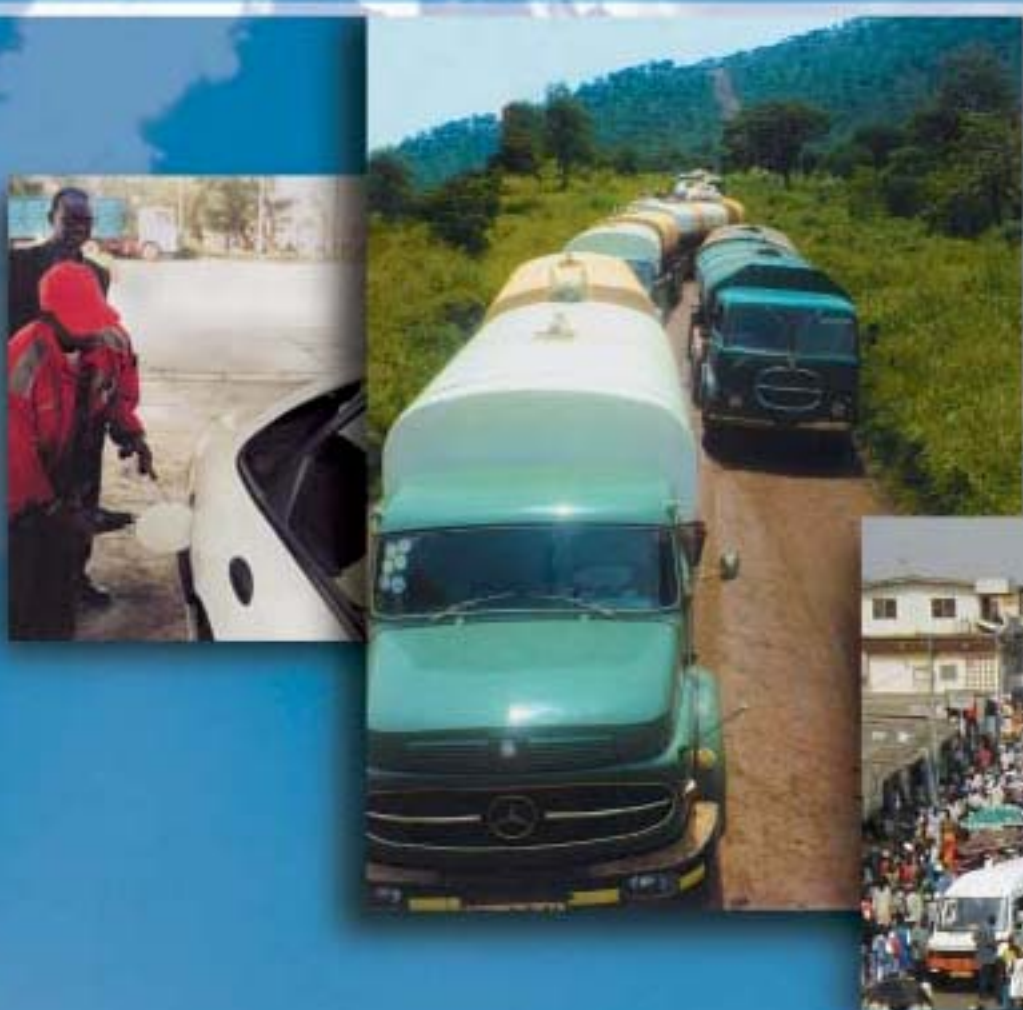




The World Bank
Clean Air Initiative
in Sub-Saharan African Cities

ESMAP

Joint World Bank/UNDP
Energy Sector Management
Assistance Programme



Phase-Out of Leaded Gasoline in Oil Importing Countries of Sub-Saharan Africa

**THE CASE OF ETHIOPIA
ACTION PLAN**

December 2003

*Clean Air Initiative Working Paper Number 13
ESMAP Technical Report Number 038/03*



PROGRAM COORDINATION FOR THE WORLD BANK CLEAN AIR INITIATIVE IN SUB-SAHARAN AFRICAN CITIES

www.worldbank.org/cleanair

Patrick Bultynck

Sr. Urban Transport Economist
The World Bank, Africa Region
pbultynck@worldbank.org

Chantal Reliquet

Sr. Urban Specialist
The World Bank, Africa Region
creliquet@worldbank.org

THE WORLD BANK GRATEFULLY ACKNOWLEDGES THE FINANCIAL CONTRIBUTION AND SUPPORT FROM:

ENERGY SECTOR MANAGEMENT ASSISTANCE PROGRAMME

<http://www.esmap.org>

Dominique Lallement
Programme Manager
ESMAP
dlallement@worldbank.org

THE COOPERATION AND SUPPORT FROM:

Eleodoro Mayorga-Alba, Technical Advisor
Lead Petroleum Economist
The World Bank, COPCO
emayorgaalba@worldbank.org

AFRICACLEAN
<http://africaclean.sn>

Foreword



This is one of four documents of a series presenting the results of studies, workshops and action plans recently undertaken for four sub-Saharan African countries (Ethiopia, Mali, Mauritania and Tanzania) on the elimination of lead in gasoline.

This document describes the work realized in Ethiopia.

These four countries have the particularity of being oil importing countries without local refining capability. The transition to unleaded gasoline should therefore theoretically be easier to implement in such a context than in oil-producing or oil-refining countries.

Several technical issues (such as the definition of specifications) and regulatory issues must however be resolved in order to eliminate lead from gasoline in these countries. This is precisely the goal of the studies realized in these four oil-importing countries.

These studies and workshops are financed by The Energy Sector Management Assistance Programme (ESMAP) which plays a decisive role towards the transfer of technology and knowledge in energy sector management to governments of developing countries and of economies in transition. By bringing its own resources and expertise, ESMAP strengthens the partnership of the Clean Air Initiative in sub-Saharan African Cities.

This ESMAP contribution also allows for reaching the goal set during the Dakar conference of June 2001: the complete elimination of leaded gasoline in sub-Saharan Africa as soon as possible, at the latest by 2005.

Dominique Lallement
Programme Manager
Energy Sector Management Assistance Programme
World Bank

Inger Andersen
Sector Manager
Water and Urban Development
World Bank Africa Region

Copyright © 2003
The International Bank for Reconstruction
and Development/THE WORLD BANK
1818 H Street, N.W.
Washington, D.C. 20433, U.S.A.

All rights reserved
Manufactured in the United States of America
First printing December 2003

ESMAP Reports are published to communicate the results of ESMAP's work to the development community with the least possible delay. The typescript of the paper therefore has not been prepared in accordance with the procedures appropriate to formal documents. Some sources cited in this paper may be informal documents that are not readily available.

The findings, interpretations, and conclusions expressed in this paper are entirely those of the author(s) and should not be attributed in any manner to the World Bank, or its affiliated organizations, or to members of its Board of Executive Directors or the countries they represent. The World Bank does not guarantee the accuracy of the data included in this publication and accepts no responsibility whatsoever for any consequence of their use. The Boundaries, colors, denominations, other information shown on any map in this volume do not imply on the part of the World Bank Group any judgment on the legal status of any territory or the endorsement or acceptance of such boundaries.

Papers in the ESMAP Technical Series are discussion documents, not final project reports. They are subject to the same copyrights as other ESMAP publications

The material in this publication is copyrighted. Requests for permission to reproduce portions of it should be sent to either: The World Bank Office of the Publisher, ESMAP Manager, or The World Bank Clean Air Initiative in sub-Saharan Africa at the address shown in the copyright notice above. ESMAP encourages dissemination of its work and will normally give permission promptly and, when the reproduction is for noncommercial purposes, without asking a fee.

Table of Contents

Executive Summary	v
1. Why the need for this Action Plan?	1
1.1 <i>Background</i>	1
1.2 <i>Objectives of this report and action plan</i>	2
1.3 <i>Overview of Ethiopia's economy and urban development</i>	2
1.4 <i>Acknowledgements</i>	2
1.5 <i>Study Team</i>	2
2. Benefits of lead phase-out	3
2.1 <i>Lead is highly toxic</i>	3
2.2 <i>WHO recommends lead phase-out</i>	4
2.3 <i>Health impacts are growing</i>	5
2.4 <i>Economic costs of health impacts</i>	6
2.5 <i>Towards improved fuel and air quality</i>	6
2.6 <i>Other benefits</i>	10
3. Potential cost advantages and disadvantages in lead phase-out	11
3.1 <i>Fuel prices – ULG is cheaper</i>	11
3.2 <i>Change-over costs</i>	12
3.3 <i>Suitability of Older Vehicles with Soft Valve Seats to Use ULG</i>	12
3.4 <i>Conclusion</i>	13
4. Priority issues and recommendations for leaded gasoline phase-out	15
4.1 <i>Fuel specifications and fuel quality</i>	16
4.2 <i>Vehicle imports and emission controls</i>	17
4.3 <i>Base line studies of emissions and health impacts and strengthening the environmental legislative framework</i>	18
4.4 <i>Public Awareness Campaign</i>	19
5. Action Plan to phase out leaded gasoline and next steps	21
6. Indicative Public Awareness Campaign	27
6.1 <i>Objectives and outputs</i>	27
6.2 <i>Target audience</i>	28
6.3 <i>Role of Civil society, media and other partners</i>	28
6.4 <i>Emerging issues</i>	29
6.5 <i>Indicative Public Awareness Detailed Plan</i>	32
7. Annex A – Terms of Reference for Preparation of this Action Plan	37
8. Annex B – Overview of Ethiopian Petroleum Market	41
9. Annex C – Draft mandate for a multi-sectoral working group to oversee action plan implementation	47
10. Annex D – Draft Outline Terms of Reference for follow on air quality activities	49
11. List of Workshop Participants	53
12. Report References	55
13. List of ESMAP Technical Paper Series	57



Abbreviations and Acronyms

Africaclean	NGO based in Sénégal promoting clean air activities in Africa
CNG	Compressed Natural Gas
CH ₄	Methane
CO	Carbon Monoxide
COHb	Carboxyhemoglobin
EPA	Ethiopian Environmental Protection Authority
EPE	Ethiopian Petroleum Enterprise
ESMAP	Energy Sector Management Assistance Program
GHG	Green House Gas
HC	Hydrocarbon
IQ	Intelligent Quotient
MEM	Ministry of Energy and Minerals
MTBE	Methyl Tertiary-Butyl Ether
NO _x	Oxides of Nitrogen
NO ₂	Nitrogen Dioxide
NGOs	Non-Governmental Organizations
PM ₁₀	Particulate Matter smaller than 10 microns
PM _{2.5}	Particulate Matter smaller than 2.5 microns
PM _{1.0}	Particulate Matter smaller than 1 micron
RON	Research Octane Number
RTA	Ethiopian Road Transport Authority
QSA	Ethiopian Quality and Standards Authority
SO ₂	Sulfur Dioxide
SPM	Suspended Particulate Matter
SSA	Sub-Saharan Africa
TA	Technical Assistance
TOE	Ton Oil Equivalent
TSP	Total Suspended Particulate
µg	Micrograms
UNEP	United Nations Environment Program
ULG	Unleaded Gasoline
VOCs	Volatile Organic Compounds

Approx. Currency Equivalent

US\$ 1.00 = 8.7 Ethiopian Birr (Date: June, 2003)

Executive Summary



The global phase-out of lead from gasoline has proceeded dramatically in the last five years. Countries in North America, Europe, Japan and Asia have phased-out leaded gasoline; about 85% of total gasoline consumption is now lead-free. However there are a number of countries that still use lead additives to boost octane levels in gasoline. Almost all of these countries are in Africa and the Middle East. The World Health Organization recommends that leaded gasoline be phased out worldwide.

An agreement was reached in June 2001 at the Dakar Conference in Senegal to launch national programs to phase-out leaded gasoline by 2005 in the countries of sub-Saharan Africa (SSA).

Follow up conferences have since been held in Abuja, Nigeria in November 2001; Dakar, Senegal in March 2002; Cotonou, Benin in April 2002 and Nairobi, Kenya in June 2002. All four conferences supported the Dakar declaration. Many countries have committed to the 2005 phase out date and Mauritius has gone a step further by aiming for phase out by August 2002.

The World Bank has obtained Energy Sector Management Assistance Program (ESMAP) funding to assist Ethiopia (and Mauritania, Mali and Tanzania) to develop an action plan, as described in this report, which demonstrates the benefits of leaded gasoline phase-out and outlines the necessary associated actions.

Lead is a poison with significant negative public health impacts. Historically, the principal source of atmospheric lead has been the combustion of alkyl lead additives in motor fuels. As SSA and other oil importing countries are confronted with fewer difficulties to phase out lead from gasoline than those operating national refineries for the supply of their markets, there is an opportunity to make a major environmental step forward through early leaded gasoline phase-out.

As shown in Chapter 2 of this report, while overall Ethiopia's urban population appears not to have the lead exposure from gasoline estimated for other countries in the region, the urban population whose main activities are in close proximity to major roads would be likely to exhibit similar lead exposure from mobile sources. Continued economic development without lead-phase out would undoubtedly increase the likelihood of spiraling negative health impacts due to lead. These negative impacts fall disproportionately on the poorer people in urban areas.

Improved fuel quality to standards similar or equal to that used by other countries in the region will also have important economic benefits:

- ▲ Economic – facilitation of regional trade and cooperation, larger markets and economies of scale;
- ▲ Security of supplies – fuel of a suitable quality can be sourced from a range of markets/suppliers;



- ▲ Facilitate capacity building – knowledge and skills enhancement will be increased through wide access to technical expertise; and
- ▲ Environmental – joint implementation of environmental standards with neighboring countries in the region;

In Chapter 4, rather than cost penalties, a change-over to unleaded gasoline is expected to lead to important savings to the economy and to motorists through:

- ▲ A switch to unleaded gasoline will lead to significant foreign exchange savings – a saving of at least US\$2M per year is anticipated;
- ▲ Changeover costs are expected to be negligible;
- ▲ The impact of unleaded gasoline on engines with soft valve seats in a small proportion of cars manufactured prior to 1980 is expected to be minor but could be compensated for by appropriate (lubricant) additives to the fuel. But additives are not recommended as they are not considered necessary; and
- ▲ Reduced maintenance costs for cars are expected.

These benefits have already been recognized by the Government of Ethiopia that has promulgated new specifications for ULG and has decided that by July 2003 all gasoline imported into Ethiopia shall be ULG.

The phase-out of leaded gasoline is but a first step in developing a more comprehensive approach to air quality management that would include actions on:

- ▲ Improving fuel quality and developing new fuel specifications;
- ▲ Upgrading the quality of vehicle imports and emission controls;

- ▲ Establishing baseline inventories of key pollutants and health effects; and
- ▲ Developing an appropriate public information or awareness campaign.

