

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



# Sub-Regional Conference on the Phase-Out of Leaded Gasoline in East Africa

Working Paper Number 9  
January 2003

## PROCEEDINGS

Nairobi,  
Kenya  
June  
5-7,  
2002

In partnership with



IPIECA





# PROGRAM COORDINATION FOR THE PHASE-OUT OF LEADED GASOLINE IN EAST AFRICA

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## THE COMMITTEE ON THE PHASE-OUT OF LEADED GASOLINE IN EAST AFRICA GRATEFULLY ACKNOWLEDGES

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International Petroleum Industry Environmental  
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Natural Resources Defense Council

Ford Motor Company

National Association of Automobile Manufacturers  
of South Africa (NAAMSA)

Kenya Petroleum Refinery Ltd

Kenya Bureau of Standards



THE WORLD BANK  
WASHINGTON DC 20433 USA

# foreword

## FOREWORD

A regional workshop on the phase-out of leaded gasoline in East Africa was held in Nairobi, Kenya, from June 5 to 7, 2002. This workshop was the third in a series initiated in Dakar, Senegal (March 2002) and Cotonou, Benin (April 2002) following the Pan-African Conference on the Phase-out of Leaded Gasoline in Sub-Saharan Africa, also held in Dakar in June, 2001.

The Nairobi workshop was jointly organized by the United Nations Environment Program (UNEP), the US Environmental Protection Agency (USEPA), the International Petroleum Industry Environmental Conservation Association (IPIECA), and the World Bank.

The workshop was attended by representatives from governments, the private sector, civil society and international organizations. Its main outcome was the adoption of an Action Plan for the Phase-out of Leaded Gasoline in East Africa.

The detailed Action Plan covers technical, regulatory, industrial, fiscal and political issues; it includes the development of awareness campaigns, training sessions, and the dissemination of information. To monitor the Action Plan, a review, to be organized by UNEP in collaboration with the main partners is expected to take place end 2003 or beginning 2004, in connection with the meeting of the African Ministers of Environment (AMCEN).

**The adoption of the East Africa Action Plan represents an important milestone in the implementation of the Dakar Declaration of June 2001 for the commitment to eliminate lead from gasoline in Sub-Saharan Africa by end 2005.**

Such progress was initiated in part through the comprehensive partnership set up by the World Bank Clean Air Initiative in Sub-Saharan Africa to reduce the impacts of urban air pollution generated by motorized transport in the region. We take this opportunity to express our gratitude to the stakeholders, partners and donors of the regional program coordinated by the World Bank.



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

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## EXECUTIVE SUMMARY

### INTRODUCTION

From June 5 to 7, 2002, a workshop on the Phase Out of Leaded Gasoline in East Africa was held at UNEP headquarters, Nairobi. The workshop was a follow up to a conference held in Dakar from 26 to 28 June 2001, where participants from 25 Sub Saharan African governments, the private sector, and civil society groups adopted the Dakar Declaration on the phase out of leaded gasoline in Sub Saharan Africa. The workshop was co-organised by USEPA, IPIECA, The World Bank, and UNEP.

Ninety-one representatives from governments, private sector, civil society and international organisations participated actively in the workshop. A detailed action plan for phasing out of lead from gasoline was the main outcome of the workshop. The action plan, agenda of the workshop, presentations, and list of participants are further included.



### THE WORKSHOP

Urban air pollution from vehicle emissions is a serious environmental threat in developing countries and especially in Africa. It is estimated that the costs of environmental damage caused by air pollution in developing country cities can be as high as 5 - 10 % of urban income of these cities.

Airborne lead is one of the most serious urban air pollutants. The use of lead in gasoline is the prime source of airborne lead pollution in African cities. Lead pollution has severe effects on human health and children's mental development in specific.

The use of leaded fuel prevents the use of catalytic converters. Catalytic converters can be instrumental in improving the air quality in African cities as they reduce vehicle emissions by more than 90%. Introduction of clean fuels and vehicle technologies not only benefit the health and environment in the cities, but also contribute to addressing regional and global environmental issues such as transboundary air pollution and global warming.

The objective of the workshop was to develop an action plan for the phase out of leaded gasoline in East Africa. Representatives from various sectors; energy, transport, health, environment, industry, civil society, and research showed a strong commitment to the phase out of lead from gasoline as soon as possible. They all agreed that no major technical obstacles exist to removing lead from gasoline in East Africa, and they developed and adopted an action plan for the complete phase out of leaded gasoline in East Africa.

### OUTCOMES OF THE WORKSHOP

The main objective of the Nairobi workshop was to develop an action plan for the phase out of leaded gasoline in East Africa, providing a framework for all partners to implement initiatives to reduce the lead levels in leaded gasoline and to introduce unleaded gasoline.

To achieve this objective the workshop was organised in four main parts:

1. Keynote presentations;
2. Topic specific presentations;
3. Working groups;
4. Closing session (adoption of the action plan).

### Keynote Presentations

Mr. Sekou Toure, Director of the UNEP Regional Office for Africa made the Conference Opening Address followed by three keynote presentations aimed at giving common background information to all participants. The presentations highlighted the environmental and health effects of the use of leaded gasoline, the technical reasons for adding lead to fuels, and highlighted the benefits and options of lead phase out.

### Topic Specific Presentations

The keynote presentations were followed by nine specific presentations that gave additional information on technical aspects, the opportunities and the challenges of phasing out lead from gasoline in East Africa, the views of the different partners, and experiences on phasing out leaded gasoline in other regions. These substantive presentations clarified that there are no technical or financial reasons to continue using leaded fuel in East Africa. They also indicated that all partners involved, governments, private sector, and civil society organisations favour the phase out of lead in gasoline in East Africa. The case studies presented showed how other regions had successfully handled the phase out of leaded gasoline.

### Working Groups

The presentations served as information for the working groups to enable them to develop an action plan for the phase out of leaded gasoline in East Africa. Three working groups were formed:

- Working group I: the role of governments in phasing out leaded gasoline and introducing unleaded gasoline;
- Working group II: the role of the private sector in phasing out leaded gasoline and introducing unleaded gasoline;
- Working group III: the role of information, marketing, and communication in phasing out leaded gasoline and introducing unleaded gasoline.

