1985 EC directive required the availability of unleaded gasoline by October 1, 1989. The EC set the maximum lead content standard for unleaded at 0.013 gpl. However, only unleaded premium (minimum 95 RON/85 MON) was required; member states were permitted, but not required, to require the availability of unleaded regular in addition.[47]

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[43] Faiz, et al., supra, at 8.

[44] Council Directive 78/611/EEC, June 29, 1978. EC directives for gasoline exclude French overseas departments.

[45] Walsh, Michael P., “Other Nations Phasing Down Lead in Gas,” EPA Journal, May 1985.

[46] “Directive on the Lead Content of Petrol,” 85/210/EEC, 3 April 1985, as amended by 85/580/EEC, 31 December 1985, and 87/416/EEC, 21 July 1987.

[47] Automotive Engineering, Jan. 1987, p.49.

Appendix D: Standards Issued by International Organizations

This section evaluates air quality standards worldwide. It identifies standards and the associated policies and other factors that will be important for establishing new air quality standards in Egypt.

The approach here is to identify the actions, activities, roles and responsibilities of counterparts that need to be in place. Its purpose is to introduce key issues and principal assumptions. It also identifies the principal risks associated with revising the Egyptian standards and assesses the institutional approaches to their mitigation.

D.1 World Health Organization

The most influential body in development of air quality regulation is the WHO, which produced its first air quality guidelines in 1987. These are now embodied in a substantial document, *WHO Guidelines for Air Quality*, last revised in 1999. The document contains an extensive discussion of air pollution generally, evaluation of the health effects of specific pollutants, and methodologies for pollution control and program management. Governments and financial institutions turn to them for an authoritative source of information.

Most important among the issues discussed in the *Guidelines* are the WHO guidelines for ambient air quality. While these are not intended as standards *per se*, they present the levels of air pollution below which lifetime exposure presents no significant health risk. As such, they provide the foundation upon which standards can be adopted. As a statement of the United Nations, these have become the universal source of ambient standards. In addition, the *WHO Guidelines* also provide guidance material for setting emission standards.

The *WHO Guidelines* present much valuable information that can be useful for developing the Egyptian program. For present purposes, the focus here is on the WHO guidelines for ambient air quality, presented in table D.1.

Table D.1. WHO Ambient Air Quality Guidelines

Pollutant	Averaging Time	Concentration
SO_2	Annual	50 µg/m^3
	24-hour	125 µg/m^3
	10-minute	500 µg/m^3
CO	8-hour	10 mg/m^3
	1-hour	30 mg/m^3
	30-minute	60 mg/m^3
	15-minute	100 mg/m^3
NO_2	annual	40 µg/m^3
	1-hour	200 µg/m^3
O_3	8-hour	120 µg/m^3
Pb	annual	0.5 µg/m^3

Source: "WHO guideline values for the 'classical' air pollutants," reprinted as Table 3.1 in Guidelines for Air Quality, WHO, Geneva, 1999.

In addition to the classical air pollutants, WHO also lists guidelines for "other air pollutants," categorized by non-carcinogenic (Table 3.2, 39 substances) and carcinogenic (Table 3.3, 16 substances) endpoints. Several of these other pollutants are important for this assessment, being also either proposed for listing or under research for listing as ambient pollutants by the EU. These are listed in table D.2.

Table D.2 WHO Other Pollutants Proposed for Standards by EU

Pollutant	Average Ambient Air Concentration	
	WHO	EU
Benzene	5.0-20.0 $\mu g/m^3$ [Table 3.3]	[proposed]
Arsenic	(1-30) 10^{-3} $\mu g/m^3$ [Table 3.3]	[proposed]
Cadmium	(0.1-20) 10^{-3} $\mu g/m^3$ [Table 3.2]	[in research]
Nickel	1-180 $\mu g/m^3$ [Table 3.3]	[in research]
PAH	$(1\text{-}10)*10^{-3}$ $\mu g/m^3$ [Table 3.3]	[in research]

D.2 Financial Institutions

Financial institutions, especially multilateral lending institutions, are uniquely positioned to determine the environmental impacts of projects they finance, and in recent years they have responded to pressure by developing policies that require project developers to meet the more stringent emission levels that would apply in developed countries. Since they govern projects wherever located, these have become the international standard for emission control. Following this lead, some private lenders have taken these as a world norm to be enforced as a condition of loan approval.[48]

Where countries have environmental systems that do not control emissions to the world standard, or where regulations are not sufficiently enforced, the regulations of the financial institutions act as the principal agency of emission control. However, since by definition only new sources or significant modifications are financed, the influence of these international organizations is limited to constraining some additions to the emissions inventory. Existing sources are not affected directly by such institutions.

There are three types of financial institutions that have a role in development:

- *Multilateral Development Banks*. There are a variety of multilateral development banks, whose objective is to alleviate poverty and improve the quality of life through financing projects. They use loan guarantees to finance projects private institutions will not support. These are of two kinds, either globally focused or regionally focused. The principal global multilateral is the World Bank Group, including the International Finance Corporation and the Multilateral Investment Guarantee Agency. The regionals include the Asian Development Bank, the Inter-American Development Bank, the European Bank for Reconstruction and Development, and the African Development Bank.

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[48] See Andrew Giaccia and Erin Buckley Bradley, "World Bank Standards," Independent Energy, October, 1995, at 62.

- *Export Credit Agencies*. These are bilateral public institutions set up by national governments to support exports and investment by companies in other countries, i.e., foreign operations of domestic companies. Their objective is to support the competitiveness and investment of their constituents, not to alleviate poverty but to support economic growth. These do not take the place of commercial banks, they provide support beyond that afforded by commercial banks—insurance and loan guarantees that insure risks commercial banks are unwilling to accept.
- *Commercial Banks*. These organizations have as their objective to profit by support of sound projects with minimal risks.