In Chapter 5 of this report, we propose three key recommendations to commence the process of leaded gasoline phase-out and to move towards a more comprehensive approach to air quality management. The three recommendations are:

- ▲ **Recommendation 1** – The Cabinet of the Government of Ethiopia immediately announces to consumers that by the beginning of 2004 leaded gasoline will be completely phased-out at that time, and instead a single grade of ULG will be supplied to the market.
- ▲ **Recommendation 2** – The Cabinet of the Government of Ethiopia commits to establishing a multi-sectoral stakeholder group by end 2003 consisting of senior members of government agencies, the oil industry, and civil society including Non-Government Organizations (NGOs) and consumer groups for a period of at least three years. The Ethiopian EPA, Ministry of Health and Ministry of Trade and Industry would have lead roles in its implementation. Further details of the role of individual organizations are made in Chapter 5. This multi-stakeholder group would oversee implementation of the public awareness activities and provide feedback and advice to implementation agencies. A proposed draft mandate for this group is included in Chapter 9 – Annex C.
- ▲ **Recommendation 3** – The Cabinet of the Government of Ethiopia commits to developing a more comprehensive approach to air quality management by end 2003 based on the Terms of Reference (ToR) described

in Chapter 10 – Annex D and recommended action plan set out in Table 5.1. Ethiopian EPA would have the lead role.

The action plan recommends an integrated approach to improve air quality starting by phasing-out leaded gasoline in Table 5.1. It consists of these three key recommendations and 12 others.

Chapter 6 of this report provides details of an indicative approach for developing a public awareness campaign to be overseen by the multi-sectoral stakeholder group – a draft mandate for this group is set out in Chapter 9 – Annex C.

After the government makes a decision to adopt the recommended Action Plan it will be possible for the Government to seek funding support from donor institutions to continue with its implementation.



1 CHAPTER

Why the need for this Action Plan?

1.1 Background

The global phase-out of lead from gasoline has proceeded dramatically in the last five years. Countries in North America, Europe, Japan and Asia have phased-out leaded gasoline; about 85% of total gasoline consumption is now lead-free. However there are a number of countries that still use lead additives to boost octane levels in gasoline. Almost all of these countries are in Africa and the Middle East.

An agreement was reached in June 2001 at the Dakar Conference, Senegal, to launch national programs to phase-out leaded gasoline by 2005 in the countries of sub-Saharan Africa (SSA).

Follow up conferences have since been held in Abuja, Nigeria in November 2001; Dakar, Senegal in March 2002; Cotonou, Benin in April 2002, and Nairobi, Kenya in June 2002. All four conferences supported the Dakar declaration. Many countries have committed to the 2005 phase out date and Mauritius has gone a step further by aiming for phase out by August 2002.

In the past decade, Ethiopia has made significant progress in introducing regulations, strategies, and guidelines for various aspects of environmental management; the Conservation Strategy and Environment Policy led to the establishment of the Environmental Protection Authority (EPA), and a national

environmental management framework. In addition, several regulations, detailed guidelines and mechanisms have been prepared for environmental assessments of investments.

Lead is a poison with significant negative public health impacts. As Ethiopia and other oil importing countries are confronted with fewer difficulties to phase out lead from gasoline than those operating national refineries for the supply of their markets, there is an opportunity to make a major environmental step forward through early leaded gasoline phase-out.

This opportunity has already been recognized by the Government of Ethiopia that has promulgated new specifications for unleaded gasoline (ULG) and has decided that by July 2003 all gasoline imported into Ethiopia shall be ULG.

The World Bank has obtained Energy Sector Management Assistance Program (ESMAP) funding to assist Ethiopia (and Mauritania, Mali and Tanzania) to develop this report and action plan to demonstrate the benefits of leaded gasoline phase-out and on-going air quality management actions. The draft version of this report and Action Plan was discussed in a workshop with Ethiopian stakeholders on June 12-13, 2003. Following comments received during the workshop, this final version of the report and Action Plan was prepared.



1.2 Objectives of this report and action plan

The objectives of this report and action plan are:

- ▲ To assist the Ethiopian Government making the decision to stop importing leaded gasoline; and
- ▲ At the same time, raise awareness in government, industry and civil society on the need to pursue policies to improve urban air quality.

While the action plan concentrates on the issue of lead in gasoline and the need for leaded gasoline phase-out, this is but a first step towards a more comprehensive approach to integrated Air Quality Management (AQM). This action plan also discusses what the priority follow-on steps towards AQM might be.

1.3 Overview of Ethiopia's economy and urban development

Ethiopia's economy as measured by gross domestic product (GDP) was an estimated US\$6.04bn in 2001. In recent years the economy has been growing at around 3% per annum. The nation's population was an estimated 65 million in 2002 and the average per capita income was US\$93 which is extremely low.

Over 90% of the population lives in rural areas with most relying on subsistence farming. The capital city of Addis Ababa had an estimated population of 2.7 million in 2002. Ethiopia's next four largest urban centers together with their populations (in 2002) are:

- ▲ Dire Dawa – 237,000;
- ▲ Nazareth – 189,000;

- ▲ Gondar – 163,000; and
- ▲ Dessie – 141,600.

1.4 Acknowledgements

The study team extends thanks to the members of the Ethiopian Government, who gave generously of their time at short notice during our mission to Ethiopia in February, 2003. We are particularly grateful to State Minister, Tadesse Haile of the Ministry of Trade and Industry and Mr. Yigzaw Mekonnen, General Manager, Ethiopian Petroleum Enterprise. We also wish to acknowledge the generous assistance of Mr. Hagos Aregay (MoTI); Mr. Martin Fayalu (Mobil Oil East Africa) and Mr. Desta Mabrutu (Chemical Engineers Association). Excellent cooperation was also provided by oil companies, non-government organizations and others.

1.5 Study Team

The World Bank's study team consists of:

- ▲ Dr Eleodoro Mayorga Alba, Lead Petroleum Economist, World Bank;
- ▲ Dr Amadou Diouf, President of the Africaclean network¹;
- ▲ Lynda Osafo, Executive Director, Junior Eco-Club Organization, Ghana and member Africaclean network;
- ▲ Menbere Taye Tesfa, Consultant, World Bank Resident Mission, Addis Ababa; and
- ▲ Philip Sayeg, Project Consultant.

¹ An NGO based in Senegal promoting clean air activities in Africa.

CHAPTER 2 Benefits of lead phase-out

2.1 Lead is highly toxic

Lead is a highly toxic, non-degradable, element that can result in damage to the brain, kidneys, blood, central nervous system, and reproductive system. Children who are exposed to high levels of lead may experience slowed cognitive development, reduced growth, and other health effects. Regulators in many countries are now aware of the insidious consequences of cumulative low-level exposure to lead, most notably decrements in neurobehavioral development of children (Dr Schwela et al, 2001). In many countries, lead use in gasoline and other products (e.g. paints) has been, or is being phased-out, as a consequence of this.

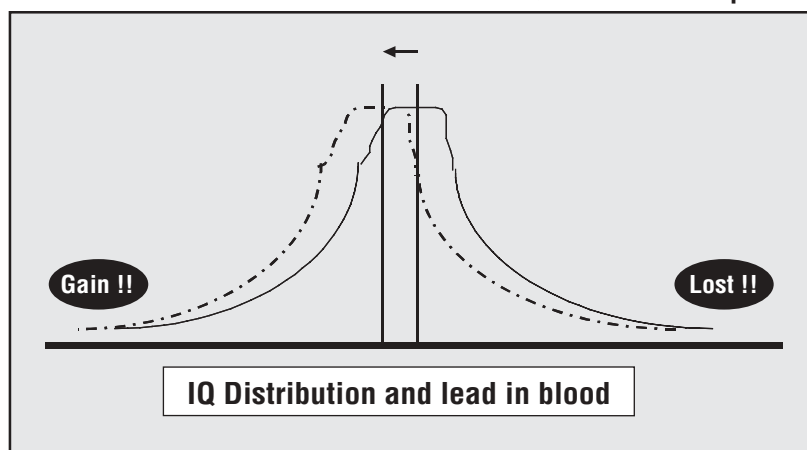
Anemic children are most vulnerable with lead more easily being able to be fixed into the bones. A loss in Intelligence Quotient (IQ) for children is a future loss in the future intelligence of the adult population that would have undesirable impacts on economic development. Figure 2.1 indicates how an average loss in intelligence implies a reduction in the capacity of society's most intelligent persons and therefore a loss in creativity.

Exposure to atmospheric lead is usually through the gastrointestinal tract as a result of consuming dust containing lead particles.

This exposure route is most important in young children, who tend to crawl and put things in their mouths. Because of a mixed and largely unplanned land use, residential dwellings, offices, shops, restaurants, schools and hospitals are usually located adjacent to major roads. This high exposure of the general population to vehicle emissions is compounded by the practice of roadside eating and walking (the majority of trips are believed to be walking trips) which increase the exposure to lead.

Atmospheric lead concentrations of $50 \mu\text{g}/\text{m}^3$ have been found in remote areas. In developed countries, where most gasoline sold is unleaded, typical annual average concentrations are between 0.1 and $0.2 \mu\text{g}/\text{m}^3$ in urban areas and between 0.01 and $0.05 \mu\text{g}/\text{m}^3$ in rural parts. Concentrations in excess of $1 \mu\text{g}/\text{m}^3$ are recorded in cities in developing countries,

Figure 2.1
Loss in IQ due to Lead Exposure



which still heavily rely on leaded gasoline (Schwela et al, 2001).

The transport and distribution of lead is primarily via air. Airborne lead can be deposited on soil and water, thus reaching humans through the food chain and in drinking water. Atmospheric lead is also a major source of lead in household dust.

Potentially airborne lead can contaminate food and vegetation, water and soil with significant environmental and health impacts (Sridhar, 2001).

Historically, the principal source of atmospheric lead has been the combustion of alkyl lead additives in motor fuels. However, in countries that have not yet started phasing out lead as an antiknock agent in gasoline, most of the lead in the environment originates from vehicular emissions. In those countries, the addition of tetra alkyl lead in motor fuels accounts for an estimated 80–90% of lead in ambient air. The degree of pollution from this source differs from country to country, depending on motor vehicle density and efficiency of efforts to reduce the lead content of petrol. In Ethiopia, there are no primary or secondary lead processing and refining factories, nor any lead alkyl manufactures, lead oxide and inorganic pigments products and grey iron foundries. Hence, the main source of lead in the atmosphere in Ethiopia is considered likely to originate from the use of leaded gasoline.

2.2 WHO recommends lead phase-out

As no amount of lead in the ambient air is considered safe, US-EPA does not specify maximum lead concentration in its standards as shown in Table 2.1. Although the current World Health Organization (WHO) standard for a maximum lead concentration in the ambient air is 0.5

$\mu\text{g}/\text{m}^3$, due to the significant negative impacts of lead on human health, the WHO recommended in 1995 that the use of lead additives in motor fuels be phased-out and that exposure to other sources of lead should be reduced (Schwela et al, 2001).

Table 2.1
Ambient Air Quality Standards in $\mu\text{g}/\text{m}^3$

Pollutant	Averaging time	Standard or Guideline $\mu\text{g}/\text{m}^3$	
		US-EPA	WHO
TSP	Daily		– ²
	Annual ¹		
PM ₁₀	Daily	150	– ²
	Annual	50	
Lead (Pb)	1-month		
	Annual		0.5
Ozone (O ₃)	1-hour		
	8-hours		120
SO ₂	Daily	365	125
	Annual	80	50
NO ₂	1-hour		200
	Annual	100	40
CO	1-hour	40 K	30 K
	8-hour	10 K	10 K

Notes:

- ¹ Geometric mean
- ² WHO no longer recommends air quality guideline for PM because there is no safe lower limit for PM.
 - Values of US-EPA are for primary standards.
 - Annual Average is an average of daily measurements taken during a period of one year.
 - $\mu\text{g}/\text{m}^3$ is a unit of measurement and refers to one millionth of a gram of a pollutant in a cubic meter of air.
 - Guideline refers to the safe level of a pollutant, for the given averaging time, to protect the public from acute health effects.
 - CO values are in 1000 (K) of $\mu\text{g}/\text{m}^3$.

Source: WHO/SDE/OEH/00.02, Geneva 2000.

2.3 Health impacts are growing

At present, because the Ethiopian vehicle fleet is small and the population dispersed, the impacts of airborne lead and other pollutants are likely to be low in an international context and in relation to other environmental issues.

However, the problem is concentrated in the major cities where the ambient atmospheric lead and associated health problem would be larger and growing. For example, a rough estimate of the amount of urban lead exposure from gasoline for Ethiopia in relation to other selected SSA or similar countries is shown in Table 2.2.

The table shows that the lead exposure in Ethiopia (and Tanzania) is expected to be lower than in neighboring Kenya or similar countries such as Ghana and Senegal. However, even though the overall lead emissions per capita in Ethiopian urban areas may be lower for those people whose main activities take place adja-

cent to major roads, their exposure can be expected to be similar to that observed in other countries where gasoline has a similar lead content to that used in Ethiopia.

Senegal provides an interesting comparison to Ethiopia—according to Table 2.2, the exposure of the urban population to lead from gasoline is much higher than in Ethiopia although this estimated “exposure” fails to take into account the very high volume of walking and other roadside activities which are common in Ethiopia’s cities.

In the absence of specific data on lead levels in blood in vulnerable groups in Ethiopia, data from Senegal may prove instructive. A recent authoritative study carried out in Dakar, Senegal (Dr. Diouf et al 2001), showed a significant difference was observed ($p=0$) between blood lead levels observed in children living in urban areas (average 106.6 $\mu\text{g/l}$) and those living in rural areas (average 68.1 $\mu\text{g/l}$). This is the maximum level in a child tolerated by

Table 2.2
Estimate of relative Lead Exposure in Selected Countries

Country	Market Share of Leaded Gasoline (%) 2002 ¹	Motor Gasoline Consumed (a) (million liters)	% of gasoline consumed in urban areas	Maximum Lead Concentration in Gasoline (gms/liter)	Average Actual Lead Concentration in Gasoline (gms/liter) ²	Actual Leaded Gas Emissions (metric tons)	Total Urban Pop (000) 1995	Exposure to Leaded Gasoline (tons per M urban 95 pop)
Ethiopia	100	188	0.70	0.6	0.06	11	8,695	0.9
Ghana	100	806	0.80	0.6	0.1	81	6,222	10.4
Kenya	100	458	0.70	0.4	0.2	92	7,763	8.3
Senegal	100	242	0.80	0.8	0.2	48	3,629	10.7
Tanzania	100	165	0.70	0.4	0.2	33	7,279	3.2

Notes:

Gasoline consumption for Tanzania and Ghana is in 2002; for other countries in 1995.

¹ Market share and fuel consumption data are for 2002 but for Kenya is 1995 data.

² Lead content for Ghana is average actual for 2001/02 (Jan 01–May 02); for Tanzania, Senegal & Kenya lead content is assumed.

Source: Adapted from WRI 2002.

the Center for Disease Control (Atlanta, USA) since 1991. The study noted that these high levels of blood lead seem to be caused by lead from automobiles. No industries likely to emit lead into the atmosphere exist within the study area.

Dr. Diouf et al (2001) compared the results to similar studies carried out in Africa and found that the recorded blood lead concentrations were similar:

- ▲ Dr. Nriagu, 1997 carried out two studies; the first one was in Nigeria, in the medium sized town of Kaduna and the average blood lead level in children aged between 1 and 6 years old was 106 µg/l; and
- ▲ In the second study, in South Africa, covering 1,200 children aged between 3 and 10 years old, the average blood lead level of children living in urban areas was 100µg/l and 38µg/l for those living in rural areas (Nriagu, Oleru et al, 1997a Nriagu, Jinabhai et al, 1997b).