Using the information given in earlier sessions, each working group had to prepare specific activities with time tables, indicating who was to take the lead.

Working Group I discussed the role of governments and called upon East African Governments to declare their intentions in phasing out leaded gasoline. It also called on the governments to harmonise fuel specifications in East Africa to ease the introduction of unleaded gasoline. Governments were requested to remove any barriers to enable the industry to provide unleaded gasoline and to develop policies for more stringent emissions standards, including monitoring and enforcement of these standards. Governments were called upon to work closely with the other partners, the industry and civil society organisations, and to support awareness raising activities to promote the use of unleaded gasoline.

Working Group II discussed the role of the private sector in the phase out of leaded gasoline. The working group called upon the private sector to take the initiative in the phase out of leaded gasoline, in close cooperation with governments and other partners. The private sector should come out to the public and declare that leaded fuel is not necessary in East Africa and provide sound technical information to governments and other partners on the availability of alternatives. The industry should also initiate awareness campaigns addressed to their own staff such as fuel attendants, so they can properly inform consumers. The industry should also participate in awareness campaigns addressed to consumers and traders.

Working Group III advised on the need for overall public awareness focused on key health and environmental issues, as well as technical issues. It is important to clarify to the public at large that unleaded gasoline actually benefits most car engines, as well as having huge health and environment benefits. Although civil society can take a lead in developing such public awareness campaigns, it was found that all partners, including government and private sector, should be integrated in these.



### Closing Session, including the Adoption of the Action Plan

The outcomes of each of the three Working Groups were presented during the closing plenary session. They formed the basic building blocks for the action plan for the phase out of leaded gasoline in East Africa. After discussions and amendments, all participants adopted the Action Plan.

The Assistant Kenyan Minister of Industry closed the Workshop and gave his full support to the Action Plan.

## THE WAY FORWARD

Since the Nairobi workshop many partners have initiated actions to phase out leaded gasoline, and promote clean fuels and vehicle technologies:

- many oil companies providing leaded gasoline, have announced their intention to reduce lead in gasoline and phase it out completely by introducing unleaded gasoline;
- governments have taken action, in situations where the governments are providing fuel to the public, to reduce the lead level of the fuels provided;
- governments and the industry have started meeting to develop plans for future fuel specifications, including phasing out leaded gasoline, and set targets accordingly;
- the Government of Kenya is in close consultation with the private sector to develop a plan for the upgrading of the Mombasa refinery, the only working refinery in the East African region, to allow it to produce unleaded fuel;
- some oil companies have gone further and decided to introduce low sulfur fuels in East Africa;
- During the workshop, the United Nations Offices in Nairobi (UNON) introduced unleaded gasoline at the United Nations' petrol station. This was officially launched during the workshop. UNON has decided to only use unleaded gasoline for its car fleet;
- Civil society organisations and the press have expressed great interest in this topic, and are preparing awareness raising activities in this regard.

At the global level, supported by the outcomes of the Nairobi workshop and other clean fuels and vehicles initiatives worldwide, the major partners have come together to develop a global partnership for clean fuels and vehicles. The objective of this partnership is to promote clean fuels and vehicles for improved air quality. Specific objectives include the phase out of leaded gasoline in countries where it is still used, to improve the quality of fuels, for example lowering sulfur levels in developing countries, and promoting the introduction of clean vehicle technologies such as catalytic converters. The members of the global partnership, including the organizers of the Nairobi workshop, will soon meet for the first time to develop their workplan.



# 2.0 ACTION PLAN

Ninety-one participants representing governments, the private sector and civil society, met in Nairobi, Kenya, from June 5 to 7, 2002 to develop an action plan for the phase-out of leaded gasoline in East Africa.

## CONSIDERING...

that human exposure to lead is a major environmental health hazard which results in a broad range of serious and often irreversible health consequences, especially in children;

that leaded fuel prevents the introduction of cleaner engines and catalytic converters which are necessary to achieve significant reductions in air pollution;

## RECOGNIZING...

that lead phase out is the essential first step to a comprehensive air pollution control strategy in East African countries;

that by building linkages with existing and future initiatives as well as involving all the relevant stakeholders will ensure successful implementation of these strategies;

that most countries in the East African sub-region still use only leaded gasoline ;

that the undisputed health and environmental dangers of leaded fuels are a serious and growing threat in East Africa;

and that there is a broad consensus among government, industry and civil society partners in favor of urgently phasing out the use of leaded gasoline;

## TAKING NOTE OF...

the decision on phasing out of leaded gasoline at the UNEP Governing Council (Decision 21/6 of February 2001) and the Dakar Declaration on the phasing out of leaded gasoline in Sub-Saharan Africa (June 2001);

the priority given to the phase out of leaded gasoline world-wide during the preparations for the World Summit on Sustainable Development (Johannesburg, August-September 2002);

and the three previous national and sub-regional Workshops on phasing out of leaded gasoline in Sub-Saharan Africa, held in Abuja (November 2001), Dakar (March 2002) and Cotonou (April 2002).

## THE PARTICIPANTS AGREE...

that in the East Africa context, considering health, environment, technology and economic factors, options are available to remove lead from gasoline;

that the only refinery in the sub-region is central to the phasing out of leaded gasoline in many countries in East Africa.

**The Participants therefore recommend that the following actions be taken urgently to prepare for and execute the phasing out of leaded gasoline:**

1. for East African Governments to declare their intention to phase out the use of lead in gasoline and to organize a group of people to work on the specific modalities for the implementation of such phase out;
2. for multi-stakeholders to convene meetings in each country to develop road maps for the phase out of leaded gasoline (including fuel specifications, pricing and taxation, and enabling activities);
3. for respective authorities of East African Governments to work towards harmonization of fuel specifications in the region to ease the introduction of unleaded gasoline and facilitate regional trade, recognizing different timeframes and needs;
4. the enactment of appropriate national legislation/ regulation to ensure more stringent fuel quality –including unleaded gasoline- and emission standards, and monitoring and enforcement of these standards;
5. the development of awareness campaigns to train and educate government officials, fuel pump operators, and service attendants, and others, to promote unleaded gasoline;
6. for industry (oil, automotive, and retailers) to declare that leaded fuel is not necessary in East Africa and to provide sound technical information and authoritative statements to government and public;
7. for Governments to remove any barriers to the provision of unleaded fuel, and for oil companies and retailers to take a leadership role in ensuring that unleaded gasoline is widely available throughout East Africa;
8. for Governments and international agencies to purchase only unleaded fuel for their own vehicle fleet consumption;
9. for civil society to encourage actions by governments and the private sector to accelerate the phase out of lead in gasoline;
10. to develop public awareness campaigns addressed to the whole population focused on key health and environmental issues and reasons for phasing out leaded gasoline;
11. to develop awareness-raising campaigns addressed to car users, auto trade, mechanics, etc., focused on vehicle performance, user benefits, etc. to dispel myths about unleaded gasoline;
12. to initiate programs to gather and generate data and information in support of the awareness campaigns (ambient air quality, emissions, lead pollution, lead blood levels, vehicle population...);
13. for the National Environment Council in Kenya, as well as similar organizations in other East African countries, to put on their agenda the phase out of leaded gasoline.