Because these institutions all apply their environmental responsibilities currently, usually a combination of local, national, and financing organization standards apply. When the standards are not all equal, which is often the case, the most stringent standard applies.

A number of environmental policies, procedures, and/or standards have thus been set by the various financial institutions, which apply to individual project financings. As a developing country, Egypt sees the application of these policies when they are applied as a condition to economic development projects.

More importantly, these various practices taken collectively create norms that industries are expected to follow. Since all financed projects ultimately affect competitive conditions, what standards are applied in one financing have economic consequences to the others.

There is a third reason to consider these as well. Since financial standards are already in the economy, they provide in essence what translates into a new source performance standard. The existence of this mechanism introduces equitable questions as companies compete and have to consider the equitable question of how to allocate the burdens fairly under such conditions.

D.2.1 The World Bank Group

The World Bank Group is a second essential source of universal standards. As mentioned above, the World Bank Group has three components, each of which has a somewhat different approach related to its functional role.

The World Bank Handbook

The World Bank published a comprehensive study of pollution control strategies and standards in its *Pollution Prevention and Abatement Handbook* (“the *Handbook*”), which first appeared in 1995. While it contains water and air quality standards, its emphasis is overwhelmingly on air. In addition to providing a comprehensive survey of environmental methods and management practices, Part Three of this volume contains discussions on three subjects relating to emission control:

- *Pollutants*. A discussion of the substances PM, arsenic, cadmium, lead, mercury, NO_x, ozone, and SO_x.
- *Pollutant Control Technologies*. A review of generic technologies for controlling PM, gasoline lead, NO_x, and SO_x.
- *Industry Sector Guidelines.* A set of performance standards for control of emissions at specific categories of stationary sources. Since these are enforced as a condition of financing a project, they are in effect sector-specific emission standards applied in a pre-construction review process.

Since the World Bank is involved in financing development, not in controlling emissions, it does not have any say in emissions that do not result from new or expanded plant. In consequence, the World Bank has not developed standards or any guidance at all regarding mobile source emissions.

The World Bank *Handbook* is the most commonly used reference for setting standards in project finance. It is applied to projects even when its standards are more stringent than the local standards. But it should be borne in mind that the World Bank guidelines, as shown in table D.3, are emission standards, and so there is no guarantee that their application results in attainment of the ambient standards.

Table D.3. World Bank Air Emission Guidelines: Parameters and Maximum Values

Source Category	Pollutants and Emission Limitations (Milligrams per Normal Cubic Meter [mg/Nm^3] unless otherwise specified)				
	PM	SOx	NOx	Metals	Other Pollutants
Aluminum manufacturing	30	—	—	—	*Total fluorine*: 2 *HF*: 1 *VOC*: 20
Base metal and iron ore mining	—	—	—	—	—
Breweries	—	—	—	—	—
Cement manufacturing	50	400	600	—	—
Chlor-alkali industry	—	—	—	—	*Cl*: 3
Coal mining and production	50				SO_2
Coke manufacturing	50	—	—	—	*benzene*: 5 (leaks) *VOC*: 20 *sulfur*: recovery at least 97% (preferably over 99%)
Copper smelting	Smelters: 20 Other sources: 50			*As*: 0.5 *Cd*: 0.05 *Cu*: 1 *Pb*: P.2 *Hg*: 0.05	—
Dairy industry					*Odor:* acceptable to neighbors
Dye manufacturing					*Cl*: 10 *VOC*: 20
Electronics manufacturing					*VOC*: 20 *phosphine*: 1 *arsine*: 1 *HF*: 5 *HCl*: 10
Electroplating industry					*VOC*: 90% recovery

Source Category	Pollutants and Emission Limitations (Milligrams per Normal Cubic Meter [mg/Nm^3] unless otherwise specified)				
	PM	SOx	NOx	Metals	Other Pollutants
Foundries	20 where toxic metals are present, 50 in other cases				
Fruit and vegetable processing	—	—	—	—	—
General environmental guidelines	*PM*: - 50 for ≥50 MWe - 100< 50 MWe	SO_2: 2,000	coal: 750 (260 ng/J or 365 ppm) oil: 460 (130 ng/J or 225 ppm) gas: 320 (86 ng/J or 155 ppm)		*dioxin* (2,3,7,8-TCSS equivalent): max 1 ng/Nm^3
Glass manufacturing	-50 -20 where toxic metals are present	SO_x: -gas fired: 700 -oil-fired: 1,800	1,000 (up to 2,000 depending on technology and if justified in the EA	*Pb + Cd*, total: 5 *other heavy metals*, total: 5 *As*: 1	*F*: 5 *HCl*: 50
Industrial estates	-Large facilities (energy consumption > 10 GJ/hour): 50 -Small facilities (energy consumption ≤ 10 GJ/hour): 150	SO_x: 2,000	-Solid fuels: 750 (260 ng/J or 365 ppm) -Liquid fuels: 460 (130 ng/J or 225 ppm) Gas: 320 (86 ng/J or 155 ppm)		H_2S: 15
Iron and steel manufacturing	50	500 (sintering)	750 (260 ng/J or 365 ppm)		*F:* 5
Lead and zinc smelting	20	SO_2: 400		*As*: 0.1 *Cd*: 0.05 *Cu*: 0.5 *Hg*: 0.05 *Pb*: 0.5 *Zn*: 1	*F*: 5 *HCl*: 50
Meat processing and rendering	150 for smokehouses with C content < 50				Odor Minimize impact on residents