Diouf et al (2001) stated that "...the (lead) levels found in our study are very high compared to those of children living in industrialized countries. In the USA children between the ages of 1 and 6 yrs had levels of 27µg/l from 1991 to 1994, whereas these were 40µg/l in 1988 to 1991, and approximately 150µg/l from 1976 to 1980. In France, the average blood lead levels were estimated at 36 µg/l in 1995 in children between 1 and 6, expecting to reach 25µg/dl by 2000. The reduction of average levels of blood lead in industrialized countries since the 80s is linked to the implementation of the "unleaded" policy that began earlier in the States than in France".

In conclusion, the amount of lead exposure in children in urban areas in Senegal was found to be very high. While Ethiopia's urban population appears not to have the lead exposure

from gasoline estimated for Senegal and the other countries shown in Table 2.2, the urban population whose main activities are in close proximity to major roads would be likely to exhibit similar lead exposure from mobile sources.

Continued economic development without lead-phase out would undoubtedly increase the likelihood of spiraling negative health impacts due to lead. These negative impacts fall disproportionately on the poorer people in urban areas.

2.4 Economic costs of health impacts

Many studies have estimated that the economic cost of poor air quality in developing countries is significant in terms of increased mortality and morbidity and in terms of health impact (estimated between 0.5 to 2.5% of GDP).

For example in the case of Thailand, that phased-out leaded gasoline over 1992 to 1996, a recent study found that the phase-out of leaded gasoline had major health and associated economic benefits as shown in Figure 2.2.

2.5 Towards improved fuel and air quality

Air quality of a given locality is determined by the amount of emissions produced by motor vehicles and other sources as well as topography and prevailing meteorological conditions. Ambient air quality in almost all large cities in the developing world today exceeds acceptable standards and is linked to major health problems of the exposed population. Health impacts vary depending on the type of pollutant, the length of exposure and the extent of interaction with other pollutant types.

Figure 2.2 Benefits of Unleaded Gasoline (ULG) Phase-out in Thailand

A study on health benefits after the implementation of the ULG policy showed that blood lead levels in traffic policemen decreased dramatically from 28.14 $\mu\text{g}/\text{dl}$ in 1988 to 5.33 $\mu\text{g}/\text{dl}$ in 2000. Similarly, blood lead levels in school children also decreased from 8.56 $\mu\text{g}/\text{dl}$ in 1993 to 5.58 $\mu\text{g}/\text{dl}$ in 2000. Therefore, it is obvious that the leaded gasoline phase-out policy yielded health benefits to the population in Thailand.

This study also calculated the monetary value of health benefits resulting from reductions in IQ loss effect on lifetime earnings in children, and in hypertension, heart disease, stroke and premature mortality in adults. The monetary value of health benefits was calculated to be 7,000 million Baht (US\$ 163M using an exchange rate of Thai Baht 43= US\$ 1.00 prevailing at March 03), while the costs of the phase-out are only 200 million Baht (US\$ 4.7M). Therefore, the benefits outweigh the costs by more than 32 fold.

However, the study found that lead in paint is another important challenge. Both children and traffic policemen whose blood lead levels exceed the standard have one common risk factor—exposure to house paint. Therefore, it is recommended that Thailand initiate measures to limit or remove lead from other sources, particularly paint.

Source: The Study on “Unleaded Gasoline Policy: Health Benefits for School Children and Traffic Policemen in Bangkok Metropolitan Administration” done by Chulalongkorn University and PCD, 2002.

As vehicles normally contribute more than half of the emissions within an urban air shed, the phase-out of leaded gasoline that is worthwhile on its own, is an important first step in improving overall fuel quality and hence air quality.

Although there is at present little hard evidence on the relative importance of other emissions, it appears that PM from badly tuned buses (and perhaps two-stroke motorcycles) is a growing problem. While there are clearly PM emission hotspots at street level, it is likely that ambient levels of PM are within accepted international standards. High levels of sulfur in diesel fuel are a major source of black smoke and particulate matter emissions that are very harmful to human health as described in Figure 2.3.

Apart from reducing the maximum content of lead in gasoline or eliminating lead altogether, another action that appears immediately beneficial is to reduce the level of sulfur in diesel fuel from its present specified maximum level of 8,500 parts per million (ppm). Most developed and many developed countries are now reducing the level of sulfur in diesel fuel to a maximum of 500 ppm or lower. This 500ppm level of sulfur content compared to the present 8,500ppm specification can be achieved at relatively low incremental cost. From the point of view of an oil importing country such as Ethiopia there may be no cost penalty for moving to low sulfur (500ppm) diesel.

Improved fuel quality such as introducing unleaded gasoline (ULG) and low sulfur diesel fuel pave the way for use of advanced tech-

nologies for emissions reduction in vehicle fleets. In gasoline powered engine vehicles, catalytic converters can then be introduced to reduce CO, HC and NO_x and in diesel powered engine vehicles, the use of purifiers and filters can cut particulate and other emissions dramatically.

ULG is needed to operate catalytic converters that come as standard in modern cars.

Catalytic converters reduce the tailpipe emissions of HC, CO and NO_x and pollutants emitted with engine exhaust gases. Lead not only reduces the efficiency of the catalyst but can destroy it.

A summary of key pollutants other than lead emitted from gasoline and diesel-powered vehicles is summarized in Figure 2.3.

Figure 2.3 Summary of Other Key Pollutants and Health Issues

Particulate matter (PM) is a growing problem in many urban areas in developing countries. Collectively, particulate pollution is often referred to as Total Suspended Particulates (TSP). Fine particulates less than 10 and 2.5 microns in size are referred to as PM10 and PM2.5, respectively. These have the most significant impact on human health because they can penetrate deep into the lungs. PM emissions are a key health concern with estimated economic damage costs much higher than for other pollutants. Major sources of particulate pollution in urban areas are likely to be industry and commerce, re-suspension of road and construction dust, and vehicles. In non-urban areas, sources such as agricultural burning contribute significantly to overall particulate pollution, and their impacts are also felt in urban areas.

Carbon monoxide (CO) is an odorless, invisible gas, formed when carbon in fuel is not burned completely. The inhalation of CO can disrupt the supply of essential oxygen to the body's tissues—thus posing a major health risk. Those who suffer from cardiovascular disease are most at risk. At high levels of exposure, CO can be fatal. Automobiles are the largest source of CO emissions. Lesser sources include industrial processes, non-transportation fuel combustion, and natural or manmade fires.

Nitrogen oxides (NO_x), including nitrogen dioxide (NO₂), are mainly produced by fossil fuel combustion in urban areas. They play a major role in the formation of ozone, particulate matter, and acid rain. Short-term exposure, even less than three hours, to low levels of NO₂ may lead to changes in lung function in individuals with pre-existing respiratory illnesses and can increase respiratory illnesses in children. Long-term exposure to NO₂ may increase susceptibility to respiratory infections and cause permanent alterations in the lung. Diesel-powered vehicles are a major contributor to NO_x emissions.

Hydrocarbons (HC) and other Volatile Organic Compounds (VOCs)—low-molecular weight compounds cause unpleasant effects such as eye irritation, coughing and sneezing, drowsiness; heavy molecular-weight compounds may have carcinogenic or mutagenic ef-

Figure 2.3 (continued)

fects. Some hydrocarbons have a close affinity for diesel particulates and may contribute to lung disease.

Ozone (O₃) is a highly reactive gas, formed by the reaction of VOCs and NO_x in the presence of heat and sunlight. Ozone can cause a range of acute health effects including eye, nose and throat irritation, chest discomfort, coughing and headaches. Children who are active outdoors when ozone levels are high are most at risk. Ozone also affects vegetation and ecosystems, decreasing yields of commercial crops and plantations and lowering the aesthetic value of national parks.

Non-health Impacts—While health impacts are no doubt the most compelling reason to take action, non-health costs of pollution are also significant. These costs include those stemming from congestion and loss of productivity, and damage to ecosystems and physical infrastructure. Transboundary and global impacts include acid rain, global warming, and damage to stratospheric ozone.

Green House Gases—Some greenhouse gases occur naturally in the atmosphere, while others result from human activities. Naturally occurring greenhouse gases include water vapor, carbon dioxide, methane (CH₄), nitrous oxide, and ozone. Very powerful greenhouse gases that are not naturally occurring include hydro fluorocarbons (HFCs), per fluorocarbons (PFCs), and sulfur hexafluoride (SF₆), which are generated in a variety of industrial processes.

Table 2.3 shows that use of catalytic converters can reduce emissions of CO, VOC, NO_x and CH₄ by 5 to 10 times compared to a well “tuned-up” car without a catalytic converter.

Indoor air pollution is also a potential or real problem in many urban households. Indoor air pollutants are recognized as a potential source of health risks to exposed populations throughout the world. Problems vary widely in industrialized and non-industrialized settings. In rural environments exposure to emissions from biomass burning for cooking or heating is the main problem. In urban areas such pollution can originate from cooking or heating, and be worsened by poor ventilation. Epidemiological

Table 2.3
Reduction in Gas Emissions in Vehicles
with or without Catalytic Converters

	without c.c.	with c.c.
“well tuned-up”		
CO (gm/km)	42.67	6.86
VOCs (gm/km)	5.62	0.67
CH ₄ (gm/km)	0.19	0.04
NO _x (gm/km)	2.70	0.52

Source: Eleodoro Mayorga Alba (2001)

studies have indicated that women and children who spend large portions of the day in the home are often exposed to high levels of pollutants there. In addition, the location of the home is a major determinant of total exposure. Poor outdoor pollution also increases indoor air pollution levels.

2.6 Other benefits

Improved fuel quality to standards similar or equal to that used by other countries in the region will have important economic benefits:

- ▲ Economic—facilitation of regional trade and cooperation, larger markets and economies of scale;
- ▲ Security of supplies—fuel of a suitable quality can be sourced from a range of markets/suppliers;
- ▲ Facilitate capacity building—knowledge and skills enhancement will be increased through wide access to technical expertise; and
- ▲ Environmental—joint implementation of environmental standards with neighboring countries in the region.

CHAPTER

Potential cost advantages and disadvantages in lead phase-out



This section discusses a number of potential costs impacts that could potentially arise from leaded gasoline phase-out although as shown below in many cases the various cost factors are favorable to the case for leaded gasoline phase-out, or very minor.

3.1 Fuel prices – ULG is cheaper in international markets

Lead is harmful to human health and does not occur naturally in gasoline. But lead has traditionally been used in gasoline since the early 1920s as it is the cheapest means of increasing octane level. It also protected exhaust valve seats in older vehicles that were designed to operate on leaded gasoline. Both of these requirements can now be met by use of ULG which has additional, significant health benefits to the population at large (EPA, 1996; Chevron, 1990; Shell; 1990).

Since around 85% of the world's gasoline sales are now ULG, ULG is almost always cheaper to purchase on world markets.

For example, prices of gasoline (leaded and ULG) varied as follows recently in selected international markets:

- ▲ Barges FOB Rotterdam for 5 days ending Jan 31, 2003²): Premium leaded gasoline (0.15g/l) was US\$ 314 – US\$ 319/ barrel

and Premium unleaded was US\$ 315 to US\$ 317/barrel. Since a barrel is approx 162.75 liters **ULG is cheaper by US\$ 0.012/liter in this example.**

- ▲ In the Gasoline International Market, FOB NEW Premium ULG was US\$ 303 per US gallon compared to FOB Medium leaded (0.15g/liter of lead) was US\$ 310.6 per US gallon. **ULG is cheaper by US \$0.043/liter in this example.**

Fuel price quotations are stated as CIF (cost, insurance and freight)—i.e. where usually the bidder would quote the product CIF meaning that they would be prepared to sell the fuel at the price including, cost of fuel, freight and insurance to bring the goods to the named port of destination e.g. CIF Djibouti.

Given that Ethiopia purchases around 188M liters of fuel per year, the foreign exchange saving to the country in purchasing ULG, compared to the leaded gasoline used in the examples, would vary between **US\$ 2.26M and US\$ 8.08M per year. This would be a major potential foreign exchange saving.**

² According to the January 2003 edition of Platt's "Oilgram Price Report"

3.2 Change-over costs

With a single grade³ of gasoline (now 91 RON) it is a straightforward matter to convert to ULG. After stopping leaded gasoline imports, after a suitable transition period in which all significant traces of lead are removed, a switch to ULG can immediately take place with no infrastructure costs or transition issues.

What is the length of a suitable transition period? This would be best determined by industry but is believed to require three rotations of gasoline in which all gasoline is flushed out and replaced each time by a new ULG load. In remote, up country locations one rotation would take around one or more months. Hence, a transition period of around six months would seem appropriate for tanks at Ethiopia's 493 petrol stations.

In addition, the government has 12 strategic fuel depots (for war, emergency) with a total capacity of 225M liters. The majority of the capacity of these strategic depots is allocated to diesel fuel and not gasoline. Some of this gasoline fuel in these up-country depots may have to be transported back to Addis Ababa to where it will be consumed at a small additional cost.

A program to flush the relevant strategic depots and other industry-owned depots would need to be planned but would not involve any additional cost.

Overall, a carefully planned changeover to ULG could be achieved with no significant extra cost being incurred.

3.3 Suitability of Older Vehicles with Soft Valve Seats to Use ULG

While generally all vehicles manufactured worldwide since 1980 are able to use ULG without engine damage there was concern that older

vehicles (with soft valve seats) may experience some problems as described above. Some models of pre-1980 European car have soft valve seats. Lead, in addition to boosting octane rating, also acts as a valve lubricant and prevents wear in engines with soft valve seats.

The chief concern in the past that has now largely been disproved has been the possibility of exhaust valve seat recession particularly when engines with soft valve seats are operated on ULG. As Ethiopia's vehicle fleet has many older vehicles, the possible extent of vehicles that may have soft valve seats needs to be considered. But there is almost no reliable data on the age structure of the vehicle fleet or their propensity to have soft-valve seats

At present the in-use Ethiopian vehicle fleet is estimated by the Ethiopian Road Transport authority to be 130,000⁴ vehicles after a recent review. Approximately 65% of the in-use fleet or 85,000 vehicles are estimated to use gasoline. These vehicles are mainly cars or used for personal transport. It is estimated that some 35% of cars are older than 20 to 23 years (i.e. pre-1980). The balance of the in-use fleet of 45,000 vehicles consists of commercial vehicles which use diesel fuel.

³ Prior to the new gasoline specification being introduced in the first half of 2003, there was only a regular grade of gasoline with 87RON. The new specification that was brought into law in early 2003 provides for both regular and premium gasoline, and leaded and unleaded types. In Ethiopia by July 1, 2003 the gasoline imported into Ethiopia will all be unleaded regular gasoline with around 90 to 91RON.

⁴ This is some 65% of the registered vehicle totals. Note that these data are very different to that reported by Raynor (2002) which stated that Ethiopia's car fleet was 43,900 vehicles and its commercial vehicle fleet was 30,400 vehicles giving a total of 74,300 vehicles.

In the USA in 1970, about a third of cars had valves seats made of soft metals. It could be assumed that less than a third of vehicles manufactured between 1970 and 1980 had soft valve seats. For the purposes of this report it has been assumed that a fifth of vehicles older than 20 years in Ethiopia may have soft valve seats. Applying this to the 35% of vehicles older than 20 years gives an estimate of around seven percent of Ethiopia's car fleet that may have soft valve seats.

While engines tend to be continually rebuilt, some older vehicles may have had their engine replaced by an imported Japanese or other engine; hence, the estimate of seven percent is thought to be on the high side.