**TO MONITOR PROGRESS IN IMPLEMENTING THIS ACTION PLAN...**

a review, organized by UNEP, will take place during the second half of 2003 (or first half of 2004) in connection with the meeting of the African Ministers of Environment (AMCEN); as part of this review each government will prepare a short report on progress, IPIECA will prepare a report on actions taken by the private sector, and civil society organizations will be invited to report on activities in relation to the action plan. UNEP will prepare a report of this review which will be sent to all participants of the East Africa Sub-Regional Workshop.

The international organizations that have supported this workshop, IPIECA, UNEP, USEPA, and The World Bank Group, will continue to support activities for the phase out of leaded gasoline in East Africa as well as in the rest of the world.

# 3.0 AGENDA

## Wednesday, June 5, 2002

Time	Subject	Speaker	Remarks
09:00 – 10:30	Registration		
10:30 – 11:00	Conference Opening and Welcome	Mr. Sekou Toure, Director, UNEP Regional Office for Africa	
11:00 – 11:30	Keynote Speech: The Need For and Benefits of, Eliminating Lead From Gasoline	Mr. Michael Walsh, Consultant	
11:30 – 12:00	Keynote Speech: Introducing Unleaded: an Industry view	Mr. Kerry Wark, IPIECA	
12:00 – 12:30	Keynote Speech: U.S. Experience with Lead Phase-out	Ms. Jane Armstrong, USEPA	
13:00 – 14:00	Lunchtime Side Event: Launch of Unleaded Gasoline at the UN service station		
14:15 – 14:30	Objectives of the meeting	Doug McCallum	
14:30 – 15:00	Downstream Petroleum Sector in Sub-Saharan Africa - A World Bank Perspective	Michel Muylle, World Bank	
15:00 – 15:15	Short Break		
15:15 – 15:35	Challenges and opportunities for Lead Phase out in East Africa: a government perspective	Jane Wanjiru Akumu Ministry of Energy, Government of Kenya	
15:35 – 15:55	Phasing out leaded fuel: the role of civil society organizations	Nyaguthii Chege Natural Resources Defense Council	
15:55 – 16:30	Questions and discussion (panel of presenters)		Moderated by Doug McCallum

## Thursday, June 6, 2002

Time	Subject	Speaker	Remarks
09.00 – 09.25	East Africa Vehicle Fleet Implications: Lead Phase Out and Emission Control	Stuart Rayner, Ford/NAAMSA	
09:25 – 09:50	Refining and Supply options for the introduction of Unleaded Gasoline	Chris House, Kenya Petroleum Refinery Ltd	
09:50 – 10:15	Regional Marketing and Distribution infrastructure: preferred methodologies for ULG distribution	Eddie Day, Shell/BP group	
10:15 – 10:45	Coffee Break		
10:45 – 11:10	Regional fuel Standards and Specifications	Ms. Margareth Rotich, Kenya Bureau of Standards	

## Thursday, June 6, 2002(continued)

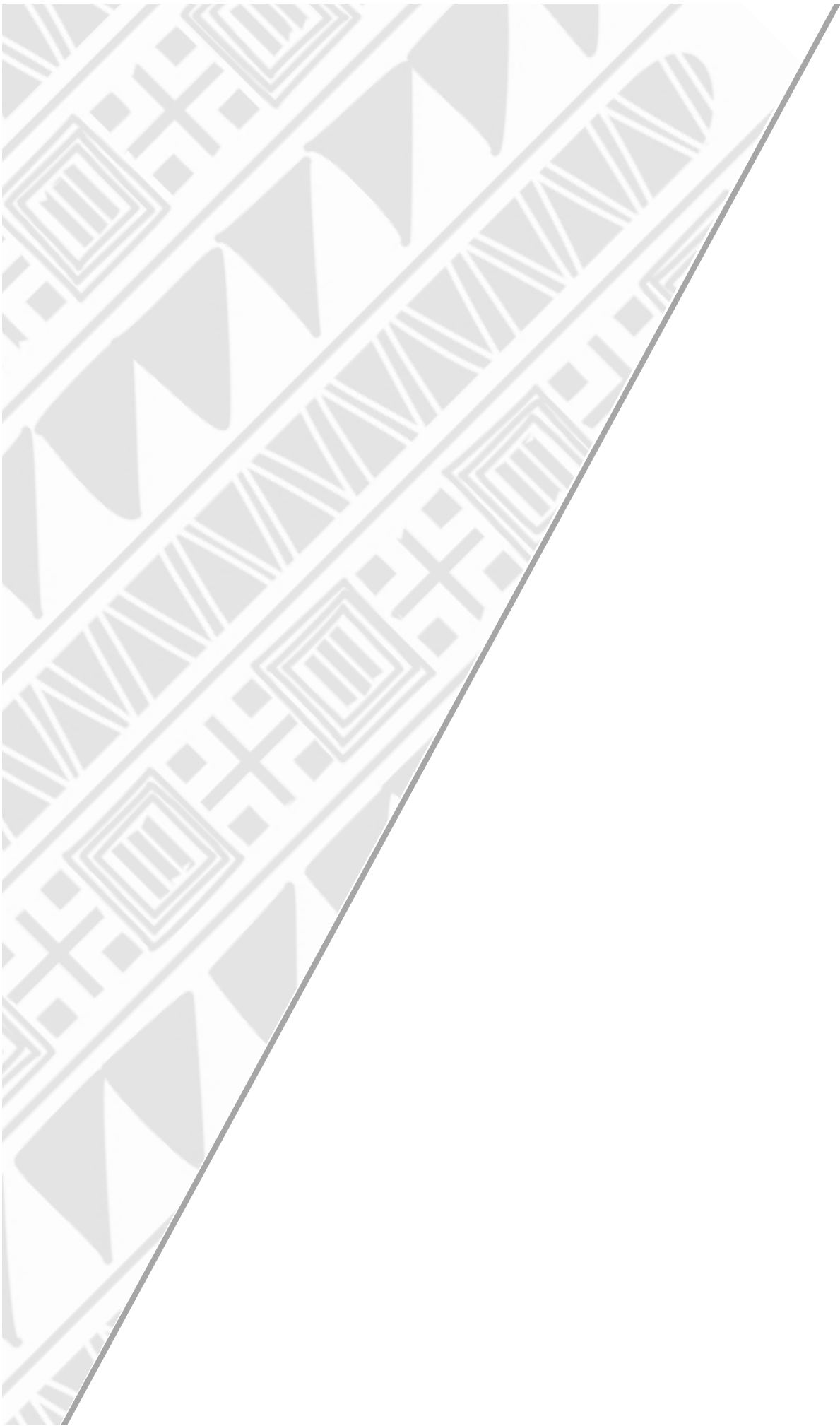
11:10 – 11:40	Lead phase out case studies: 1. Vietnam/Thailand 2. Bahrain	Nazeema Abrahams Rob Cox	
11:40 – 12:15	Questions and discussion (panel of presenters)		Moderated by Doug McCallum
12:15 – 12:45	Instructions to Break-Out Groups*	Doug McCallum	
12:45 – 14:15	Lunch		
14:15 – 15:15	Break Out Groups: formulation of Regional and Functional Action Plans		Led by designated rapporteurs & facilitators
15:15 – 15:45	Coffee Break		
15:45 – 17:00	Break out Groups: formulation of Regional and Functional Action Plans		Led by designated rapporteurs & facilitators
18:00 – 19:30	Reception		
<p>* Breakout Groups structured as follows: Group I: The role of Government in introducing ULG Group II: The role of the private sector in introducing ULG Group III: The role of information, marketing and communication in introducing ULG</p>			