Source Category	Pollutants and Emission Limitations (Milligrams per Normal Cubic Meter [mg/Nm^3] unless otherwise specified)				
	PM	SOx	NOx	Metals	Other Pollutants
Mini steel mills	-50 -20 where toxic metals are present	2,000	750		
Mixed fertilizer plants	50		-Nitrophosphate units: 500 -Mixed acid units: 70		NH_3: 50 *F*: 5
Nitrogenous fertilizer plants	50		300		NH_3: 50 *urea*: 50
Oil and gas development (onshore)		1,000	oil: 460 (130 ng/J or 225 ppm) gas: 320 (86 ng/J or 155 ppm)		*VOC:* 20 H_2S: 30 *Odor*: not offensive at receptor end (H_2S at property line < 5 $\mu g/m^3$)
Pesticides formulation	-20 -5 where very toxic compounds are present				*VOC*: 20 *Cl:* 5
Pesticides manufacturing	-20 -5 where very toxic compounds are present				*VOC*: 20 *Cl:* 5
Petrochemicals manufacturing	20	500	300		*HCl*: 10 *Benzene*: -Emissions: 5 -Plant fence: 0.1 ppb *1,2 dicholoroethane*: -Emissions: 5 -Plant fence: 1.0 ppb *Vinyl chloride*: -Emissions: 5 -Plant fence: 0.4 ppb NH_3: 15

Source Category	Pollutants and Emission Limitations (Milligrams per Normal Cubic Meter [mg/Nm^3] unless otherwise specified)				
	PM	SOx	NOx	Metals	Other Pollutants
Petroleum refining	50	Sulfur recovery units- 150 -Combustion units- 500	460 (130 ng/J or 225 ppm)		*H_2S*: 15 *Ni + V*: 2
Pharmaceutical manufacturing		20			*Active ingredients* (each): 0.15 *Class A compounds* (total): 20 *Class B compounds* (total): 80 *Benzene*: 5 *Vinyl chloride*: 5 *Dichloroethane*: 5
Phosphate fertilizer plants	50	Sulfuric acid plant: *SO_2*: 2 kg/t acid *SO_3*: 0.15 kg/t acid			*F*: 5
Printing industry					*VOC*: 20 *Cl*: 10
Pulp and paper mills	Recovery furnace: 100	*Total S*: -Sulfite mills- 1.5 kg/t air-dried pulp -Kraft and other- 1.0 kg/t air-dried pulp	2 kg/t air-dried pulp		*H_2S:* 15 (lime kilns)
Sugar manufacturing	-100 -Mills < 8.7 MW heat input to boiler: 150mg/Nm_3		-Liquid fuels: 460 (130 ng/J or 225 ppm) -Solid fuels: 750 (260 ng/J or 365 ppm)		*Odor:* acceptable to residents
Tanning and leather finishing					*Odor:* acceptable to residents
Textiles industry					*VOC:* 20

Source Category	Pollutants and Emission Limitations (Milligrams per Normal Cubic Meter [mg/Nm^3] unless otherwise specified)				
	PM	SOx	NOx	Metals	Other Pollutants
Thermal power, new plants	50 mg/Nm_3	-Total SO_2: 0.2 metric ton/day MWe on first 500 MWe, 0.1 tpd over 500 MWe -Flue gases: 2,000 mg/Nm_3 (500 tpd total)	**Thermal plants**: -Coal: 750 (260 ng/J or 365 ppm) -Oil: 460 (130 ng/J or 225 ppm) Gas: 320 (86 ng/J or 155 ppm) **Combustion turbine plants**: -Gas: 125 Diesel (No. 2): 165 Fuel oil (No. 6 and other: 300 **Coal < 10% Volatile matter**: 1,500 mg/Nm_3		
Thermal power, rehabilitation of existing plants	-100 -rare cases: 150 mg/Nm_3				*CO:*
Vegetable oil processing	50				*Odor*: acceptable to neighbors
Wood preserving industry					*VOC:* 20

Source: Table 1, *World Bank Handbook*, at 194-95.

International Finance Corporation

A second institution within the World Bank Group is the International Finance Corporation (IFC), which is the private sector finance arm of the World Bank. IFC provides funding and advice to private sector ventures and projects in developing countries in partnership with private developers. It is the largest multilateral source of loan and equity financing for private sector projects in the developing world. The IFC generally follows the *World Bank Handbook* for its standards. However, in addition, it has also established a "Procedure for Environmental and Social Review of Projects."

Multilateral Investment Guarantee Agency

The Multilateral Investment Guarantee Agency (MIGA) was established in 1988 to offer guarantees to encourage the flow of foreign direct investment to its developing member countries for economic development. MIGA applies the *World Bank Pollution Prevention and Abatement Handbook* in its operations. MIGA has also adopted its own environmental policies, including procedures for consideration of project impacts, which are set out in its "Environmental and Social Review Procedures."[49] In addition it has additional policies set out in its "Draft Environmental Assessment and Disclosure Policies and Environmental Review Procedures."[50]

D.2.2 Regional Development Banks

The world network of regional development banks have important influence on applying emission control requirements on new projects they finance or develop. The following quick survey indicates the practices they use.

African Development Bank

The AfDB provides assistance to private enterprises and financial institutions through term loans, equity and quasi-equity guarantees, and underwriting and advisory services. The AfDB requires environmental impact statements for all projects. Its environmental policies were made public in a series of policy statements that list principles of responsible environmental management. It provides a number of methods and measures for improving environmental performance of industry projects.

The AfDB is listed here first because it is the first line of approach to finding practices and techniques that would be applicable in Egypt. However, research was not done to determine the level of experience or expertise in application of air quality management tools and techniques, and other like organizations are listed below as possible additional sources of practices and techniques.

Asian Development Bank

The Asian Development Bank (ADB) provides financial and technical assistance by extending loans and equity investments for its developing member countries, provides technical assistance, and promotes public and private investment. The ADB reviews the environmental impacts of its projects and policies, encourages developing countries to develop environmental programs, and trains staff on environmental aspects of economic development. Its environmental guidelines are not available on line but are available by request.