But it appears that in the past, too much lead has been added to gasoline for the purposes of lubrication – only some 0.02gm/liter are needed for lubrication purposes. That is, even in older cars with soft valve seats the amount of lead required is small. Only every fourth or fifth tank need be leaded (Shell Science and Technology).

But studies by US-EPA found that the theoretical problem of valve seat recession that could occur if soft-valve seat engines use ULG is unlikely to occur. Under laboratory test conditions, it was found that some five hours of driving at 100km/hr would be required to cause the problem to start to occur and then the (old) car is likely to fail from some other problem.

Chevron (1990), a US Oil Company, has concluded that all typical US passenger cars and light-duty trucks are safe from valve recession when operated on ULG. Weaver (1996) "...concluded that much of the concern about valve seat recession in normal use has been misdirected and exaggerated".

Radian (1994) concluded that reducing lead in gasoline is a win-win action as it will extend

spark plug life, increase the interval between oil changes and extend exhaust system and muffler life. These findings have been also confirmed by US-EPA (1985).

That is, recent international experience has confirmed that the potential damage to be at worst, a minor issue and to the extent that the problem exists, is able to be completely resolved by the addition of appropriate (lubricant) additives to the fuel.

Finally, many countries around the world with older car fleets similar to those in SSA countries have recently phased-out leaded gasoline without use of lead-substitute additives in ULG (e.g. Colombia, Honduras, Bolivia, and Guatemala) and no problems have been reported.

Participants from the Ethiopia workshop considered that valve seat recession was a non issue in the context of Ethiopia. Hence, no further action on this subject was recommended.

3.4 Conclusion

It is concluded that there are no significant costs involved in changeover to ULG. In summary,

- ▲ A switch to ULG will lead to significant foreign exchange savings;
- ▲ Changeover costs are expected to be negligible;
- ▲ The impact of ULG on engines with soft valve seats is expected to be insignificant and no additives to lubricate soft-valve seats are required; and
- ▲ Reduced maintenance costs for cars are expected.

CHAPTER

4 Priority issues and recommendations for leaded gasoline phase-out



The discussion of overall benefits (Chapter 2) and costs (Chapter 3) of the phase-out of leaded gasoline shows that the benefits are likely to greatly exceed the costs which are virtually nil or actually in favor of the leaded gasoline phase-out decision.

The Government of Ethiopia has already shown foresight and promulgated new standards for gasoline including ULG. As of July 1, 2003, only ULG will be imported into Ethiopia. What remains to be done is to announce the phase-out date to consumers once all traces of lead are flushed out of the distribution system. Other actions such as those that improve the quality of other fuels are also required.

It is therefore recommended that:

- ▲ **Recommendation 1** – The Cabinet of the Government of Ethiopia immediately announces to consumers that by the beginning of 2004 leaded gasoline will be completely phased-out at that time, and instead a single grade of ULG will be supplied to the market.

As demonstrated in this report, the phase-out of leaded gasoline is but a first step in developing a more comprehensive approach to air quality management which would include actions on:

- ▲ Improving fuel quality and developing new fuel specifications;

- ▲ Upgrading the quality of vehicle imports and emission controls;
- ▲ Establishing baseline inventories of key pollutants and health effects; and
- ▲ Developing an appropriate public information or awareness campaign.

The issues involved in leaded gasoline phase-out and air quality improvement involve many groups in society and consequently it is recommended that:

- ▲ **Recommendation 2** – The Cabinet of the Government of Ethiopia commits to establishing a multi-sectoral stakeholder group by end 2003 consisting of senior members of government agencies, the oil industry, and civil society including Non-Government Organizations (NGOs) and consumer groups for a period of at least three years. The Ethiopian EPA, Ministry of Health and Ministry of Trade and Industry would have lead roles in its implementation. Further details of the role of individual organizations are made in Chapter 5. This multi-stakeholder group would oversee implementation of the public awareness activities and provide feedback and advice to implementation agencies. A proposed draft mandate for this group is included in Chapter 9 – Annex C.

The benefits from a more comprehensive approach to air quality management are ex-



pected to be significant and it is therefore recommended that:

- ▲ **Recommendation 3** – The Cabinet of the Government of Ethiopia commits to developing a more comprehensive approach to air quality management by end 2003 based on the Terms of Reference (ToR) described in Chapter 10 – Annex D and recommended action plan set out in Table 5.1. Ethiopian EPA would have the lead role.

These first three recommendations are considered fundamental or key recommendations. A series of important associated recommendations that flow from the above are presented below. Except where indicated the recommended actions below are believed to be cost neutral or favorable to the lead phase-out decision (i.e. save money).

4.1 Fuel specifications and fuel quality

Ethiopia's present gasoline fuel specifications (contained in Annex A) have recently been updated and generally considered appropriate for the present. A remaining concern is that there is no control of benzene and aromatics – it would be desirable that the standards be revised to contain limits for these compounds. In the June workshops, the Ethiopian Petroleum Enterprise (EPE) expressed their view that proceeding to control limits for benzene and aromatics should be based on a cost-benefit analysis and this study should be commenced as soon as possible. In the short to medium term, it would be desirable that fuel quality standards be set on a regional basis.

Therefore, it is recommended that:

- ▲ **Recommendation 4** – EPE immediately conduct a cost-benefit analysis to examine the appropriate limits for benzene and aromatics and that the gasoline standard be modified accordingly.

Diesel and other fuel specifications are also in need of updating. In Ethiopia at present the standard for sulfur content in diesel fuel is 1% by weight or 1,000 ppm (actual average is 0.85% or 8,500ppm). This is probably due to Middle East Refineries processing high sulfur crudes. Most developed and many developing countries have specified or are considering lowering the maximum permitted sulfur levels in diesel fuel to 500ppm or lower.

Even though there are at present no measurements of air quality, as sulfur is a major contributor to smoke and PM emissions from buses and other commercial vehicles, it would appear that it would be highly beneficial to reduce sulfur content in diesel fuel. As Ethiopia is an oil importing country it may be able to source low sulfur diesel fuel on world markets for no additional cost. At the workshop held in Addis Ababa on June 12–13, 2003 it was considered that lower sulfur diesel fuel is required but the cost-effectiveness of moving to lower sulfur fuel and the timetable for implementation needs further study.

Even though there is an absence of comprehensive measurements of air quality or the source of emissions it is known that Ethiopia's buses and trucks are gross polluters of PM and black smoke.

As a first step, therefore, it is recommended that:

- ▲ **Recommendation 5** – Ethiopia's Quality and Standards Authority commit to lowering the sulfur content in diesel fuel. After detailed study of the cost-effectiveness

of moving to lower sulfur diesel, it will propose the target sulfur levels and associated timetable.

To support the leaded gasoline phase-out decision and program for overall fuel quality improvement, it is recommended that:

- ▲ **Recommendation 6** – Ethiopia’s Quality and Standards Authority should develop appropriate revised specifications for diesel fuel and other fuels. Ideally, these should be developed on a regional or sub-regional basis.

The quality of fuel sold into the market has been an issue in the past. Ethiopia’s Quality and Standards Authority does not presently have the power to enforce the in-market fuel quality. One mechanism may be for the Quality and Standards Authority to contract an independent, capable institution to monitor the quality of fuels sold in the market. An alternative mechanism may be for a new institution to be established to carry out this in-market quality compliance. It is therefore recommended that:

- ▲ **Recommendation 7** – The Ethiopian Government should establish an appropriate mechanism to monitor the quality of fuels sold in the market.

4.2 Vehicle imports and emission controls

As for many other developing countries, Ethiopia relies on the import of second hand vehicles to supply its vehicle markets. New vehicles are also imported but have a minor role.

Second hand vehicles have typically already done significant mileage and are usually aged

between 5 and 10 years. As the source of most vehicles would be Europe most would be equipped with functioning catalytic converters when they enter the country. At present, these catalytic converters are left intact while operating in Ethiopia on today’s leaded gasoline. They are therefore destroyed in-use by the lead additive.

As the Ethiopian vehicle market is price-sensitive⁵ there appears to be an exhibited preference for older vehicle imports (towards 10 years old rather than five years) with most likely poorer performance in terms of emissions.

While significant benefits are to be derived from the use of ULG on its own, even greater benefits to air quality and public health will be incurred through the reduction of other emissions by the mandatory use of catalytic converters in cars. It is therefore recommended that:

- ▲ **Recommendation 8** – All cars imported into Ethiopia from January 1, 2004 be fitted with a functioning catalytic converter and that this is to be certified by the exporter in the country of origin, and the importer in Ethiopia prior to the vehicle being registered for on road use in Ethiopia.

⁵ The tax rates are the same for both new and imported vehicles. When used cars are imported, a depreciation discount of 10% per year for a maximum period of three years, (30% maximum for 3 years or more) is allowed on the customs-determined value of the vehicle, not on the purchase price. There is no restriction on imports based on the age of vehicles. The tax rates are: 40% duty plus up to 50% excise tax, 15% Value-added tax and 5% bank charges. The major advantage of importing used cars comes from the low price for second hand cars in Europe and elsewhere.

- ▲ **Recommendation 9** – Ethiopian Road Transport Authority should not register an imported vehicle without these two certifications being present.

At present, there are no regulations governing the quality of imported new or second hand vehicles, their age or the extent of their emissions. Ethiopia's present system of reliance on second hand imports while having many benefits needs to be adjusted to ensure that over time, the quality and level of technology (which with fuel quality governs emission levels in new vehicles) in imported vehicles continue to improve.

- ▲ **Recommendation 10** – It is recommended that in the short term the Ministry of Finance and Economic Development structure taxes on imported vehicles so as to favor younger, less-polluting vehicles. For gasoline-powered vehicles these should have working catalytic converters.

There is no effective inspection and maintenance (I/M) system for in-use vehicles at present in Ethiopia. It is recommended that:

- ▲ **Recommendation 11** – In the medium term (2 to 4 years) the effectiveness of the existing system of I/M be investigated and options to improve the I/M system be developed and analyzed to reduce emissions from in-use vehicles. A traditional I/M system may be difficult to sustain due to lack of capacity—an appropriate system may consist of random checking of gross pollutants. The responsible agencies are the Ethiopian Environmental Protection Authority and the Road Transport Authority.

4.3 Base line studies of emissions & health impacts & strengthening the environmental legislative framework

Given a decision to phase-out leaded gasoline it is recommended that:

- ▲ **Recommendation 12** – In order to create a suitable base-line to measure the benefits of the lead phase-out decision, statistically valid measurements of blood level lead in currently vulnerable groups (e.g. traffic policemen, school children etc) and a suitable control group, should be carried out in Addis Ababa. The responsible agency is the Ministry of Health.

Prior to designing other interventions to reduce other pollutants initial base line, studies to establish an initial emissions inventory and the likely severity of health impacts of each pollutant will need to be developed. They will require technical assistance which may be able to be provided by the World Bank, the United Nations Environment Program (UNEP) or other donors. The estimated cost of this activity is US\$ 100,000. It is recommended that:

- ▲ **Recommendation 13** – An emissions inventory from mobile and other sources be developed by the Ethiopian Environmental Protection Authority. The following pollutants should be targeted at first with both ambient and roadside measurements conducted at a small range of representative sites in Addis Ababa:
 - PM_{2.5}
 - CO
 - HC and
 - NO_x

The main agency responsible would be the Ethiopian Environmental Protection Authority (EPA). The estimated cost of this activity is US\$ 500,000.

In the medium term, EPA will require technical assistance and training to establish a functioning, embryonic monitoring system and this may be able to be provided by the World Bank and/or the United Nations Environment Program (UNEP). The World Bank will aim to facilitate Regional Cooperation in SSA to achieve a harmonized approach to air quality monitoring possibly on a sub-regional basis.

As part of a strengthened environmental monitoring framework that is being studied by the Ethiopian EPA at present there is a need for appropriate laws to control emissions from mobile and stationary sources. To assist in the enforcement of these laws, on-going compliance monitoring and additional strengthening of enforcement capacity are required. It is recommended that:

- ▲ **Recommendation 14** – As an integral part of a strengthened environmental monitoring framework for Ethiopia, Ethiopian EPA establish an appropriate legal basis to measure and ensure compliance of emissions from mobile and stationary sources with appropriate standards.

4.4 Public Awareness Campaign

The public needs to be empowered through information and education to advocate for and accept unleaded gasoline as a positive factor as well as to address potential concerns of the users. Information is required for stakeholders to understand the details such as effect on vehicles, health and environment and fuel specifications. It is also important to inform the public what others are doing (alignment with

the rest of the world). There is also the need to justify the proposed action plan to the public. It would be desirable that the public have information on the actions other sub-Saharan countries have taken to phase out leaded gasoline and its implications.

Initial visits to Ethiopia indicate that there is also a general lack of information on unleaded at the government level and there are some public impressions, myths and misconceptions about the negative effects of lead on vehicles, the effect of unleaded fuel on vehicles as well as a lack of knowledge on the role of the catalytic converter, and the health effects of lead on adults and children.

Discussions also revealed that it is the duty of the Government to communicate on the positive move it is taking in order to get the Public to support the initiative.

Lessons show that building the capacity in the community is a slow process but confidence can be built eventually. Confident and well informed communities enhances understanding of health risks, allays myths and misperceptions. As community awareness is enhanced they can be expected to start to advocate for improved air quality and the phase out of lead from fuel.

The decision to phase out the use of leaded gasoline and subsequent actions to adopt a more comprehensive approach will be supported by a well designed approach to public awareness rising, therefore, it is recommended that:

- ▲ **Recommendation 15** – a public awareness campaign, designed to inform the public, government officials, industry and others, be developed as an integral component of the decision to phase-out the use of leaded gasoline and of the subsequent actions to improve air quality on a more comprehensive basis. The recommended multi-sector stakeholder group would be overseeing this activity although it is envis-

aged that the Environment Protection Authority and Ministry of Health could have a role as a technical secretariat certainly at the commencement of the campaign.

The broad recommended actions that correspond to this recommendation are shown in Table 5.1 of the next chapter. However, in Chapter 6 these recommended actions are expanded with a detailed but indicative public awareness plan that can be expected to be modified during implementation. The cost of

the public awareness activity to support the lead phase-out decision and associated awareness rising is expected to be \$100,000 in the first year of implementation with a funding commitment of \$50,000/year allocated for subsequent years. This funding would be additional and would not include relevant budgets of industry, government agencies etc for similar activities. A three-year program of public awareness rising is the minimum that should be contemplated.

5 CHAPTER

Action Plan to phase out leaded gasoline and next steps



The recommended actions presented in Chapter 4 together form the basis of an Action Plan (Table 5.1) that would move Ethiopia towards a more integrated approach to air quality

management in Addis Ababa and other urban areas, starting with the leaded gasoline phase-out decision.