## Friday, June 7, 2002

Time	Subject	Speaker	Remarks
09:00 – 10:30	Report Back from Break out Groups (10 minute presentations followed by questions/clarifications)	Rapporteurs	Moderated by Doug McCallum
10:30 – 11:00	Coffee Break		
11:00 – 12:30	Finalising Action Plan and Conference statement		Moderated by Doug McCallum
12:30 – 13:30	Closing statements Conference ends	Kenya Government/UNEP	

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## 4.0 PRESENTATIONS





# 4.1 KEYNOTE SPEECH

## The Need for and Benefits of Eliminating Lead from Gasoline

Michael Walsh, Consultant UNEP/IPIECA

### The Need For and Benefits of Eliminating Lead From Gasoline

Michael Walsh, Consultant UNEP/IPIECA

Nairobi, Kenya

June 2002



-1-

### Outline

- Why Lead Was Added to Gasoline
- Why A Consensus To Eliminate Lead
- International Experience
- Next Steps

-2-

### Why Are Fuels Important?

- Fuel Constituents Directly Affect Emissions/Air Quality/Health
- Fuel Changes Can Immediately Impact on Emissions From All Existing Vehicles
- Fuel Composition Can Enable/Disable Pollution Control Technology

-3-

### Why Was Lead Added To Gasoline

- Low Cost Octane Enhancer
- Higher Octane Allowed Better Engines
  - More Efficient
  - Higher Power Output

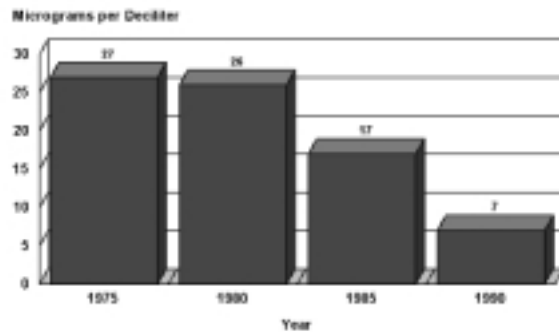
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### We Have Learned However Lead In Gasoline Has Negative Side Effects

- High Ambient Lead Levels
- Serious Health Risks
- Precludes The Use of Catalytic Converters To Reduce Other Hazardous Vehicle Pollutants (CO, HC, NOx & Toxics)
- Higher Vehicle Maintenance Costs

-5-

### Blood Lead Levels Considered Elevated



Is Any Lead Acceptable From A Health Standpoint?

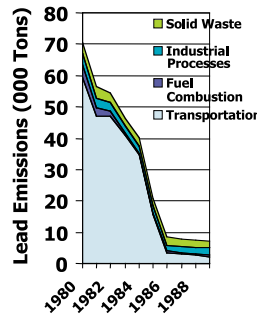
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### Children Are Especially Susceptible To Adverse Health Effects

- increased likelihood of exposure,
- increased absorption, and
- increased susceptibility of the brain.

-7-

### Trend in Lead Emissions and Air Quality in the US



- 87% Decrease in Average Ambient Lead Levels in 189 Urban Sites Over This Same Period
- Median Blood Lead Level Declined From 9.2 to 2.8 micrograms/dL

-8-

### The Experience Of Egypt - Health Effects Study

- Heart Attacks - 6,500 to 11,600
- Strokes - 800 to 1,400
- Premature Deaths (Adults) - 6,300 to 11,100
- Infant Deaths - ~820
- Average IQ Loss in Children - 4.25 Points

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### The Experience of Egypt The Role of Gasoline

- Peak Ambient Levels ~ 10 micrograms/m<sup>3</sup>
- ~ 2/3rds from Gasoline; 1/3 Smelters