European Bank for Reconstruction and Development

The European Bank for Reconstruction and Development (EBRD) offers loans, equity and quasi-equity investments, guarantees, and advisory services to support projects in the 26 countries in central and

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[49] See www.miga.org/disclose/soc_rev.htm.
[50] See www.miga.org/disclose/preface.htm.

eastern Europe in which it operates. EBRD projects are required to meet national and EU environmental standards. Environmental assessments must be carried out, and project sponsors must develop an environmental action plan. Environmental monitoring is required over the life of the loan.

Inter-American Development Bank

The Inter-American Development Bank (IDB) is composed of 46 member countries, 26 of which are countries in Latin America or the Caribbean and have borrowing status. In analysis of proposed projects, the IDB reviews environmental impacts and incorporates factors to avoid adverse impacts.

D.3 Trade Assistance Organizations

National organizations provide trade assistance such as loan guarantees and direct loans. For example, in the U.S. the Overseas Private Investment Corporation (OPIC) provides loan guarantees for U.S. small businesses and cooperatives. OPIC practices draw from four sets of environmental guidelines to evaluate the environmental and social impacts of projects: (1) Environmental Handbook, revised April 1999; (2) the World Bank Handbook; (3) the IFC environmental health and safety guidelines, to address issues not covered by World Bank Handbook; and (4) the World Bank Operational Directives.

D.4 World Trade Organization

The World Trade Organization (WTO) is not a source of project finance. However, it has a substantial role in international environmental policy by seeking to minimize disparity in trade rules that can lead to trade discrimination. Developing countries are under some pressure in the international community to reconcile their environmental practices and standards to meet world norms.

D.5 International Organization for Standardization

The International Organization for Standardization (ISO) is a federation of national standards bodies with member organizations from 111 countries. It has developed a series of specification standards for environmental management systems, which are known collectively as ISO 14000. The series contains six guidance standards:

- Environmental Management Systems
- Environmental Auditing
- Environmental Labeling
- Environmental Performance Evaluation
- Life-cycle Assessment
- Terms and Definitions

Of greatest interest is the guidance for Environmental Management Systems, ISO 140001. Organizations from 42 countries participated in the drafting procedure. Under ISO 14001, companies can voluntarily become certified; certification requires third-party auditing. There is a widespread movement of multinational companies to become certified in order to show good corporate citizenship. Certification is the formal recognition that a company or organization is operating an environmental management system (EMS) that meets established standards. Unfortunately, ISO 14000 focuses on compliance with national regulation rather than with environmental performance. Given the differences in regulatory standards among countries, ISO 14000 does not provide a guarantee of comparable performance.

On the other hand, the ISO 14000 series does provide a rich source of internationally-accepted methodologies for monitoring and modeling emissions. These could be quite useful in establishing new testing protocols in Egypt.

Appendix E: Meetings and Interviews

I departed for Cairo in the evening of Tuesday, May 2, 2000 and arrived in Cairo in the early hours of Thursday, May 4. I departed early on May 16. In my second week I interviewed the following individuals:

- Dr. Ahmed Gamal Abdel-Rehiem, Environmental Advisor to the Cairo Air Improvement Project (CAIP) and the Egyptian Environmental Affairs Agency (EEAA), Ministry of State for Environmental Affairs
- Abdelhavez H. Adelhafez , Faculty of Engineering, Cairo University, Giza
- Prof. Fawzy M. El-Mahallawy, Faculty of Engineering, Cairo University, Giza
- Dr. Ahmed Hamza, Senior Technical Advisor, Environmental Compliance Unit, Industrial Sources, EEAA, Ministry of State for Environmental Affairs
- Ahmed Ismael, consultant for EEAA environmental inspection
- Eng. Dahlia Lotayef, Planning Director, Follow-up and Technical Cooperation Department, EEAA, Ministry of State for Environmental Affairs
- Dr. Nefisa S. Abo El-Seoud, Director of Environmental Engineering, Hazardous Substances and Waste Management, EEAA, Ministry of State for Environmental Affairs
- Nader Shehata Doas, GC environmental lab manager, EEAA, and
- Esko Meloni, Senior Advisor, Finnish Institute of Environment, Egyptian Pollution Abatement Project (EPAP)

In addition, I have also interviewed:

- David Fratt, Home Office Project Officer for CAIP, Chemonics International, Washington, D.C.
- Eng. Yasser Sherif, General Manager, Environics, Cairo
- Lee Pasarew, Director, Middle East Programs, Office of International Activity, U.S. EPA, Washington, D.C.

In addition to these interviews my counterpart, Dr. Mahmoud Nasralla, conducted additional interviews.

Technical Glossary

Alert thresholds	Levels beyond which there is an acute risk to human health and at which immediate steps must be taken. These standards are the minimum limit values that member states must achieve; however, member states can establish their own more stringent limits.
Ambient air	Unrestricted open air outside buildings
CO non-attainment area	An area or region where the carbon monoxide (CO) levels fail to meet the ambient air quality standard (AAQS) promulgated by a regulatory agency. Usually non-attainment is designated when the CO level exceeds the AAQS for a specified number of days during an annual period.
Mazout	A high boiling point, residual fraction obtained from crude oil processing by distillation. Mazout is used as a lower cost fuel for combustion sources such as electrical power plants, lead smelters, etc. Use of Mazout as a fuel results in high emissions of particulate matter, polycyclic aromatic hydrocarbons, sulfur dioxide, and other pollutants.
Mobile source emissions	Emissions from mobile vehicles such as automobiles, trucks, and buses.
Oxygenated fuel	Fuel to which an oxygen-rich compound has been added. Methyl tertiary butyl ether (MTBE) is one of the additives commonly used to formulate oxygenated fuel (gasoline).
Ozone non-attainment area	An area or region where the ozone (O_3) levels fail to meet the ambient air quality standard (AAQS) promulgated by a regulatory agency. Usually non-attainment is designated when the O_3 level exceeds the AAQS for a specified number of days during an annual period.
Period of exposure	Length of time that exposure to a pollutant occurs, usually exposure above a specified concentration level.
Reformulated gasoline	Gasoline reformulated to reduce pollutant emissions when used as a vehicle fuel.
Stationary source emissions	Pollutant emissions from fixed-location sources such as electrical power plants, petroleum refineries, steel plants, etc. Stationary source emissions are commonly emitted from confined conduits such as stacks or ducts. These are classified as point-source emissions. However, stationary source emissions may also include fugitive (non-confined) emissions emitted from stock piles or process operations