Table 5.1
Action Plan for leaded gasoline phase-out and next steps

Recommended Actions	Immediate	Year 1 (03/04)	Years 2 to 4 (04/05 to 06/07)
1.	The Cabinet of the Government of Ethiopia immediately announces to consumers that by the beginning of 2004 that leaded gasoline will be completely phased-out at that time, and instead a single grade of ULG will be supplied to the market.		
2.	Ethiopian Cabinet commits to establishing a multi-sectoral stakeholder group by end 2003 consisting of senior members of government agencies, the oil industry, and civil society including Non-		



Table 5.1 (continued)

Recommended Actions	Immediate	Year 1 (03/04)	Years 2 to 4 (04/05 to 06/07)
	Government Organizations (NGOs) and consumer groups. This group should be established for a period of at least three years.		
3.	Ethiopian Cabinet commits to developing a more comprehensive approach to air quality management by end 2003 based on the Terms of Reference (ToR) described in Annex C.		
Fuel specifications and fuel quality			
4.	EPE immediately conducts a cost-benefit analysis to examine the appropriate limits for benzene and aromatics and to modify the gasoline standard accordingly.		
5.		Ethiopia's Quality and Standards Authority commits to lowering the sulfur content in diesel fuel. After detailed study of the cost-effectiveness of moving to lower sulfur diesel, it will propose the target sulfur levels and associated timetable.	

Table 5.1 (continued)

Recommended Actions	Immediate	Year 1 (03/04)	Years 2 to 4 (04/05 to 06/07)
6.		Ethiopia's Quality and Standards Authority should develop appropriate revised specifications for diesel fuel and other fuels. Ideally, these should be developed on a regional or sub-regional basis.	
7.		The Ethiopian Government should establish an appropriate mechanism to monitor the quality of fuels sold in the market.	
Vehicle imports and emission controls			
8.		All cars imported into Ethiopia from January 1, 2004 are required to be fitted with a functioning catalytic converter. This is certified by the exporter in the country of origin, and the importer in Ethiopia prior to the vehicle being registered for on road use in Ethiopia.	
9.		The Ethiopian Road Transport Authority refuses to register an imported vehicle without sighting the export and import documents that certifies a functioning	

Table 5.1 (continued)

Recommended Actions	Immediate	Year 1 (03/04)	Years 2 to 4 (04/05 to 06/07)
10.		<p>catalytic converter is present.</p> <p>The Ministry of Finance and Economic Development should structure taxes on imported vehicles so as to favor younger, less-polluting vehicles. For gasoline-powered vehicles these should have working catalytic converters.</p>	
11.			<p>Ethiopian Environmental Protection Authority and the Road Transport Authority should study the effectiveness of the existing system of I/M and develop and analyze options to improve the I/M system in order to reduce emissions from in-use vehicles. A traditional I/M system may be difficult to sustain due to lack of capacity—an appropriate system may consist of random checking of gross pollutants.</p>

Table 5.1 (continued)

Recommended Actions	Immediate	Year 1 (03/04)	Years 2 to 4 (04/05 to 06/07)
Base line studies of emissions and health impacts & strengthening the environmental legislative framework			
12.		Ethiopian Environmental Protection Authority and Ministry of Health develop a suitable base-line to measure the benefits of the lead phase-out decision with statistically valid measurements of blood level lead in vulnerable groups and a suitable control group in Addis Ababa. Cost: US\$100,000.	
13.	Sources of technical assistance for preparation of the emissions inventory should be considered by the Ethiopian Environmental Protection Authority. These sources could include the World Bank and/or the United Nations Environment Program (UNEP).	Ethiopian Environmental Protection Authority prepares an appropriate emissions inventory from mobile and other sources. The following pollutants should be targeted: PM _{2.5} ; CO; HC; and NO _x . Cost: US\$500,000.	The World Bank facilitates Regional Cooperation in SSA to achieve a harmonized approach to air quality monitoring possibly on a sub-regional basis.

Table 5.1 (continued)

Recommended Actions	Immediate	Year 1 (03/04)	Years 2 to 4 (04/05 to 06/07)
14.		As part of a strengthened environmental monitoring framework for Ethiopia, Ethiopian EPA establish as an appropriate legal basis to measure and ensure compliance of emissions from mobile and stationary sources with appropriate standards.	
Public awareness campaign			
15.	Ethiopian Cabinet commits to developing a comprehensive approach to public awareness rising as further amplified in Chapter 6.	On-going consultation and activities as described in Chapter 6 (Table 6.1). Cost: Year 1: US\$ 100,000 ⁶ .	On-going consultation and activities as described in Chapter 6 (Table 6.1). Cost: US\$ 50,000/ year subsequently.
16	Identify sources of funding for the public awareness activity and develop initial materials as discussed in Chapter 6 (Table 6.1).		

⁶ This funding would be additional and would not include relevant budgets of industry, government agencies, etc. for similar activities.

CHAPTER 6

Indicative Public Awareness Campaign



This section of the report and action plan amplifies the details of what might constitute an appropriate approach to developing a public awareness campaign that is suitable for Ethiopia. Once a commitment is made to the phase-out of lead in gasoline and to the need for a public awareness campaign, the details of the campaign can be refined to match prevailing circumstances and other proposed sub-regional programs such as that proposed by UNEP.

Creating opportunities for the participation of the public in the implementation of national action plans (through information gathering and dissemination) to phase out leaded fuel in oil importing countries such as Ethiopia will help to provide information and build capacity on the health risks, legislation, partnership opportunities with various stakeholders and advocacy needed for its success.

This will in turn build capacity at community level to engage in local initiatives and interventions and to be part of a consultative group that would feed into policy and decision making in the implementation of the lead phase-out plan and air quality management plans.

It is envisaged that once a decision is made by Ethiopian Cabinet to phase-out leaded gasoline and to commit to other actions in the Action Plan (Table 5.1), then the recommended multi-sectoral stakeholder group (A proposed draft mandate for this group is included in Chapter

9 – Annex C) would take responsibility for overseeing the development and implementation of an appropriate public awareness campaign. This stakeholder group would need funding and the technical support of a secretariat—it is envisaged that the Ethiopian Environment Protection Authority and Ministry of Health could play this role on a joint basis initially.

As discussed in Chapter 4 and summarized in Table 5.1, the cost of the public awareness activity to support the lead phase-out decision and associated awareness rising is expected to be \$100,000⁷ in the first year with a funding commitment of \$50,000/year allocated for subsequent years. A three-year program of public awareness rising is the minimum that should be contemplated.

6.1 Objectives and outputs

The objectives of a suitable public awareness campaign are:

- ▲ To sensitize and create awareness of the public on the change from leaded fuel to ULG, the health risks of car generated air pollution and exposure to leaded gasoline,

⁷ This funding would be additional and would not include relevant budgets of industry, government agencies etc for similar activities.



thus exposing them to the benefits to health, safety and environment.

- ▲ To assist the public to understand that unleaded gasoline will not adversely affect vehicle performance and to empower the public to enable them participate in initiatives/interventions towards the prevention and management of air pollution and the implementation of a lead phase-out plan.

The desired outputs are:

- ▲ Enhanced understanding by civil society and the creation of a well-informed public on the health risks of exposure to lead and benefits of the phase out plan for effective decision-making;
- ▲ Public acceptance of the new fuel as a positive factor that improves air quality and thereby protects public health is ensured;
- ▲ Civil society and local communities are involved in the phase-out plan and participating in initiatives to improve air quality management and control; and
- ▲ Education materials for priority issues and messages for the lead phase-out and air quality public education awareness strategy are developed/adapted.

6.2 Target audience

The target audience of the proposed public awareness campaign would include:

- ▲ Motorists and the general public;
- ▲ Mechanics/garages;
- ▲ Local Communities and Schools (Parents/School children);
- ▲ Government officials and consultants;
- ▲ Parliamentarians and other policy makers;

- ▲ The mass media (journalists);
- ▲ Pump attendants and dealers;
- ▲ Government Institutions; NGOs; Civil society; Higher learning institutions;
- ▲ Car importers; Fleet owner Organizations; Taxi Drivers Association; Garage Associations; and
- ▲ Development Partners.

Materials and messages for the campaign

It is recommended that materials for the information campaign be developed and shared on a regional basis in order to reduce costs and ensure uniformity. It should be community friendly, present facts and focus on culture.

Information should be targeted to different groups such as decision makers as well as the general public.

Initially messages for the campaign should focus on health, environment and economic benefits of unleaded gasoline.

6.3 Role of Civil society, media and other partners

The involvement of the following government institutions is essential to ensure the success of a public awareness campaign:

- ▲ Ethiopian Ministry of Trade and Industry;
- ▲ Ethiopian Petroleum Enterprise;
- ▲ Ethiopian Environmental Protection Authority;
- ▲ Ethiopian Quality and Standards Authority;
- ▲ Ethiopian Road Transport Authority;
- ▲ Ministry of Health;
- ▲ Ministry of Education;
- ▲ Ministry of Information; and
- ▲ Chamber of Commerce.

The following stakeholders shown in Table 6.1 need to be closely involved for information sharing and support.

6.4 Emerging issues

The following emerging issues provide challenges and opportunities for developing an

Table 6.1
Role of Civil society, media and other partners

Stakeholder	Role	Detail
Civil Society- NGO's, Associations and Networks	<ul style="list-style-type: none"> ▲ Involvement/participation of local coalition NGO's and Networks such as Africaclean, in Information Gathering and Dissemination to facilitate broad consensus (political and social) and acceptance among stakeholders and the public. ▲ Provide information, knowledge and expertise and sensitize during consultations to create awareness on health risks of car-generated pollution, lead in fuel, impacts of the phase-out and other successful phase-out programs. ▲ Advocacy – lobbying governments to act and monitoring compliance according to national action plans regarding fuel specs, quality enforcement and pricing. ▲ Participate in group training 	<p>Issues to include:</p> <ul style="list-style-type: none"> ▲ The elimination of lead from gasoline as the first step to improve air quality in the SSA ▲ Dispelling the myths and telling the facts about lead in fuel (and blood lead levels), that all cars can use unleaded fuel. ▲ No extra cost and cheaper on the world market ▲ That average lead content is already reduced (0.01-0.09g/l) ▲ That safe alternatives to lead are available ▲ Negative impacts of urban air pollution especially lead and PM on health. ▲ Vehicle imports and maintenance (In Ethiopia at least 35% of gasoline-powered vehicles are older than 20 years.) ▲ Participation in Local initiatives and capacity building on lead phase-out issues. ▲ Improved Health & environment ▲ Decreased maintenance cost of vehicle ▲ Better engine performance

Table 6.1 (continued)

Stakeholder	Role	Detail
		<ul style="list-style-type: none"> ▲ Child Health and Environment ▲ Broad message declarations by government to phase out lead ▲ Support statements from development partner
The Media	<p>Facilitating a national media outreach to generate demand for the unleaded fuel and support for the campaign. This includes a variety of communication channels for mass media (radio, TV, newspapers, leaflets and bill boards, press releases/conferences).</p> <ul style="list-style-type: none"> ▲ Participate in group training 	This also includes specific targeting for Addis Ababa and other major cities using little/group media for identified groups such as street groups/traders, mechanics, commercial transport owners and operators, gasoline pump attendants and schools.
The Private Sector- Fuel transporters who are private owners, Haulage truck owners, Commercial Transport unions, Individuals	Advocacy and support.	Participate in training, baseline studies and other interventions.
Parents and Schools	Advocacy.	Participate in training through curriculum developed for teachers and related activities, focusing on child health issues.
Research Institutions, University, Environmental protection Authority	Monitoring and baseline studies.	Baseline surveys—on relevant behaviors such as usage of fuel, trends in fuel usage, issues of concern, blood lead levels and air quality.
Development Partners-WHO, UNEP, World Bank	Financial and technical support.	Funding for local initiatives, Emissions monitoring, Air Quality Baseline studies and Information dissemination.

Table 6.1 (continued)

Stakeholder	Role	Detail
Regulatory Agencies- Ethiopia's Quality and Standards Authority, Ethiopian Road Transport Authority	Provide technical support.	Information dissemination and materials development.
Government Ministries & agencies for Health, Environment, Energy and Transport, Standards	Set up multidisciplinary stakeholder steering committee on public information/ education. Participate in group training	To develop communication plan and steer public awareness activities.
Oil marketing companies/ Associations	Provide financial and technical support.	For awareness campaigns; Research-Monitoring and baseline studies; Participation in consultations; and Training programs for target groups.
Parliament	Legislation and advocacy. Participate in group training	Vehicle import tax regulations, emissions and other regulations.

appropriate public awareness campaign and encouraging public participation:

- ▲ The thinking that there might be price differences or extra cost incurred by the change to unleaded gasoline. The public needs to be assured that there is no extra cost. This needs to be verified within the framework of the changes to the oil marketing arrangements anticipated after October 2003;
- ▲ The need for education about the perceived effects of unleaded gasoline on old vehicles especially when at least a third of vehicles are over 20 years. The effect on the valve seat in older vehicles needs to be explained. It may be necessary to identify specific models of vehicles that are likely to be adversely affected by unleaded gasoline to afford a more scientific basis and help the public fully appreciate the issues including that effects are likely to be minimal;
- ▲ The concern about fuel quality and implication of current RON Levels, fuel specifications and public opinion after the change over if vehicles develop “normal” faults, etc;
- ▲ The role and benefits of catalytic converters and how to maintain their correct functioning;
- ▲ The need for discussion of options of other safe alternatives to lead as well as the advantages and disadvantages of each;
- ▲ Information dissemination on the need to minimize the health impacts of lead and other pollutants as well as impact on water quality to encourage prioritization of air quality measurements and assessments of blood lead levels. There is little informa-

tion on lead poisoning or any specific measure of the extent of the poisoning;

- ▲ Benefits of unleaded gasoline to motorists: reduced health impacts, reduced maintenance;
- ▲ Regulation on importers of old polluting vehicles; and
- ▲ The need for information of both technical difficulties in phasing out lead and social implications to the public as well as assessments of collaborative studies in countries that have phased out and those with high levels of lead in gasoline.

6.5 Indicative Public Awareness Detailed Plan

The first part of the indicative public awareness plan includes an evaluation (through baseline studies and available information) of the public’s general level of awareness of the adverse effects of lead on health as well as the level of concern and misconception about the effects of ULG. The result of evaluation and monitoring activities will provide information for the educational campaign scope (scale and costs), message content and information to be developed and/or adapted from other sources.

Table 6.2
Indicative Public Awareness Detailed Plan

Recommended Actions	Immediate	Year 1 (03/04)	Years 2 to 4 (04/05 to 06/07)
The recommended actions are indicative and will be modified during implementation. They flow from key overarching actions set out in Table 5.1.	Create multi-stakeholder group to oversee implementation of the public awareness activities and provide feedback for implementation agencies—identify main stakeholders and partners in air quality management and the lead phase-out activities.	Consultation on a quarterly basis with representatives of identified target groups.	Consultation on a quarterly basis with representatives of identified target groups.

Table 6.2 (continued)

Recommended Actions	Immediate	Year 1 (03/04)	Years 2 to 4 (04/05 to 06/07)
	<p>Conduct a situational analysis/survey and develop a database on available information/research and evaluate public's general level of awareness of lead effects and air pollution. Develop monitoring indicators and survey tools. US\$ 10,000.</p>	<p>Conduct a baseline survey on relevant behaviors, public perceptions on the health risks trends of usage of fuels, perceptions on impacts on vehicle fleet, fuel specs and quality and blood lead levels.</p>	<p>Monitor impact of the campaign against indicators developed.</p>
	<ul style="list-style-type: none"> ▲ Organize consultative workshops to feedback information from the baseline research and to disseminate information on the national action plan. ▲ Organize showing of video documentary "Leaded Gasoline the silent threat" by the Clean Air Initiative (World Bank) in major urban areas. ▲ Other available documentaries on health impacts. 	<ul style="list-style-type: none"> ▲ Initiate mass communication and information dissemination program for targeted groups based on surveys, research, available information and materials adapted. ▲ Assess audience needs and an indication of preferred communication methods to facilitate acceptance of the new fuel and to dispel myths fears etc. 	