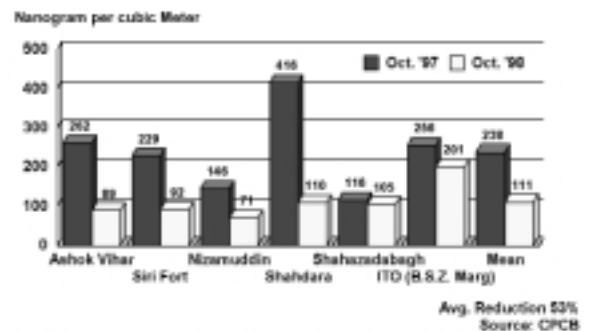
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## The Experience of Egypt Results of Action

- Refinery Modifications
  - Process Changes
  - 15% Oxygenates
- Within 6 Months
  - 85% Unleaded Nationally
  - 100% Unleaded in Cairo

-11-

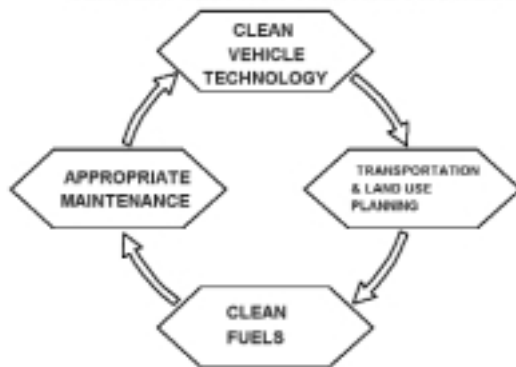
## Ambient Particulate Lead in Delhi Pre and Post Unleaded Petrol



Lead Phase Out Started in September 1998

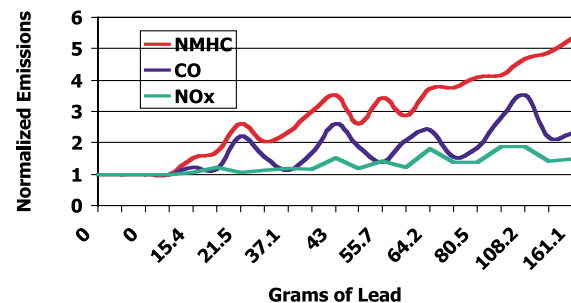
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### ELEMENTS OF A COMPREHENSIVE VEHICLE POLLUTION CONTROL STRATEGY



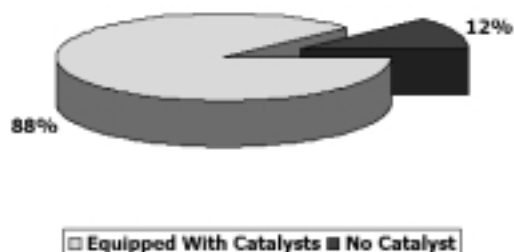
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## Impact of Lead on Catalyst Performance



-14-

## Substantial CO, HC, NOx Benefits Foregone With Leaded Gasoline



-15-

## Unleaded Gasoline: Gateway To The Future

- Direct Health Benefits
- Technology Enabling
- Modern Vehicle Technology
  - Low "Conventional" Emissions
  - Low Greenhouse Gas Emissions
  - Retrofit Technologies
- Modern Gasoline Technology
  - Low Benzene
  - Low Sulfur
  - Low Volatility

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## Lead Free Fuel Can Be Used in Older Vehicles

- Valve Recession Problem Has Not Materialized
- Need Sustained High Speed, High Load Operation
- Lead Substitutes Exist if Needed
- No Other Impediments Identified

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## Refinery Modifications Available To Replace Lead In Gasoline

- Increase Reformer Severity to Raise Reformate Octane
- Increase Production/Use of High Octane Blend stocks
  - Reformate
  - FCC Gasoline
  - Alkylate
  - Isomerate
  - Oxygenates

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## Quality Tradeoffs For Key Gasoline Blendstocks

	High Octane	Low RVP	Low Olefins	Low Benzene	Low Aromatics
Butanes	Yes	No	Yes	Yes	Yes
Alkylate	Yes	Yes	Yes	Yes	Yes
Isopentane	Yes	No	Yes	Yes	Yes
C6 Isomeric	No	Yes	Yes	Yes	Yes
L1 FCC Naphtas	Yes	No	No	No	Yes
L1V FCC Naphtas	No	Yes	Varies	Yes	No
Reformate	Yes	Yes	Yes	No	No
MTHU	Yes	No	Yes	Yes	Yes

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## Worldwide Consensus

Leaded Gasoline Should Be Eliminated

- Alternatives Are Widely Available
- Health Concerns No Longer Debatable
- Catalysts Are Best Solution To CO, HC, NOx Problems and Only Work With Lead Free Gasoline
- Modern Engines Designed For Lead Free Fuel

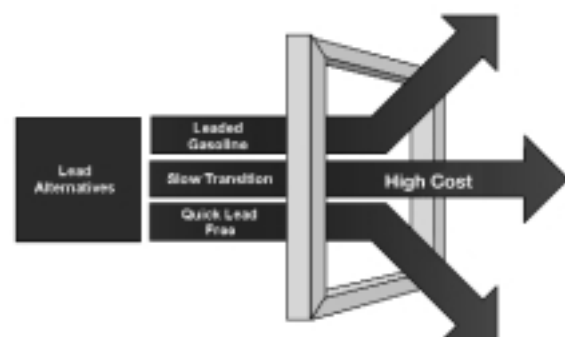
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Sales of Leaded Gasoline  
End of 2002



-21-

## Issue: Fast Track or Slow Track



-22-

## Problems With A Slow Transition

- Risks of Contamination
  - Deliberate
  - Accidental
- Expense of Dual Distribution System
  - Delivery
  - Pumps & Storage
  - Vehicles
- Administrative

-3-

## Progress In Eliminating Leaded Gasoline In Southeast Asia



-4-

## Policy Options For Lead Free

- Command and Control
- Vehicle Market Driven
- Fuel Pricing
- Combination

-5-

## Our Purpose Is To Develop Action Plans

- What Steps Need To Be Taken
- Who Needs To Take Them
- Specific Schedule For Actions
- Identify Outcomes

-6-



# 4.2 KEYNOTE SPEECH

## Introducing Unleaded: An Industry View

Kerry Wark, ExxonMobil, Regional Director  
Fuels Marketing Africa & Middle East, ExxonMobil/IPIECA

Esteemed Delegates, Distinguished Ladies and Gentlemen,

I appreciate the opportunity to address this conference on the Phase-out of Leaded Gasoline in East Africa. It is a pleasure to share this opening session with representatives of Government, Civil Society, and International organizations committed to the Phase-out of Leaded Gasoline initiative.