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البرنامج المصري للسياسات البيئية
وحدة دعم البرنامج

العناصر الأساسية لمراجعة المواصفات القياسية لنوعية الهواء في مصر

إعداد:
ألان لويب

أبريل 2001

تقرير مُقدَم إلى:

الوكالة الأمريكية للتنمية الدولية – القاهرة
وجهاز شئون البيئة

مُقدم من:
مشروع السياسات البيئية والدعم المؤسسي EPIQ
مشروع ممول من الوكالة الأمريكية للتنمية الدولية،
إدارة شركة إنترناشيونال ريسورسز جروب المحدودة

ملخص:
تحتفظ الوكالة الأمريكية للتنمية الدولية بتاريخ طويل من الاهتمام بالقضايا البيئية في مصر. ومنذ بداية الثمانينات وحتى منتصف التسعينيات، انحصرت الاهتمامات الرئيسية للوكالة في أعمال إنشاء وإحلال وتجديد البنية التحتية مثل محطات وشبكات مياه الشرب والصرف الصحي. ثم تحول الاهتمام مع بداية التسعينيات إلى مناطق خارج المراكز الحضرية في مدينتي القاهرة والإسكندرية. ففي القاهرة الكبرى، تحولت الجهود من البنية التحتية إلى الدعم المؤسسي بحيث يمكن تشغيل المرافق بصورة اقتصادية تمشياً مع جهود الحكومة المصرية لتحرير الاقتصاد.

وفي نفس الوقت، زاد إدراك كلٍ من الحكومة المصرية والوكالة الأمريكية للتنمية الدولية بمدى معاناة المناطق الحضرية في القاهرة من زيادة غير مسبوقة في التلوث خاصةً تلوث الهواء. وقد قامت الوكالة الأمريكية للتنمية الدولية بتمويل عدد من المشروعات قصيرة الأمد للمساعدة في تقييم الموقف من بينها دراسة أعدتها عام 1994 عن مشروعات التنمية والبيئة (PRIDE)، والتي أكدت مخاطر تأثير تلوث الهواء على الصحة العامة. ثم قامت الحكومة المصرية والوكالة الأمريكية للتنمية الدولية بالتخطيط لمشروع ضخم للتصدي لمشكلة تلوث الهواء هو مشروع تحسين هواء القاهرة الذي تضمن عدداً من المبادرات المميزة التي تستهدف استيفاء احتياجات محلية محددة.

ومع أخذ خطورة مشكلات نوعية الهواء في الاعتبار، قامت الوكالة الأمريكية للتنمية الدولية بإنشاء مشروع جديد بموجب برنامج السياسات البيئية والدعم المؤسسي **(EPIQ)** لتوفير الموارد اللازمة لمعالجة مشكلات تلوث الهواء في مصر. وتقوم الوكالة الأمريكية للتنمية الدولية حالياً بتمويل البرنامج المصري للسياسات البيئية **(EEPP)** والذي يهدف إلى تناول السياسات التي تؤثر على البيئة في مصر على المدى الطويل. وقد عُهِدَ إلى وحدة دعم البرنامج **(PSU)** بالبرنامج المصري للسياسات البيئية تنفيذ 14 مهمة عمل خلال المرحلة الأولى من البرنامج، منها تقييم المواصفات القياسية لنوعية الهواء في مصر، والتي صاغتها مصر في قانون البيئة رقم 4 لسنة 1994 ولائحته التنفيذية. وفي خطوة مهمة، تقوم الوكالة الأمريكية للتنمية الدولية بتمويل إنشاء نظام لمراجعة وتعديل مواصفات انبعاثات الهواء بصفة دورية بالتعاون مع جهاز شئون البيئة.

وفي إطار هذه الجهود، أعدت وحدة دعم البرنامج دراسة تحليلية لمقارنة المواصفات المصرية مع البرامج الكبرى لنوعية الهواء. وشمل التحليل حصر لكافة البرامج البارزة سواءً المحلية أو الدولية، حيث ركز التحليل على المواصفات التي تستخدمها الولايات المتحدة الأمريكية، ودول الاتحاد الأوروبي، ومنظمة الصحة العالمية. وبالإضافة إلى ذلك، تم عقد سلسلة من الاجتماعات في مصر مع المساهمين الرئيسيين في المشروع (تم تسجيل كافة الجهات في الملحق رقم هـ) لتحديد الأولويات ثم عرضها على جهاز شئون البيئة لتقييمها.

ويمكن تقسيم المواصفات القياسية لتلوث الهواء إلى فئتين رئيسيتين: مواصفات نوعية الهواء ومواصفات الحد من انبعاثات الهواء. وبسبب الاختلافات الجوهرية بين الاثنتين، توجد برامج مميزة للسيطرة على الانبعاثات من المصادر الثابتة والمتحركة. وقد تم تقييم جميع هذه الفئات في ضوء المواصفات العالمية.