Table 6.2 (continued)

Recommended Actions	Immediate	Year 1 (03/04)	Years 2 to 4 (04/05 to 06/07)
	<ul style="list-style-type: none"> ▲ Other available documentaries on health impacts. ▲ Adapt posters and materials developed by the US-EPA ▲ Organize workshop to adapt / develop materials ▲ Coordinate with the Ethiopian Ministry of Trade and Industry, and Health and other local regional and international agencies, /stakeholders. ▲ Committees/stakeholders on materials, and type of media to be used. ▲ Establish budget needs and timing. 	<ul style="list-style-type: none"> ▲ Prepare ToR and issue contract for materials development and dissemination. ▲ Develop/adapt critically important messages pre-test and proceed with mass production – prepare/adapt audio visuals, flip charts, information fact sheets. ▲ Link specific messages to identified target groups 	
	<p>Develop a communication plan for implementation including launching the program at a forum, TV/ Radio discussions on health and developmental effects caused by exposure to lead, and what to do when changing to ULG.</p>	<ul style="list-style-type: none"> ▲ Use selected communication channels under mass and other media for specific target groups and the general public (Radio, TV, Billboards, newspapers, Information services department, Flip charts, group discussions, audiovisuals, Video documentary). 	<ul style="list-style-type: none"> ▲ Implementation of public awareness campaign in collaboration with stakeholders. ▲ Activities for public relations, advocacy and advertising ▲ Training talks, seminars and forums for identifiable nationwide groups. ▲ Organize children' programs in schools and on TV on hazards of leaded gasoline and benefits of unleaded gasoline.

Table 6.2 (continued)

Recommended Actions	Immediate	Year 1 (03/04)	Years 2 to 4 (04/05 to 06/07)
		<ul style="list-style-type: none"> ▲ Actively collaborate with local agencies and other organizations doing education and awareness programs, research, etc. on air quality management and leaded fuel phase-out (e.g. US-EPA, Alliance to End Childhood Poisoning, Africaclean, UNEP, WHO). 	
	<p>Create channels of communication for civil society input into policy and decision making</p>	<ul style="list-style-type: none"> ▲ Coordinate the set up of resource centers with management options (such as managed by local authorities in collaboration with civil society groups/NGO's) for implementation in the capital city and one other major urban center to facilitate information flow between the community and other stakeholders. ▲ Elicit consensus on future use of the center which could be open for use as reference center 	<p>Invite proposals for local initiatives/interventions to promote general air quality management issues and disseminate information on the phase-out.</p>



CHAPTER

Annex A – Terms of Reference for Preparation of this Action Plan

Energy Sector Management Assistance Program Improvement of the urban air quality and Phasing out of lead from gasoline in oil importing countries of Sub-Saharan Africa

THE CASE OF ETHIOPIA

TERMS OF REFERENCE FOR CONSULTANT SERVICES

7.1 Background

Following the agreement reached at the Dakar Conference (June 2001) the ESMAP Program has allocated funds for studies required for the preparation and implementation of national and sub-regional plans to eliminate lead additives from gasoline and to contribute in this way to the improvement of urban air quality in SSA countries net importers of petroleum products.

These importing countries are confronted with fewer difficulties to phase out lead from gasoline than those operating national refineries for the supply of their markets. The studies to be made will focus exclusively on the impacts to be expected from the change of products' quality only at the level of the consumers.

Indeed, for Ethiopia, as well as for other countries that import directly petroleum products, the studies should address the issues related to the consumer's preferences. The studies will be carried out at the same time of the setting up of a multi-organization working team gathering the different Government agencies, the oil companies and the organizations of the civil society that are interested by the formulation

of recommendations to eliminate lead additives from gasoline and to continue longer term efforts to improve the quality of air in their main cities.

In 2001, Ethiopia imported all of its petroleum products. Considering the prevailing price distortions, diesel is preferred by the majority of car owners. The consumption of the fishing artisan sector represents a significant percentage of the total gasoline supplied to these markets.

Ethiopia does not operate refineries. With the separation of Eritrea, Ethiopia has become independent of the product supplied by the AZAB Refinery. The supply of petroleum products is achieved by the means of procurement operations that still considers the importation of leaded gasoline.

7.2 Objective

The main aim of the consultant services hereby requested is the formulation and implementation of a national plan for eliminating leaded gasoline from the Ethiopian fuel market as well as the review of technical, environmental and

economic issues to be covered in the efforts of a network of public and private entities that is joining efforts to improve the air quality in both countries.

7.3 Scope of Work

The consultant services will cover the following topics:

- ▲ The evaluation of the current and future car fleet and the respective gasoline markets, including the fuel transportation, storage and distribution system(s).
- ▲ The analysis of scenarios of the possible evolution of the car fleet and other gasoline and motor fuels markets.
- ▲ Evaluation of the gasoline quality, octane grades and other specifications. Existing technical specs, typical imported gasoline(s) and proposed specifications.
- ▲ Possible problems of smuggling and products adulteration.
- ▲ The evaluation of the impacts of the lead and other atmospheric pollutants emissions from petroleum products.
- ▲ The identification of key stakeholders and determination of their importance and respective roles.
- ▲ Review of the legislation and regulatory measures and assessment of possible changes to reduce the air pollution (environmental regulations, vehicle importation rules, technical specifications of the petroleum products, etc). Review of the institutional capacity to enforce regulations.
- ▲ Study of the impacts related to the replacement of the currently available gasoline(s) for the unleaded type and proposal to reduce these impacts.
- ▲ Formulation of a national plan to improve air quality starting by the elimination of lead

additives from gasoline, transition issues, evaluation of costs and benefits and preparation of a preliminary proposal for its financing.

- ▲ Proposal for the Terms of Reference and mandate of a multi-sectoral working team to implement the air quality improvement plan.
- ▲ Development of the concept for a public awareness campaign to inform on the health impacts of air pollutants starting by those from the use of leaded gasoline. Best practice campaign addressed to vehicle owners on possible measures to reduce air pollutions.

7.4 Duration of the Task

The expected net amount of time the consultant will dedicate to this task is estimated in 2.5 months to be developed during a maximum contractual duration of six months.

7.5 Consultant Qualifications

The consultant should demonstrate international experience in the preparation and implementation of programs for the elimination of lead from gasoline and related areas of work. He should be familiar with the petroleum supply procedures and markets of developing countries. He should know the typical consumer issues to be resolved when changes are carried out in their fuel supply

7.6 Reports

The preparation of the proposed national study will involve the following reports:

- ▲ **Field visit:** At an agreed time, the consultant will make a field visit to Ethiopia. During this visit, the consultant will obtain from different stakeholders up to date information and will have the opportunity to test any preliminary recommendation to be included in the proposed national plan.
- ▲ **Inception Report:** Three weeks after the field visit, the consultant should present an inception report with the methodology that will be applied and a work program of the activities to be undertaken. This report will be commented by the local government counterparts and the World Bank.
- ▲ **Preliminary Report:** To be presented after the field visit and not later than three months after the field visit. The report will include the results and observations as well as proposals and recommendations on the issues listed in the scope of work. This report will be first commented by the local counterparts and the World Bank and in an improved version will be presented in a workshop to the different stakeholders.
- ▲ **Final Report:** After the workshop the consultant will be able to insert improvements and corrections and present its final report.

7.7 Coordination and Local Counterparts

The Ministry responsible for the energy sector and the supply of petroleum products will directly supervise the project administration and technical work. In principle The Minister will nominate a local coordinator who will assure the coordination of the parties concerned in each country (petroleum companies, consumers, local civil society members, other government agencies, etc). The resident mission of the World Bank will support the coordinator task in the organization of the field visits and the preparation of the workshops for the presentation of the consultant report.

The consultant is encouraged to make use as much as possible of local experts for activities such as data collection and partial reports on consumer's interests.

In relation to contacts with the civil society, the consultant will liaise with the network of AFRICACLEAN and the Alliance for Ending Childhood Lead Poisoning.

Declaration of Dakar Regional Conference on the Phasing-out of Leaded Gasoline in Sub-Saharan Africa

The participants from 25 sub-Saharan African countries, representing governments, industry and civil society, and from international organizations attended the Regional Conference on the Phasing-Out of Leaded Gasoline (Dakar, June 26 – 28, 2001).

Considering:

- ▲ The recommendations and resolutions of WHO, WB and UNEP stating the high priority of lead phase out worldwide,

Declaration of Dakar (continued)

- ▲ That surveys on blood lead levels in SSA city populations show that in many cases WHO guidelines are exceeded, bringing in particular at risk children's development and intellectual performance.
- ▲ That delays to start using unleaded gasoline are precluding the introduction of vehicles equipped with catalytic converters and thus the development of urban clean air policies in growing cities of SSA.
- ▲ The support expressed by the oil industry and the NGO community in favor of a prompt government action phasing out leaded gasoline.

Agree to:

1. Join efforts to accelerate the formulation and implementation of programs to completely phase out leaded gasoline in all SSA countries as soon as possible, latest by 2005.
2. Recommend governments to reduce the lead content in gasoline—currently 0.8 g/l in most SSA countries—to average not more than 0.4 g/l by 2002 and to an average not more than 0.2 g/l by 2003.
3. Encourage countries with independent import facilities to accelerate their respective lead phasing out programs.
4. Harmonize the gasoline norms in all sub-regional markets, in order to foster intra-regional trade and traffic; and request IPIECA, in collaboration with national and international oil companies and representatives from the automobile industry, to assist in the formulation of a complete set of fuels technical specifications.
5. Complete the sub-regional action plans within the next 12 months framing the respective national clean air programs.
6. Request the oil supply chain operators to improve their production, storage and distribution facilities in accordance with the target lead phase out frame.
7. Request WHO, UNEP, WB and bilateral environmental agencies such as US-EPA to support SSA stakeholders in developing the capacity to implement the lead phase out programs within air quality management.
8. Develop an appropriate public information campaign with an active participation of NGOs community.
9. Request the WB and other international donor agencies to give a high priority to lead phase out in economic policy dialogues with the SSA governments and to continue supporting required technical assistance programs and assisting in the financing of viable investments.
10. Request OAU and other regional organizations (ECOWAS, WAEMU, SADCC, CAEMU, etc.) to endorse the phasing out of leaded gasoline in their priority programs and to contribute to the harmonization of standards and technical specifications.

CHAPTER

Annex B: Overview of Ethiopian Petroleum Market

The petroleum sector in Ethiopia is heavily controlled by the government. The Ethiopian Petroleum Enterprise (EPE) is a State-enterprise operating under the auspices of the Ministry of Trade and Industry and has a key role. Since there are no operating refineries in Ethiopia, EPE conducts a tender every six months for Ethiopia’s fuel supplies.

The main oil marketing companies operating in the Ethiopian retail market may tender for these supply contracts. These companies are: Mobil Oil Ethiopia (and affiliate of Exxon Mobil Corporation), Shell Ethiopia⁸ (Affiliate of Royal Dutch Shell), and Total Ethiopia

(Affiliate of TotalFinaElf). There are also independent oil traders that may bid for the supply contracts—the main ones are IPG (International Petroleum Group) and Bakri.

From January 2001 until January 2003, Ethiopia had been importing gasoline (87RON) from Saudi Arabia’s Yanbu Al-Sinaiyah refinery leaded gasoline. Until early 2003, in Ethiopia there was only regular gasoline with a specified minimum RON of 87 and maximum lead content of 0.6gm/liter (See Table 8.1).

⁸ Shell purchased Agip Ethiopia in 2001.

Table 8.1
Specification of Regular Gasoline Required by Ethiopian Petroleum Enterprise (Prior to mid 2003)

Test	Specification	Test Method
Research Octane Number (RON)	Min 87	ASTM D2699
Density @ 15 Deg. C	Report	ASTM D1298
Distillation:		
10% Volume. Deg. C	Max. 70	ASTM D86
50% Volume. Deg. C	Max. 125	
90% Volume. Deg. C	Max. 180	
Final Boiling Point Deg. C	Max. 210	
Color	Yellow/Orange	Visual Appearance
Total Sulphur @ Weight	Max. 0.2	ASTM D1266
PEID Vapor Pressure @ 37.8 Deg. C (Kg/cm ²)	Max. 0.70	ASTM D323



Table 8.1 (continued)

Test	Specification	Test Method
Existent Gum (mg/100 ml)	Max. 4	ASTM D381
Oxidation Stability Induction Period (Minutes)	Min. 240	ASTM D525
Lead Content (g/liter)	Max. 0.6	ASTM D526
Copper Corrosion (3 hours @ 50 Deg. C)	Max. No. 1 strip	ASTM D130
Doctor Test	Negative	ASTM D235
Benzene (% Vol.)	Max. 0.5	

Source: Ethiopian Petroleum Enterprise (EPE)

Since around 85% of the world’s gasoline sales are now ULG, ULG is almost always cheaper to purchase on world markets.

For example, in one market (Barges FOB Rotterdam for 5 days ending Jan 31, 2003⁹): Premium leaded gasoline (0.15g/l) was US\$ 314 – US\$ 319/ barrel and Premium unleaded was US\$ 315 to US\$ 317/barrel. Since a barrel is approx 162.75 liters **ULG is cheaper by US\$ 0.012/liter in this example.** In the Gasoline International Market, FOB NEW Premium ULG was US\$ 303 per US gallon compared to FOB Medium leaded (0.15g/liter of lead) was US\$ 310.6 per US gallon. **ULG is cheaper by US\$ 0.043/liter in this example.**

For this reason, in its recent supply contract, Exxon Mobil imported ULG from the Yanbu Al-Sinaiyah refinery and added gasoline to make a leaded gasoline that was required. As shown in Table 8.2, for the period between January 2001 and May 2002, for various shipments, the lead (Pb) content varied between <0.01 g/l to 0.05g/l although the official standard specifies a maximum volume of 0.6g/liter.

In one shipment it was 0.013g/l that is technically ULG.

Ethiopia’s Quality and Standards Authority while technically responsible for the standards has no ability to carry out in-country checks of fuel quality. The country relies on a system of pre-shipment certification which by and large is satisfactory. However, a new gasoline specification was brought into law in early 2003. This set specifications for regular and premium gasolines of unleaded and leaded types. As shown in Table 8.3, the new regular unleaded gasoline specification raised the minimum RON to 91RON.