I represent the International Petroleum Industry Environmental Conservation Association, or IPIECA, and my company, ExxonMobil Corporation. My message is simple -- we stand ready to do our part in the effort to phase-out Leaded Gasoline from our fuels distribution chains.

Let me start with defining both organizations, then I will explain why this issue is important to us, and finally, discuss the specific role the oil industry can play to facilitate the phase-out of Leaded Gasoline in East Africa.

First, who is IPIECA? IPIECA is comprised of many private and state owned oil companies, as well as various national, regional and international trade associations. IPIECA holds formal United Nations consultative status as a Non-Governmental Organization. Its prime aim is to help members address long-term global environmental challenges, facilitating discussion/information exchange.

ExxonMobil is better known in this part of Africa as Mobil. We hold significant investments in Africa, and share the desire of your governments to see your economies grow, and its people prosper. With a workforce in excess of 4,000 employees, we market fuels and lubes in 35 African countries, including Kenya, Ethiopia, Djibouti, Eritrea and Mauritius. ExxonMobil is also engaged in significant Oil & Gas production activities in a number of these countries, and are partners in 4 refineries in the Region [Gabon 11.7%; Senegal 11.8%; Cameroon 8%; and Cote d'Ivoire 8%].

So, why is this issue important to us? In 1999 two oil companies, Exxon and Mobil decided to merge to form ExxonMobil, my company. Each of those companies had been working the Lead Phase-out issue for years in various parts of the world. A key step in the early part of the merger planning process was to define the values we would share as a combined company and adopt a firm set of Standards of Business Conduct governing all aspects of our operations.

When we looked at our combined operations in relation to these standards, we identified Leaded Gasoline as a product that was inconsistent with the fundamental values that guide our business activities. In particular, we recognized that in the continent of Africa, where we are one of the dominant marketers, the issue of removing lead from gasoline is less advanced than anywhere else in the world. We saw we had a responsibility, and as a result, redoubled our Leaded Gasoline Phase-out efforts. To be most effective, we chose to work through IPIECA, joined in partnership with the World Bank, which had a similar effort underway.

The Petroleum industry position on this issue is represented in the following statement adopted by all IPIECA members:

**"IPIECA members encourage governments in countries still using Leaded Gasoline to develop lead phase-out action plans and finally mandate the elimination of lead as an additive. We recognize that affordable energy supplies are just one of many other issues critical to the health and public welfare of people, particularly in countries of the developing world. We understand that each**

country must set their own priorities and timetables on these issues. Therefore, we intend to approach lead phase-out constructively by working with governments, automobile manufacturers and others to address the economic, political, and supply barriers to quick action".

You may ask: "Why don't we want to sell Leaded Gasoline?" Two reasons: First, using Leaded Gasoline perpetuates air pollution from motor vehicles because it harms catalytic converters and prevents their broader use. Modern vehicles fitted with catalytic converters are 98% less polluting than they were 35 years ago. These benefits could be available to Africa over time by bringing both new and previously owned catalyst equipped vehicles into the vehicle fleet -- but not until lead is removed from gasoline.

Second, numerous scientific studies show that exposure to lead in particulate form, introduced in the air by vehicular exhaust fumes, presents health concerns particularly in children.

For these two reasons, we are focusing our energies on encouraging countries still using Leaded Gasoline to phase it out in the shortest possible time.

Since IPIECA began actively working this issue, momentum has been building around the world to phase-out Leaded Gasoline. Several countries in Africa and the Middle East have set timelines for the elimination of Lead in Gasoline -- South Africa, Egypt, Tunisia, Mauritius, Saudi Arabia, Kuwait, and Oman -- have decided to phase-out Leaded Gasoline in their domestic markets. We are excited to see this momentum building and want to help it along.

The oil industry can play a key role in facilitating lead phase-out in your respective countries. First, I believe this process can proceed most effectively if there is a partnership between government, industry, and the development banks. One company cannot do this alone, and even all the IPIECA members working together cannot do this alone. There are many other local and state owned companies involved in the refining, importing, and marketing of Leaded Gasoline in Africa that must also be part of the solution.

We all recognize each government will set standards for lead in Gasoline in its markets and enforce those standards. Government officials in each country are responsible to make the difficult decision on how to prioritize the lead phase-out problem versus other problems, to allocate available resources, and to set time frames for implementing solutions.

We urge governments to work with industry, IPIECA and the World Bank to develop solutions that recognize all costs in the supply chain, in manufacturing, in storage and in distribution.

¥ Some countries are fortunate in that they import all gasoline requirements. With these countries, the solution is simple - as unleaded gasoline on global markets, on a landed cost basis is now generally cheaper than leaded gasoline, the total conversion can take place in the very near future with unleaded fuels simply backing out leaded fuels. Some consideration must be given to a very small percentage of old vehicles that may need a lead replacement additive - this is not a significant issue and it has been readily handled in countries that have phased out lead.

¥ Other countries have a challenge when their refineries are not capable of manufacturing unleaded gasoline to fully replace leaded grades. Here difficult decisions must be made to determine if modification of existing refineries is an economic proposition or if they are better converted to import storage facilities for unleaded and other grades.

To determine the optimum path forward for the earliest conversion to unleaded gasoline, we urge governments to study these matters and options carefully.

The first Sub-Saharan Conference on Leaded Gasoline Phase-out was successfully held in Dakar, Senegal in June 2001. That conference set the pace for concerted effort by all governments to achieve the objective of Leaded Gasoline Phase-out by 2005. Follow-up conferences have since been held in Abuja, Nigeria in



November 2001; Dakar, Senegal in March 2002; and Cotonou, Benin in April 2002. All three conferences agreed to continue the efforts initiated by the 2001 Dakar declaration in developing and implementing action plans for phase-out of Leaded Gasoline.

Many countries have committed to the 2005 phase-out timetable and Mauritius has gone a step further by revising its timetable to August 2002. This conference provides yet another opportunity to reinforce the Dakar declaration and formulate action plans to phase-out Leaded Gasoline in this part of Sub-Saharan Africa. I have no doubt, this event will be the catalyst for driving the process to eliminate Lead from Gasoline in East Africa by 2005.