وقد تمت مقارنة مواصفات نوعية الهواء في مصر مع المواصفات المناظرة لها في كل من الولايات المتحدة الأمريكية ودول الاتحاد الأوروبي ومنظمة الصحة العالمية. وقد أظهرت

المقارنـة أن مواصـفات نوعيـة الهـواء المحيط فـي مصـر (مثـل الهـواء خـارج المبـاني) لا تخـرج كثيرا عن إطار هذه المواصفات ولكن هناك بعض التعديلات التي يجب إدخالها عليها.
أولاً: الحدود المقبولة لثاني أكسيد النتروجين والرصـاص أقل كثيراً من المواصفات المقبولـة فـي العالم. ويوصي هذا التقرير بأن تقوم مصر بوضع مواصفات أكثر صرامة.
ثانيـاً: يوصــي هـذا التقريـر أيضـاً بـأن تقـوم مصـر بإعـادة فحـص متوسـط الوقـت بالنسـبة لكافـة المواصفات.
ثالثـاً: يوصـي هـذا التقريـر بـأن تقـوم مصـر بـالنظر فـي حـذف اثنـين مـن الملوثـات وهمـا الـدخان الأسـود، وذلـك بسـبب ازدواجيتـه مـع المـواد العالقـة ذات قُطـر 10 ميكـرون أو أقـل (PM_{10}), والجسيمات الصلبة الكلية العالقة (TSP) حيث أنها مواد صلبة كبيرة لا يمكن استنشاقها بعمق فـي الرئتين مما لا يسبب مشاكل صحية.
رابعاً: يوصي هذا التقرير بـأن تعيد مصـر النظـر فـي إضـافة مواصفات للمـواد العالقـة الصـغيرة التـي يمكـن استنشـاقها بعمـق فـي الـرئتين وللمُركبـات العضـوية المتطـايرة التـي تحـد مـن تكـوين الأوزون المحيط.

كما يجب النظر أيضا في إضافة 11 ملوث من ملوثات الهواء الخطرة إلى مواصفات نوعية الهواء في مصر وذلك نظراً لأنها تسبب أضراراً صحية نتيجة التعرض البسيط لها. وبعض هذه الملوثات موجود حالياً في القائمة كمواد مسجلة تحت مواصفات "الانبعاثات" أو مواصفات "أماكن العمل".

وقد تم تصنيف مواصفات الانبعاثات من المصادر الثابتة في مصر أولاً حسب نوع الملوث ثم حسب نوع الصناعة التي تنطبق عليها المواصفات. وبالمقارنة نجد أن برامج المواصفات العالمية الثلاثة تقوم بتصنيف المواصفات حسب المصدر، وطبقاً للمواصفات الأمريكية يتم التصنيف حسب نوع المعدات وليس نوع الصناعة. وبسبب هذه الاختلافات الأساسية فليس من الممكن عمل مقارنة مباشرة بين المواصفات المصرية لانبعاثات المصادر الثابتة وبين المواصفات الأمريكية أو الأوربية أو مواصفات منظمة الصحة العالمية. ومع ذلك توجد بعض الملاحظات المفيدة.
أولاً: القانون المصري غير محدد ويدرج الملوثات في مجموعات متعددة بحدود مختلفة. ثانياً: تم كتابة مواصفات الانبعاثات في صورة أرقام مطلقة بدون تحديد متوسط الأوقات، وبينما يؤدي ذلك إلى تخفيف الضرر إلا أنه لا يؤدي بالضرورة إلى خفض تلوث الهواء.
ثالثاً: قائمة الملوثات غير شاملة، وهناك العديد من ملوثات الهواء غير مسجلة بها. لذلك فإن المبدأ الحاكم – طبقاً للملوث بدلاً من المصدر – يجعل التطبيق المتساوي للقواعد مستحيلاً ويجعل عملية إدارتها صعبة للغاية.

وقد أعرب المساهمون من الجانب المصري عن رأيهم بأن معظم مواصفات الانبعاثات – مثل مواصفات ثاني أكسيد الكبريت – غير حازمة بدرجة كافية، وأثاروا قضايا السيطرة على محتوى الكبريت في الوقود كأفضل الطرق للتحكم في الانبعاثات.

وبالإضافة إلى ذلك فإن طريقة تحديد مواصفات الانبعاثات من مصادر الاشتعال تتبع طريقة "رنجلمان" العتيقة لقياس نسبة العتامة للدخان الناتج بدلاً من استخدام طريقة التحليل الكمي لقياس الحجم والتركيب الكيمائي وحجم الجزيئات التي تتكون منها هذه الانبعاثات.

كما تمت مقارنة مواصفات الانبعاثات من المصادر المتحركة مع المواصفات الأمريكية والأوربية (منظمة الصحة العالمية لم تصدر مواصفاتها للمصادر المتحركة). وقد كشفت هذه المقارنة عن اختلافات أساسية.
أولاً: يتم في مصر قياس انبعاثات ماسورة العادم كنسبة مئوية إلى حجم الانبعاثات، بينما المواصفات الأمريكية والأوربية تقيس الملوث بالجرام حسب المسافة التي تقطعها السيارة. ثانياً: بروتوكول الاختبار المصري لا يمكن مقارنته بسهولة مع البروتوكول الأمريكي أو الأوربي، ففي مصر يتم فقط قياس أول أكسيد الكربون والهيدروكربونات والدخان الأسود ولا يتم قياس الهيدروكربونات التي لا تحتوي على الميثان، أو أكاسيد النتروجين أو المواد العالقة والتي كما ذكرنا سابقاً تعد مفيدة أكثر من قياس الدخان الأسود فقط. وبينما لا توجد طريقة للمقارنة المباشرة بين المواصفات، إلا أن هناك بعض الملاحظات المفيدة.