However, due to the existence of a trade protocol between Sudan and Ethiopia, in early 2003 the Ethiopian Petroleum Enterprise (EPE) agreed to import some 10,000 tones/month of gasoline during 2003 from Sudan’s Khartoum refinery that can produce 90RON unleaded gasoline. This is around 85% of

⁹ According to the January 2003 edition of Platt’s ‘Oilgram Price Report’

Table 8.2
Lead Content for Gasoline Imports to Ethiopia, Jan 01–May 02

Sample Test dates	RON Min 87	Sulfur (Wt%) 0.15	RVP at 37.80°C Kg/cm ² Max 0.7	Lead Content (g/l) Max 0.6
4 JAN 01	87.3	0.01	0.63	0.05
11 JAN 01	86.0	0.03	0.65	0.09
5 FEB 01	86.0	0.03	0.64	0.09
23 FEB 01	86.3	0.04	0.61	0.05
7 MAR 01	86.5	0.08	0.65	0.09
31 MAR 01	86.4	0.03	0.65	0.07
22 APR 01	86.3	0.12	0.64	0.07
2 MAY 01	86.3	0.10	0.65	0.07
27 MAY 01	86.1	0.09	0.65	0.07
7 JUN 01	86.4	0.09	0.67	0.07
13 JUN 01	91.3	0.07	9.5PS1	0.02
24 JUN 01	86.4	0.06	0.66	0.07
19 JUL 01	86.1	0.05	0.60	0.07
6 AUG 01	86.3	0.05	0.63	0.07
12 AUG 01	86.2	0.04	0.57	0.07
20 AUG 01	86.3	0.02	0.66	0.07
8 SEP 01	86.5	0.05	0.65	0.07
17 SEP 01	86.3	0.05	0.64	0.07
30 SEP 01	86.3	0.05	0.66	0.07
10 OCT 01	87.9	0.06	0.67	<0.01
29 OCT 01	87.1	0.05	0.65	<0.01
13 NOV 01	86.5	0.04	0.66	0.07
22 NOV 01	86.2	0.05	0.66	0.07
5 DEC 01	86.2	0.02	0.63	0.07
20 DEC 01	86.2	0.01	0.64	0.07
18 JAN 02	86.3	0.03	0.65	0.07
24 FEB 02	86.1	0.05	0.62	0.07
4 MAR 02	86.4	0.07	0.64	0.07
20 MAP 02	86.2	0.07	0.66	0.07
19 APR 02	86.3	0.08	0.65	0.05
17 MAY 02	88.2	0.06	0.64	<0.01
4 MAY 02	86.1	0.07	0.66	0.05

Source: Ethiopian Petroleum Enterprise

Table 8.3
Ethiopia's New Gasoline Specification (Early 2003)

No	Characteristics		Requirements		Test Method	
1	Octane rating		Premium	Regular	ES 636:2001	
	a) Research Octane No (RON), min	Leaded	93	87		
		Unleaded	95	91		
	b) Motor Octane No (MON), min	Leaded	83	77		ES 637:2001
Unleaded		85	81			
2	Color		Red	Orange/ Yellow	Annex A of spec	
3	Density at 20°C, g/ml		0.705–0.74		ES 641:2001	
4	Distillation (<i>At vapor pressure of 54Kpa and at 101.3Kpa pressure (760 mm Hg)</i>)					
	a) Temperature, °C for					
	10% (by volume) evaporated, max.					70
	50% (by volume) evaporated					77–121
	90% (by volume) evaporated, max.					190
b) Final boiling points °C, max.		225				
c) Residues, % (by volume) max.		2.0				
5	Reid vapor pressure (RVP), Kpa, max		69		ES ISO 3007 :2001/ ES ISO 644 :2001	
6	Lead content, g Pb/l, max	Leaded	0.4		ES 640:2001	
		Unleaded	0.013		ES 645:2001	
7	Oxidation Stability—induction Period, minutes, min		240		ES 634:2001	
8	Existent gum contents, mg/100ml, max		4		ES 627:2001	
9	Sulphur content	Leaded	0.15		ES 635:2001	
		Unleaded	0.10			
10	Copper strip corrosion (3 h at 50°C), max		1		ES ISO 2160:2001	

Source: Ethiopian Standard ES 624:2001

Ethiopia's gasoline consumption. Exxon Mobil who in mid 2003 was again awarded the wider oil supply contract will provide the balance of the gasoline as ULG at 91RON as well as other

oil products from the Middle East. This in effect means that by July 1, 2003, Ethiopia's gasoline will be entirely ULG at around 90 to 91RON. That is a slightly lower RON than the

new specifications set out but higher than the 87RON, minimum set in the former regular gasoline specification.

In 2002, fuel sales (retail and other) were as described in Table 8.4. Diesel fuel sales dominate and reflect the high proportion of commercial vehicles in the fleet (or alternatively, the relatively few cars).

EPE imports gasoline from Sudan directly and transports it by truck to Addis Ababa where it is distributed around the country. Fuel imports sourced by EPE from other sources (e.g. Middle East) enter the country through the port of Djibouti from where it is transported by truck to Addis Ababa from where it is then transported to up country depots and gasoline fuel stations for retail sales by the private oil marketing companies. There are 493 gasoline stations (for retail sales) of which about half are in Addis Ababa. In addition, the government has 12 strategic fuel depots (for war, emergency) with a total capacity of 225M liters. The majority of the capacity of these strategic depots is allocated to diesel fuel and not gasoline.

The government continues to consider the possible option of developing an oil products pipeline between Djibouti and Addis Ababa. This appears to be potentially beneficial but would be very high cost. A feasibility study of the costs

and benefits of such a pipeline may be warranted.

Approximate market shares for the retail sales of gasoline through Ethiopia's service stations in 2002 were:

- ▲ Mobil – 23.84%
- ▲ Shell – 31.85%
- ▲ Agip (now Shell) – 18.29%
- ▲ Total – 26.02%

Fuel prices are tightly controlled by government and have remained unchanged since early 2002.

There is believed to be an issue of mixing kerosene with gasoline and diesel fuel but the extent of this problem is unknown.

Table 8.5 describes the price structure of retail fuel prices for diesel and gasoline in Ethiopia. In order to maintain prices the government requires that retailers absorb costs within their distributors' margin¹⁰. At January 2003, the price was Birr 440/liter or about US\$ 0.50/liter.

It is understood that the Ethiopian Government has decided to open the oil distribution and marketing industry to other companies. The Ministry of Trade and Industry announced in April 2002, that they will not continue the prevailing Distribution Agreement that they

Table 8.4
Fuel Sales by Type 2002, Ethiopia (units: liters)

Fuel Type(1)	2002
Gasoline 87RON (MSP)	188,235,023
Kerosene	231,106,302
Diesel (Gas Oil)	727,694,961
LPG	1,653,214

Source: Mobil Ethiopia, Fuel includes retail and other sales.

¹⁰ Distributors' margin includes: (i) transport margin which for paved roads is Ethiopian 0.35c / liter per km (in this case these cents are 0.01 of a birr); (ii) marketing margin of distributors; and (iii) retailers' margin. The total (i.e. (i) + (ii) + (iii)) distributors' margin has been set at Ethiopian 44.4 cents/ 100 liters (approx US\$ 0.04387) or 10.09%. Retail fuel prices are set by location but will vary dependent on distance from ports of entry – there is a set transport rate (set per km and by type of road).

Table 8.5
Addis Ababa Retail Fuel Price (Birr)

January 1, 2003

Component	MOGAS Regular gasoline	ADO (Diesel)
1. Price at Djibouti port	194.40	181.93
2. Djibouti-Dewek/Galafi Transportation Cost	8.10	8.10
3. CIF value (1+2)	202.50	190.03
4. Excise tax (30% ON 3)	60.75	0.00
5. Value added tax (15% on 3+4)*	39.49	28.51
6. Municipality tax*	2.00	2.00
7. Road Fund	9.50	8.00
8. Stabilizing fund	85.16	2.41
9. EPE margin	4.30	4.75
10. EPE invoice price (1+4+5+6+7+8+)	395.60	227.60
11. Distributor's margin*	44.40	44.40
12. New retail price (10+11)	440.00	272.00
13. Prevailing retail price	440.00	272.00
14. Difference-cents (121-13)	0.00	0.00
15. Difference-percentage (14/13)	0	0

* All Sales and Municipality Taxes will be transferred to the Road Fund.

** Distributors' Margin includes Transport Cost and Retailers' Margin.

Note: The Djibouti-Deweke/Galafi Transport cost is considered only for tax purpose.

Source: Ethiopian Petroleum Enterprise (EPE)

signed with Mobil, Shell, Total and Agip (now Shell) in 1969. This will expire on 24 October 2003. The Government's stated intention is

to open the retail distribution and marketing of oil products to new players with the aim of improving the quality of services and products.

CHAPTER

Annex C—Draft mandate for a multi-sectoral working group to oversee action plan implementation

The global phase-out of lead from gasoline has proceeded dramatically in the last five years. Countries in North America, Europe, Japan and Asia have phased-out leaded gasoline; about 85% of total gasoline consumption is now lead-free. However there are a number of countries that still use lead additives to boost octane levels in gasoline. Almost all of these countries are in Africa and the Middle East. The World Health Organization recommends that leaded gasoline be phased-out worldwide.

An agreement was reached in June 2001 at the Dakar Conference in Senegal, to launch national programs to phase-out leaded gasoline by 2005 in the countries of sub-Saharan Africa (SSA).

Follow up conferences have since been held in Abuja, Nigeria in November 2001; Dakar, Senegal in March 2002; Cotonou, Benin in April 2002 and Nairobi, Kenya in June 2002. All four conferences supported the Dakar declaration. Many countries have committed to the 2005 phase-out date and Mauritius has gone a step further by aiming for phase-out by August 2002

Lead is a poison with significant negative public health impacts. As SSA and other oil importing countries are confronted with fewer difficulties to phase out lead from gasoline than those operating national refineries for the supply of their markets, there is an opportunity to make a major environmental step

forward through early leaded gasoline phase-out.

The phase-out of leaded gasoline is but a first step in developing a more comprehensive approach to air quality management that would include actions on:

- ▲ Improving fuel quality and developing new fuel specifications;
- ▲ Upgrading the quality of vehicle imports and emission controls;
- ▲ Establishing baseline inventories of key pollutants and health effects; and
- ▲ Developing an appropriate public information or awareness campaign.

Government agencies will retain the key responsibilities for phasing-out leaded gasoline and its replacement with unleaded gasoline, as well as follow on actions aimed at securing a more comprehensive approach to air quality management.

As the issues involved in leaded gasoline phase-out and air quality improvement are complex and involve many groups in society and consequently it has been recommended that once the government commits to phase-out leaded gasoline and follow on actions to improve air quality, a multi-sectoral stakeholder group consisting of senior members of government agencies, the oil industry, and civil society including Non-Government Organizations

(NGOs) and consumer groups should be established.

The objectives (i.e. mandate) for this multi-sectoral stakeholder group that should be established for a period of at least three years shall be to:

- ▲ Steer the overall air quality management activities in the medium to the long term;
- ▲ Provide an independent source of advice, comment and feedback for government agencies responsible for key implementation actions for phasing-out leaded gasoline and its replacement with unleaded gasoline as well as follow on actions aimed at securing a more comprehensive approach to air quality management;
- ▲ Take responsibility for developing the public awareness campaign and associated expenditure decisions of relevant components with the close cooperation of government agencies and other groups;
- ▲ Obtain sources of funds for implementation of relevant public awareness campaign expenditures from relevant stakeholders, government and international funding agencies;
- ▲ Coordinate the relevant communication campaigns of other groups (e.g. industry, government, media) so that a consistent message is transmitted to the public during the phase-out of leaded gasoline and its replacement with unleaded gasoline as well as follow on actions aimed at securing a more comprehensive approach to air quality management;
- ▲ Coordinate with sub-regional public awareness campaigns to ensure that messages are consistent and activities are compatible and efficient; and

The multi-sectoral stakeholder group should aim to establish a small full time secretariat within six months of being established to carry out the needed work—the secretariat should aim to supplement its resources as required with the assistance of members of the stakeholder group.

The initial steps to establish the multi-sectoral stakeholder group should be established immediately the Government commits to phase-out leaded gasoline. The initiating steps should be taken jointly by the Ethiopian Ministry of Trade and Industry; Ministry of Health and the Environmental Protection Authority.

10

CHAPTER

Annex D - Draft Outline Terms of Reference for follow on air quality activities

10.1 Background

The global phase-out of lead from gasoline has proceeded dramatically in the last five years. Countries in North America, Europe, Japan and Asia have phased-out leaded gasoline; about 85% of total gasoline consumption is now lead-free. However there are a number of countries that still use lead additives to boost octane levels in gasoline. Almost all of these countries are in Africa and the Middle East. The World Health Organization recommends that leaded gasoline be phased-out worldwide.

An agreement was reached in June 2001 at the Dakar Conference in Senegal to launch national programs to phase-out leaded gasoline by 2005 in the countries of sub-Saharan Africa (SSA).

Follow up conferences have since been held in Abuja, Nigeria in November 2001; Dakar, Senegal in March 2002; Cotonou, Benin in April 2002 and Nairobi, Kenya in June 2002. All four conferences supported the Dakar declaration. Many countries have committed to the 2005 phase-out date and Mauritius has gone a step further by aiming for phase-out by August 2002.

Lead is a poison with significant negative public health impacts. As SSA and other oil importing countries are confronted with fewer difficulties to phase out lead from gasoline than

those operating national refineries for the supply of their markets, there is an opportunity to make a major environmental step forward through early leaded gasoline phase-out.

The phase-out of leaded gasoline is but a first step in developing a more comprehensive approach to air quality management that would include actions on:

- ▲ Improving fuel quality and developing new fuel specifications;
- ▲ Upgrading the quality of vehicle imports and emission controls;
- ▲ Establishing baseline inventories of key pollutants and health effects; and
- ▲ Developing an appropriate public information or awareness campaign.

Government agencies will retain the key responsibilities for phasing-out leaded gasoline and its replacement with unleaded gasoline, as well as follow on actions aimed at securing a more comprehensive approach to air quality management.

As the issues involved in leaded gasoline phase-out and air quality improvement are complex and involve many groups in society and consequently it has been recommended that once the government commits to phase-out leaded gasoline and follow on actions to improve air quality, a multi-sectoral stakeholder



group consisting of senior members of government agencies, the oil industry, and civil society including Non-Government Organizations (NGOs) and consumer groups should be established.

10.2 Objectives

The objectives of these outline draft Terms of Reference (ToR) cover needed research and technical assistance to provide a sound information base to monitor the benefits of phasing-out leaded gasoline and for supporting the design of subsequent more comprehensive activities to improve air quality generally. The objectives of the ToR are to:

- ▲ Establish an appropriate emissions inventory from mobile and other sources;
- ▲ Create a suitable base-line to measure the benefits of the lead phase-out decision through statistically valid measurements of blood level lead in currently vulnerable groups;
- ▲ Undertake a public perception survey and develop a database on available information/research and evaluate public's general level of awareness of lead effects and air pollution including develop monitoring indicators and survey tools; and
- ▲ Prepare an updated and prioritized action plan for improving air quality.

While the work required to satisfy each of the above objectives is discrete and independent to a large extent it shall be carried out under a single contract with appropriate experts being brought to bear on each separate aspect of the work.

The following sections describe the key tasks required to be undertaken to satisfy each of the above objectives.

10.3 Key tasks to satisfy each objective

10.3.1 Task 1—Establish an appropriate emissions inventory

Establish Inventory—The purpose of this task is to support the Ethiopian Environmental Protection Authority (EPA) and develop an initial and approximate emissions inventory from mobile and stationery sources to support on-going air quality management activities. Initial work should be carried out to confirm the scope of the pollutants to be monitored that have been initially identified as:

- ▲ $PM_{2.5}$
- ▲ CO
- ▲ HC and
- ▲ NO_x

Both ambient and roadside measurements should be made as necessary to establish an inventory of sufficient accuracy to identify the:

- ▲ Relative contributions to each pollutant from mobile and other sources; and
- ▲ Ambient and roadside measurements over various periods of time to describe the extent to which pollutants exceed established international standards.