Industry can play a key role in this process and we would like to be partners in this effort. We can offer advice on HOW best to achieve the lead phase-out goals set by your governments. We can lay out a range of refining and supply options, provide cost data, show the impact of using various fuels on the vehicle population, and show the impact of fuel changes on local air quality. Such advice from our industry can help streamline the phase-out process, minimize supply disruptions to the marketplace, minimize costs to citizens, and improve air quality.

This conference offers an important opportunity that is worth seizing. We have the Oil industry, Car Manufacturers, Research Institutes and the NGO community poised to work with Government officials to develop action plans to phase-out Leaded Gasoline in this part of Africa.

This is an opportunity to take an important step towards improving the quality of air and life of the citizens of your countries. I encourage you to take advantage of this opportunity and begin laying the groundwork that will result in cleaner air, lower health care costs, and most important, healthier and more productive citizens. The international petroleum industry stands ready to do its part to help make this happen.

In closing, I would like to commend the efforts and dedication of all those who have directly or indirectly contributed to making this conference a success. On behalf of my IPIECA colleagues, I want to say that we are looking forward to working with all of you in the months ahead to move this initiative along.

Thank you.



# 4.3 KEYNOTE SPEECH

## U.S. Experience with Lead Phase-Out

Jane Armstrong, Senior Policy Advisor, International Activities, USEPA

### U.S. Experience with Lead Phase-out

Jane Armstrong  
Senior Policy Advisor,  
International Activities - U.S. EPA  
Office of Transportation and Air Quality



### The Toxicity of Lead

- Heavy metals such as chromium, manganese, and nickel, although toxic at high levels, are actually required nutrients at lower levels
- But lead has no known beneficial effect in the body

-1-

-2-

### The Toxicity of Lead

- Low level exposure affects the nervous system, the reproductive system, and the immune system
- Lead is classified as a probable human carcinogen

-3-

### The Toxicity of Lead

- There is no known threshold; any exposure is of concern
- Children are most affected

-4-

## U.S. Experience with Phase-Out

- In the 1970's, lead concentrations in U.S. cities were at hazardous levels
- The U.S. also wanted to introduce clean vehicles with catalyts

-5-

## U.S. Requirements for Lead in Gasoline

- Lead was reduced from 2.4 grams/gallon to 0.1 gram/gallon by 1986
- Lead was banned in 1995
- Average blood lead content dropped by more than 85 percent

-6-

## Valve Seat Recession

- Lead deposits on valve seats prevent abrasive wear
- Some older engines may have soft valve seats

-7-

## Valve Seat Recession

- Cars operating under normal conditions show little valve seat wear
- U.S. Army found no problems with jeeps, cars, trucks, tractors, motorcycles, or combat vehicles

-8-

## Vehicle Maintenance Benefits

- Exhaust systems
- Tune-ups
- Oil Changes

-9-

## Exhaust Systems

- Leaded fuel is more acidic than unleaded
- Higher acidity accelerates tailpipe and muffler corrosion
- Mufflers last twice as long with unleaded fuels

-10-

## Tune-ups

- Lead deposits on electrodes shorten spark plug life
- Unleaded fuel increases plug life by about 80 percent

-11-

## Oil Changes

- Lead deposits cause corrosion
- Engine oil accumulates corrosion debris
- Oil changes are needed more frequently

-12-

## Improved Emission Performance

- Unleaded fuel made catalyst cars possible
- Hydrocarbons were also reduced due to lower combustion chamber deposits

-13-

## Improved Fuel Economy

- Increased energy of the gasoline by more intensive processing
- Reduced spark plug fouling
- Exxon study found a 1 to 5 percent improvement

-14-

## U.S. Experience with Implementation

- Unleaded required at most gasoline stations 2 months before catalyst cars appeared
- Fuel nozzles were made smaller for unleaded fuel
- Catalyst cars were equipped with inlet restrictors

-15-

## Compliance and Enforcement

- Gasoline stations were inspected
- Gasoline nozzles were measured
- Fines up to \$10,000 per day

-16-

## Problems with Enforcement

- Leaded gasoline cost less than unleaded
- Drivers believed that that leaded gas gave better performance
- In 1985, sixteen percent of catalyst cars were misfueled

-17-

## Summary

- Lead phase-out protects health and is the first step to clean air
- No real technical barriers for use in old fleets
- Make sure the public is informed about the benefits

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# 4.4

## Downstream Petroleum Sector in Sub-Saharan Africa: A World Bank Perspective

Michel Muylle, Senior Gas Specialist, World Bank

### Clean Air Initiative Downstream Petroleum Sector in Sub-Saharan Africa



Michel S. Muylle, Senior Gas Specialist, World Bank  
Nairobi Sub-regional Workshop, June 2002

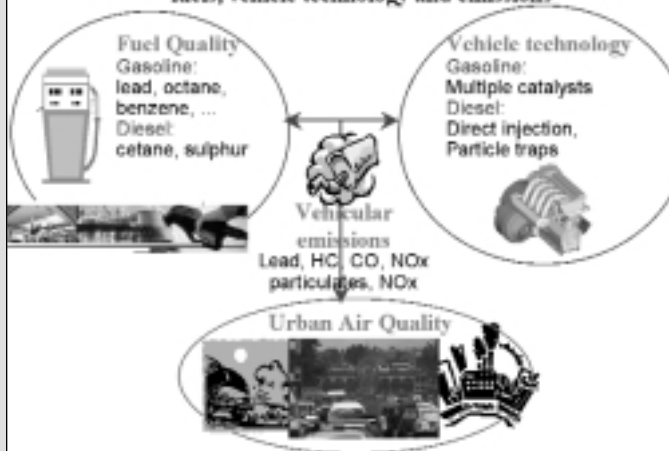
### Content

- Review of 30+ studies on the sector
- Key issues
- Recommendations

-1-

-2-

### Air Quality – a direct link between the quality of fuels, vehicle technology and emissions



-3-

### Review of SSA downstream sector

#### Background

- Cuneo Study
- 37 Bank sponsored or managed studies on the sector ('95-2001)