أولاً: قياس انبعاثات ماسورة العادم في لحظة محددة لم ينجح في إيجاد عينة تمثل الظروف الحقيقية للقيادة. كما أنه في حالة اختبار السيارة عند السرعة الخاملة (كما هو الحال في المواصفات المصرية) تكون الانبعاثات في حدها الأدنى. وبالإضافة إلى ذلك فإن المواصفات تنطبق على جميع أنواع السيارات – البنزين والديزل والغاز الطبيعي المضغوط، والدراجات البخارية، وسيارات الركوب، والأتوبيسات، وسيارات النقل. ومن المرجح ألا تستوفي السيارات الكبيرة شروط هذه المواصفات، بينما نجد أن نفس هذه المواصفات متساهلة للغاية مع السيارات الصغيرة، وهذا يعني أن مصر تُضيع فرصة سهلة لخفض الانبعاثات.

لذلك يجب إعادة صياغة المواصفات المصرية لمصادر الانبعاثات المتحركة في ضوء المواصفات الأمريكية أو الأوربية، حيث أن التكنولوجيا اللازمة لهذه المواصفات متاحة، كما تم خفض التكلفة إلى الحد المقبول، بالإضافة إلى أن إدخال هذه التكنولوجيا في تصميم السيارات يؤدي إلى تحسينات كبيرة في استهلاك الوقود.

وتُمثل مواصفات الوقود البُعد الآخر في مواصفات الانبعاثات من المصادر المتحركة. ويوجد لدى مصر بالفعل وقود خالٍ من الرصاص، ويجب عليها الإسراع في حظر استخدام الكميات المتبقية من الوقود المحتوي على الرصاص. وبالنظر لدرجات الحرارة العالية وغياب وسائل التحكم في أبخرة السيارات، نوصي أيضاً بإضافة وسائل التحكم في التطاير إلى مواصفات الوقود المباع في المناطق الحضرية للتحكم في تكوين الأوزون المحيط. وتتميز مصر بوجود احتياطيات متنامية من الغاز الطبيعي بالإضافة إلى التقدم الذي أحرزته في تشجيع استخدام الغاز الطبيعي المضغوط كوقود للسيارات. وقد أظهرت الحوافز فائدتها في تشجيع التحول لاستخدام الغاز الطبيعي المضغوط كوقود.

اعتبارات عامة: وأخيراً، تواجه مصر مشكلة أكبر من تحديد مواصفات نوعية الهواء، وتتمثل في غياب الوعي بحجم العلاقة بين تلوث الهواء وصحة الإنسان. فمصر تتأثر سنوياً بالعواصف الترابية والرملية التي تنطلق في الجو ثم تنقشع تاركة وراءها مفهوم مؤداه أن الهواء السيئ سيذهب بعيداً بنفسه. وحتى وقت قريب كان هناك قدر ضئيل من الوعي العام عن تلوث الهواء. إلا أنه منذ عدة سنوات ومع الفترات التي تراكمت فيها الملوثات واحتبست فوق سماء القاهرة (المعروفة محلياً باسم السحابة السوداء)، زاد الوعي العام بهذه المشكلة. إلا أن المتسببون في انبعاث الملوثات مازالوا لا يرون أنفسهم مصادر للتلوث، ولا يفهمون السبب من وضع هذه المواصفات القياسية ولا لماذا يجب عليهم تحمل التكاليف أو الجهد للالتزام بهذه المواصفات.

وبدراسة تطور برنامج الولايات المتحدة الأمريكية لنوعية الهواء سنعرف ماذا يفتقد البرنامج المصري، وهو ما يتمثل في: الفهم الواضح للعلاقة بين نوعية الهواء وحماية صحة الإنسان، بجانب القوانين المستخدمة لتحقيق خفض الانبعاثات إلى المستويات التي توفر نوعية مناسبة من الهواء.

وقد عبر المساهمون من جهاز شئون البيئة عن غياب هذه العلاقة الواضحة من خلال عدة محاور تتراوح بين التراث التاريخي والثقافي من عدم الالتزام إلى عدم وجود العقوبات الرادعة للمخالفين بموجب القانون رقم 4 لسنة 1994 ولائحته التنفيذية.

إن أي برنامج يتضمن تكلفة أو يتطلب تضحية محددة – والتحكم في نوعية الهواء يتضمن هذين العنصرين – يمكن أن ينجح فقط للمدى الذي يسمح به الرأي العام. فيجب أن تكون هناك إرادة سياسية، وموارد لتطبيق القانون، مع الالتزام من جانب الحكومة والصناعة، ودرجة عالية من القبول لدى القطاعات المهنية والعلمية.

وبنـاءً علـى ذلـك، نوصـي عنـد إجـراء أي عمليـة لتعـديل المواصـفات القياسـية لنوعيـة الهـواء بضرورة استخدام محورين أساسيين كنقطة بداية، وهما:

- صياغة المواصفات القياسية لنوعية الهواء بالطريقة التـي تحقق حمايـة صـحة الإنسـان بالدرجة الأولى بجانب حماية البيئة.
- صياغة المواصفات القياسية لانبعاثـات الهـواء بالطريقـة التـي تجعـل تركيـز الملوثـات فـي حدود المواصفات القياسية لنوعية الهواء.

ومن أجل البدء في عمليـة وضـع المواصـفات الجديـدة سيصـبح مـن الضـروري الإجابـة أولاً علـى الأسئلة الرئيسية التي أثارها المساهمين الرئيسيين فـي تنفيذ المشـروع. وأحـد هـذه الأسـئلة يتنـاول مـدى التطبيـق الشـامل لهـذه المواصـفات فـي جميـع أنحـاء مصـر سـواءً بسـواء أم إمكانيـة تنـوع واختلاف هذه المواصـفات بـاختلاف المنـاطق. وتـدل الخبـرة الدوليـة علـى أن مواصـفات الهـواء المحيط يجب أن تكون واحدة لكل الأمـاكن. إن السماح للأنشـطة الصـناعية بالانتقـال إلـى منـاطق غير مُلَوَّثة حالياً يلغي الحوافز المتمثلة في التحديث كما يؤدي إلى عدد من المساوئ.