Propose training—Equipment used during the project shall be transferred to EPA. EPA shall receive initial training towards assisting EPA to establish a functioning, embryonic monitoring system. The consultant should propose and carry out a suitable initial training activity recognizing that in the medium term a sub-regional approach to training could be provided by the World Bank and/or the United Nations Environment Program (UNEP) through a program similar to their previous Global Environment Monitoring Systems (GEMS)/Air.

10.3.2 Task 2—Create a suitable base-line to measure the benefits of the lead phase-out decision

The consultant shall propose and implement with advice of the Ministry of Health and the multi-sectoral stakeholder group a series of statistically valid measurements of blood level lead in currently vulnerable groups (e.g. traffic policemen, school children etc) and a suitable control group in Addis Ababa. The aim is to establish a suitable base-line to monitor blood lead levels over time.

10.3.3 Task 3—Undertake initial public perception surveys

The purpose of the public perception surveys is to develop a database on available information/research and evaluate the public's general level of awareness of lead effects and air pollution including develop monitoring indicators and survey tools.

The consultant shall reserve US\$ 10,000 of the total budget for this technical assistance at the disposal of the multi-sectoral stakeholder group to conduct suitable public perception surveys.

10.3.4 Task 4—Prepare updated air quality action plan

Based on the above tasks the consultant shall prepare an updated, integrated air quality action plan that addresses in a prioritized manner the following components:

- ▲ Priority pollutants from mobile sources; and
- ▲ Priority pollutants from stationary sources.

The updated action plan will therefore address further priority actions on:

- ▲ Improved fuel quality and harmonized, sub-regional fuel quality specifications in the context of desirable longer term air quality improvement goals;
- ▲ Vehicle emission standards for new and in-use vehicles;
- ▲ Emissions reduction strategies from stationary sources;
- ▲ Strategies for improving indoor air quality;
- ▲ Soundly based urban and transport planning and management; and
- ▲ Capacity building.

11

CHAPTER

List of Workshop Participants

1. H. E. Ato Fantaye Biftou – MoTI
2. Ato Arkebe Ogbay – Mayor of Addis Ababa
3. Ato Hilawi Yoseph – Vice Mayor
4. Ato Hagos Aregay – MoTI
5. Ato Yigzaw Mekonnen – GM of EPE
6. Ato Worku Gossaye – EPE
7. Ato Dinku Abowa – EPE
8. Ato Tadesse Tilahun – GM, Shell Ethiopia Ltd, represented by Ato Alemu Berhe
9. Mr. Martin Fayulu – Mobil Oil East Africa Ltd
10. Mr. Roland Sorbier – GM Total Ethiopia
11. Mr. Joha Salin – US Embassy Com/Eco Secretary
12. Ato Zemedkun Girma – Addis Ababa Road Transport Authority
13. Ato Teklai W Gerima – Addis Ababa Road Transport Authority
14. Ato Kassahun H. Marriam – Eth. RTA, represented by Ato Demeke Bekele
15. Ato Sileshi Taye Belihu – Ministry of Health
16. Ato Abebe Tadege – National Meteorology Services Agency
17. Ato Zerou Girmay – Eth. Environmental Protection Authority
18. Ato Misikir Tesfaye – Eth. Environmental Protection Authority
19. Ato Getachew Eshete – AA Environmental Protection Authority
20. Ato Getaneh Gebre – Addis Ababa Road Transport Authority
21. Two Representatives of taxi driver associations
22. Ato Bezu Workie – Representative of gas station owners
23. Ato Tesfaye Mekonnen – Representative of gas station owners
24. Ato Mesai Girma – GM, Quality and Standards Authority of Ethiopia (QSAE)
25. Ato Alemayehu Belete – QSAE
26. Ato Kebede – GM CRDA
27. Ato Hussein Shibeshi – Sec General, AACC
28. Ato Andualem Tegegn – Sec. General, ECC
29. Ato Diriba Tura – Head of AA Trade Bureau
30. Ato Mulugeta Amha – Commissioner of Science and Technology
31. Ato Beyene G Meskel – General Manager of PESA
32. Ato Mengistu Tefera – MoFED, adviser to the Minister and Board of EPE
33. Ato Asres W. Georgis – Energy Agency
34. Ato Abiy Hunegnaw – Head, Department of Petroleum, Ministry of Mines
35. Ato Mesfin Abate – Ethanol Project, Fincha Sugar Factory
36. Ato Aimiro Wondimagegnehu Focus on Children (NGO)
37. Two Representatives of the Chemical Engineers Association
38. Ato Amakilew Cherkosie – GM Forum for Street Children Ethiopia
39. Representatives of the Media (ETV, Walta, Reporter, Addis Tribune, Capital, Fortune)
40. Ato Lema Jote – Ethiopian Consumers Association
41. Ato Mehari W Agegnehu – Ethiopian Environment Protection Authority

12

CHAPTER

Report References

- Chevron (1990) *Use of Unleaded Gasoline in Cars Designed for Leaded Gasoline*, Technical Bulletin, USA.
- Diouf A (et al), *Level of Exposure to Lead Eliminated by Automobiles – Impact on Oxidative Stress and the Nutritional Status of Senegalese Children*. Paper presented at the Regional Conference on the Phase-Out of Unleaded Gasoline, Dakar, Senegal, 26–28 June.
- East Africa Group (2001), *Action Plan – Presented at Learning Activities: Conference Agenda Regional Conference on the Phase-Out of Unleaded Gasoline*, Dakar, Senegal, 26–28 June.
- Mayorga Alba, E (2002), *Overview of Technical, Policy and Regulatory Options in Integrating Lead Phase-Out in Air Pollution Abatement Strategies*, Presentation at Workshop on the Phase Out of Leaded Gasoline in East Africa, Nairobi, June 5–7, 2002.
- Muylle, M (2002), *Downstream Petroleum Sector in sub-Saharan Africa – A World Bank Perspective*, Presentation at Workshop on the Phase Out of Leaded Gasoline in East Africa, Nairobi, June 5–7, 2002.
- Nriagu J., Oleru NT, Cudjoe C, Chine A (1997a) – *Lead Poisoning of Children in Africa, III*. Kaduna, Nigeria. *Sci. Total Environ*; 197 (1–3), 13–9.
- Nriagu J, Jinabhai CC, Naidoo R, Coutsooudis A (1997b) – *Lead Poisoning of Children in Africa, II*. Kwazulu/Natal, South Africa. *Sci. Total Environ*; 197 (1–3), 1–11.
- Radian Corporation (1994), *Motor Vehicle Pollution Control in Bangkok: A Strategy for Progress*. A Report prepared for the Pollution Control Department, Thailand.
- Rayner, S (2002), *East Africa Vehicle Fleet Implications: Lead Phase Out and Emission Control*, Presentation at Workshop on the Phase Out of Leaded Gasoline in East Africa, Nairobi, June 5–7, 2002.
- Schwela D, Phoenix J (2001), *Leaded Gasoline: An Overview of Environmental and Health Impacts*, Presented at the Regional Conference on the Phase-Out of Unleaded Gasoline, Dakar, Senegal, 26–28 June.
- Thomas V, Kwong A (2001) *Ethanol as a lead replacement: phasing out leaded gasoline in Africa*, Center for Energy and Environmental Studies, H-214 Engineering Quadrangle, Princeton University, Princeton, NJ 08544-5263, USA, Published by Elsevier Energy Policy, 29 (2001), pp 1133–1143.
- Shell Company of Thailand Limited (1990), *Unleaded Gasoline, Questions and Answers*.
- Sridhar MKC (2001), *Environmental Lead Levels in African Cities*.
- US-EPA (1985), *Costs and Benefits of Reducing Lead in Gasoline: Final Regulatory Impact Analysis*. EPA-230-05-85-006. Office of Policy Analysis, USA Environmental Protection Agency, Washington DC.

Weaver, C (1996), *Personal Communication*.
(Specialist in Fuels, Emissions and Engine
Technology).

World Resources Institute (2002), *Research
Center; Maps and Indicators: Health. Ex-
posure to air polluted with lead from
gasoline in developing countries*, [http://
www.wri.org/wri/ehi/leaddev.html](http://www.wri.org/wri/ehi/leaddev.html) (ac-
cessed 10 January 2003).

13

CHAPTER

List of Technical Paper Series

of

Joint UNDP/World Bank

ENERGY SECTOR MANAGEMENT ASSISTANCE PROGRAMME (ESMAP)

Region/ Country	Activity/Report Title	Date	Number
SUB-SAHARAN AFRICA (AFR)			
Ethiopia	Phase-Out of Leaded Gasoline in Oil Importing Countries of sub-Saharan Africa: The Case of Ethiopia—Action Plan	12/03	038/03
	Sub-Saharan Petroleum Products Transportation Corridor: Analysis and Case Studies	03/03	033/03
	Phase-Out of Leaded Gasoline in sub-Saharan Africa	04/02	028/02
	Energy and Poverty: How can Modern Energy Services Contribute to Poverty Reduction	03/03	032/03
Kenya	Field Performance Evaluation of Amorphous Silicon (a-Si) Photovoltaic Systems in Kenya: Methods and Measurement in Support of a Sustainable Commercial Solar Energy Industry	08/00	005/00
	The Kenya Portable Battery Pack Experience: Test Marketing an Alternative for Low-Income Rural Household Electrification	12/01	005/01
Nigeria	Phase-Out of Leaded Gasoline in Nigeria	11/02	029/02
Senegal	Regional Conference on the Phase-Out of Leaded Gasoline in sub-Saharan Africa	03/02	022/02
Swaziland	Solar Electrification Program 2001–2010: Phase 1: 2001–2002 (Solar Energy in the Pilot Area)	12/01	019/01
Tanzania	Mini Hydropower Development Case Studies on the Malagarasi, Muhuwesi, and Kikuletwa Rivers Volumes I, II, and III	04/02	024/02
Uganda	Report on the Uganda Power Sector Reform and Regulation Strategy Workshop	08/00	004/00
WEST AFRICA (AFR)			
	LPG Market Development	12/01	017/01

CLEAN AIR INITIATIVE IN SUB-SAHARAN AFRICAN CITIES**EAST ASIA AND PACIFIC (EAP)**

Cambodia	Efficiency Improvement for Commercialization of the Power Sector	10/02	031/02
China	Assessing Markets for Renewable Energy in Rural Areas of Northwestern China	08/00	003/00
	Technology Assessment of Clean Coal Technologies for China Volume I—Electric Power Production	05/01	011/01
	Technology Assessment of Clean Coal Technologies for China Volume II—Environmental and Energy Efficiency Improvements for Non-power Uses of Coal	05/01	011/01
	Technology Assessment of Clean Coal Technologies for China Volume III—Environmental Compliance in the Energy Sector: Methodological Approach and Least-Cost Strategies	12/01	011/01
Thailand	DSM in Thailand: A Case Study	10/00	008/00
	Development of a Regional Power Market in the Greater Mekong Sub-Region (GMS)	12/01	015/01
Vietnam	Options for Renewable Energy in Vietnam	07/00	001/00
	Renewable Energy Action Plan	03/02	021/02

SOUTH ASIA (SAS)

Bangladesh	Workshop on Bangladesh Power Sector Reform	12/01	018/01
------------	--	-------	--------

EUROPE AND CENTRAL ASIA (ECA)

Russia	Russia Pipeline Oil Spill Study	03/03	034/03
--------	---------------------------------	-------	--------

LATIN AMERICA AND THE CARIBBEAN (LAC)

	Regional Electricity Markets Interconnections — Phase I: Identification of Issues for the Development of Regional Power Markets in South America	12/01	016/01
	Regional Electricity Markets Interconnections — Phase II: Proposals to Facilitate Increased Energy Exchanges in South America	04/02	016/01
	Population, Energy and Environment Program (PEA), Comparative Analysis on the Distribution of Oil Rents (English and Spanish)	02/02	020/02
	Estudio Comparativo sobre la Distribución de la Renta Petrolera Estudio de Casos: Bolivia, Colombia, Ecuador y Perú	03/02	023/02
	Latin American and Caribbean Refinery Sector Development Report – Volumes I and II	08/02	026/02
	The Population, Energy and Environmental Program (EAP) (English and Spanish)	08/02	027/02
Ecuador	Programa de Entrenamiento a Representantes de Nacionalidades Amazónicas en Temas Hidrocarbúricos	08/02	025/02

Guatemala	Household Fuel Use and Fuel Switching	06/03	036/03
Nicaragua	Memoria Taller de Electrificación Rural	08/02	030/02
GLOBAL			
	Impact of Power Sector Reform on the Poor: A Review of Issues and the Literature	07/00	002/00
	Best Practices for Sustainable Development of Micro Hydro Power in Developing Countries	08/00	006/00
	Mini-Grid Design Manual	09/00	007/00
	Photovoltaic Applications in Rural Areas of the Developing World	11/00	009/00
	Subsidies and Sustainable Rural Energy Services: Can we Create Incentives Without Distorting Markets?	12/00	010/00
	Sustainable Woodfuel Supplies from the Dry Tropical Woodlands	06/01	013/01
	Key Factors for Private Sector Investment in Power Distribution	08/01	014/01
	Cross-Border Oil and Gas Pipelines: Problems and Prospects	06/03	035/03
	Monitoring and Evaluation in Rural Electrification Projects: A Demand-Oriented Approach	07/03	037/03

Previous Working Papers Available from the World Bank on The Clean Air Initiative in Sub-Saharan African Cities

Working Paper No. 1: Clean Air Initiative in Sub-Saharan African Cities – Dakar Seminar, December 17 & 18, 1998 - Urban Transport and Air Quality in Dakar – Proceedings (SSATP and Urban Mobility, February 1999).

Working Paper No. 2: Air Quality Studies in Urban Context – Dakar and Ouagadougou Cases – Final Reports (SSATP and Urban Mobility, September 1999).

Working Paper No. 3: Clean Air Initiative in Sub-Saharan African Cities – Work in Progress (January 2000).

Working Paper No. 4: Air Quality Study in Urban Context - Cotonou Case – Synthesis (October 2000).

Working Paper No. 5: Regional Conference on the Phase-Out of Leaded Gasoline in Sub-Saharan Africa – Dakar, Senegal, June 26–28, 2001 – Proceedings (December 2001).

Working Paper No. 6: National Conference on the Phase-Out of Leaded Gasoline in Nigeria – Abuja, Nigeria, November 15–16, 2001 – Proceedings (March 2002).

Working Paper No. 7: Sub-Regional Conference on the Phase-Out of Leaded Gasoline in Nigeria and Neighboring Countries – Cotonou, Benin, April 11–12, 2002 – Proceedings (June 2002).

Working Paper No. 8: Sub-Regional Conference on the Phase-Out of Leaded Gasoline in West Africa – Dakar, Senegal, March 26–27, 2002 – Proceedings (July 2002).

Working Paper No. 9: Sub-Regional Conference on the Phase-Out of Leaded Gasoline in East Africa – Nairobi, Kenya, June 5–7, 2002 – Proceedings (January 2003).

Working Paper No. 10: 1998-2002 Progress Report of the World Bank Clean Air Initiative in Sub-Saharan African Cities (January 2003).

Working Paper No. 11: Rapport d'avancement 1998–2002 de l'initiative sur la qualité de l'air dans les villes d'Afrique sub-saharienne de la Banque mondiale (Janvier 2003).

Working Paper No. 12: Second Steering Committee : The Road Ahead – Phase II : 2003–2006 (May 2003).