وتعتبـر المراجعـة الدوريـة للمواصـفات الجديـدة بصـفة منتظمـة عمليـة ضـرورية. ففـي الولايـات المتحـدة الأمريكيـة، يُشـتَرَط مراجعـة المواصـفات كـل 5 سـنوات علـى الأقـل أو عنـدما تظهـر معلومات جديدة. وحتى مع توافر الموارد في البلاد، يعتبر هذا الجدول أقل صرامة ممـا ينبغـي. وبالنسبة لمصـر يعتبـر مراجعـة هـذه المواصـفات كـل 5-10 سـنوات مناسـباً حتـى تواكـب التطـور العالمي والتقدم العلمي.

ويجب على رجال القانون، أثناء وضـع المواصـفات الجديـدة، النظـر فـي سـن التشـريعات اللازمـة. وطبقـاً لمـا أفـاد بـه المسـاهمون فـي المشـروع مـن جهـاز شـئون البيئـة فـإن الإجـراءات التشـريعية الحالية غير واضحة، كما أن الجهة المنوط بها سُلطة تطبيق القانون غير مناسبة. ولا يوجد فقط تعـارض فـي المواصـفات بصـيغتها الحاليـة، بـل إن هنـاك أيضـاً غيـاب لمنهجيـة طـرق قيـاس الانبعاثات، وعدم تناسق في المسئوليات والأنظمة الإدارية.

وهنـاك شـكوى متكررة من نقص العمالـة اللازمـة لتنفيـذ القـانون وأن الجهـاز الـوظيفي يفتقـر إلـى الموارد اللازمة لتنفيذ واجباتـه. كمـا أن هنـاك حاجـة ماسـة إلـى المعدات والأجهزة وقطـع الغيـار والسيارات والأفراد المدربون. وقد علق أحد موظفي جهاز شئون البيئة بقوله أنه على الرغم من أن القانون ينظم أكثر من 300 مادة كيمائية ونسب تركيزها داخل المبـاني فـإن مـوظفي الجهـاز لا يستطيعون قياس أكثر من اثنين أو ثلاثـة مـن هـذه المـواد ممـا يجعـل هـذا الجـزء مـن القـانون بـدون معنـى.

وتتنـاول إحدى الانتقادات الأخرى افتقار المواصفات إلى قاعدة علميـة أو طبيـة راسـخة، فـالمنهج الكمي ضروري لوضـع المواصفات وتطبيقها ويمكن استخدام طرق علمية أكثر حداثـة للـربط بـين مواصـفات الانبعاثـات وبـين مواصـفات الهـواء المحـيط. لـذا يجـب أن يكـون إعـداد مواصـفات صـارمة جزءاً مـن عمليـة المراجعـة والتعديل ولكـن فـي نفس الوقت يجب ألا يصـبح أداةً لتأجيل تنفيذ هذه المواصفات.

ومن الواضـح أيضـاً أن البرنـامج يحتـاج إلـى وضـع إجـراءات قياسية محددة وطـرق جمـع للعينـات ذات مواصــفات معتمـدة لتأكيـد الجـودة أو مراقبــة الجـودة. وقـد يفيـد الاعتمـاد علـى منهجيـة المواصفات القياسية التي تم إقرارها واستخدامها بالفعل فـي منظمـات التمويـل الدوليـة أو المنظمـة

الدولية للتوحيد القياسي ISO. وهذه المواصفات متاحة واستخدامها سوف يسهل من وضع هذه المنهجية موضع التنفيذ. وهذا الأمر حيوي لنجاح أي مواصفات تعتمدها مصر.

وهناك نتيجتان واضحتان هما:
أولاً: العلاقة بين الانبعاثات ونوعية الهواء، حيث يجب التأكيد عليها كأسلوب جديد.
ثانياً: بالرغم من أن تحقيق المواصفات الصحية غير منتظر على المدى القريب، إلا أنه لا ينبغي تجاهل المواصفات القياسية لنوعية الهواء، ولا بد من وجود طريقة للعمل على تحقيقها بأسلوب معقول ومناسب.

وقد يكون من المناسب إصدار مواصفات قياسية جديدة دون انتظار لإشارات من الظروف المحيطة. حيث يجب الاستعانة بالتكنولوجيات المختلفة والمصادر التي تستخدمها من أجل تطبيق المواصفات الجديدة بغض النظر عن تأثيراتها المحددة. والأسلوب الأكثر ملائمةً يتمثل في إصدار مواصفات قياسية لكل صناعة على حدة مع التركيز على تحديث التكنولوجيا المستخدمة في هذه الصناعة إلى المستويات العالمية.

وسوف تتمثل المهمة الأولي في رصد كافة مصادر التلوث ووضع نقاط للصناعات المختلفة من أجل تحديد أولوياتها في جدول يشمل الآتي: الصناعات التي تنبعث منها كميات كبيرة من الملوثات المسببة للمشكلات (الجسيمات العالقة ومشتقاتها)، والصناعات ذات المنشآت القديمة التي تشكل فرصة جيدة للتجديد والتحديث، والصناعات ذات رؤوس الأموال الضخمة والصناعات المهمة. وسوف تنخفض الانبعاثات الكلية كلما تقدم العمل طبقاً للقائمة، صناعةً ثم أخرى.

ويظل الاهتمام الأكبر هو صحة وحياة الشعب المصري. وفي ختام هذا التقرير نؤكد بأنه يُمكننا البدء من الآن في اتخاذ خطوات إيجابية.