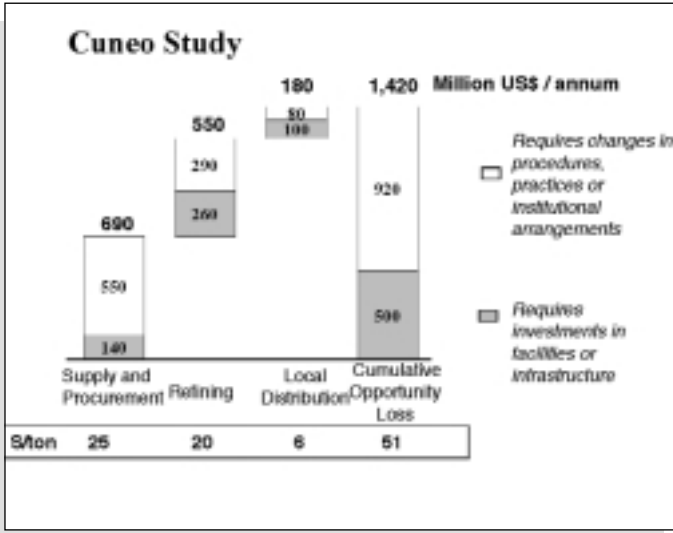
#### Consolidation

- Objectives
- Status

#### Dissemination

- Stakeholders awareness (oil companies, transport, health, ...)
- Public outreach and education

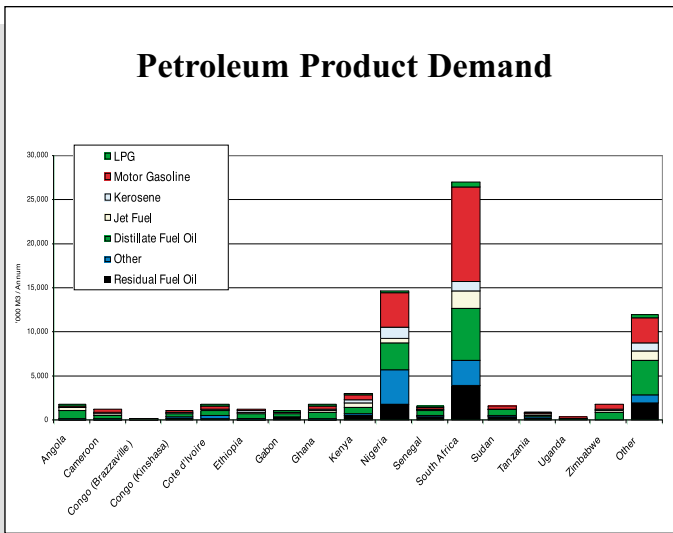
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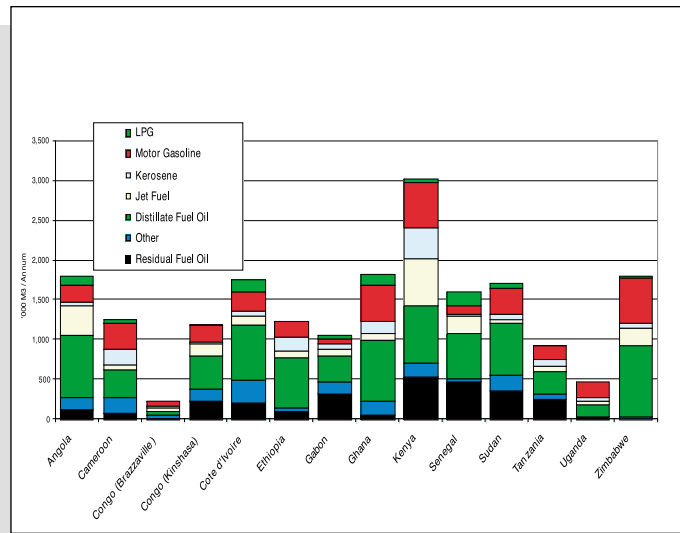
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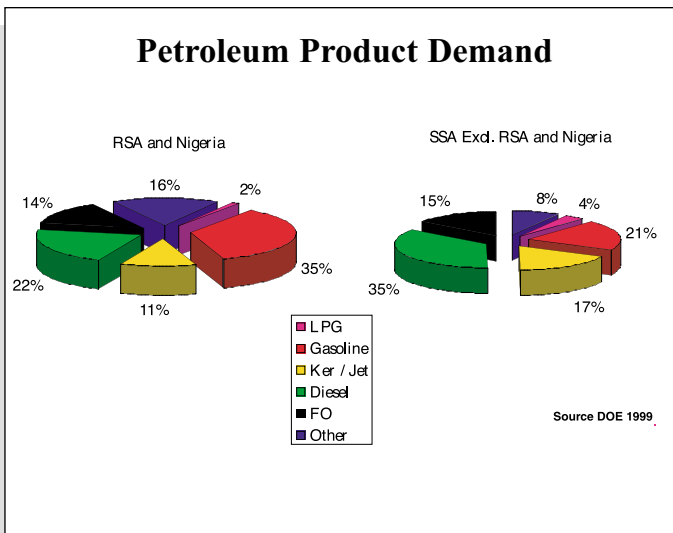
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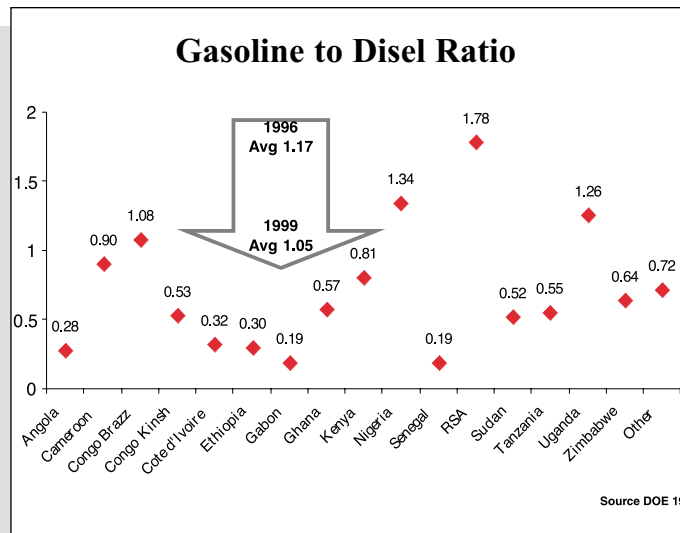
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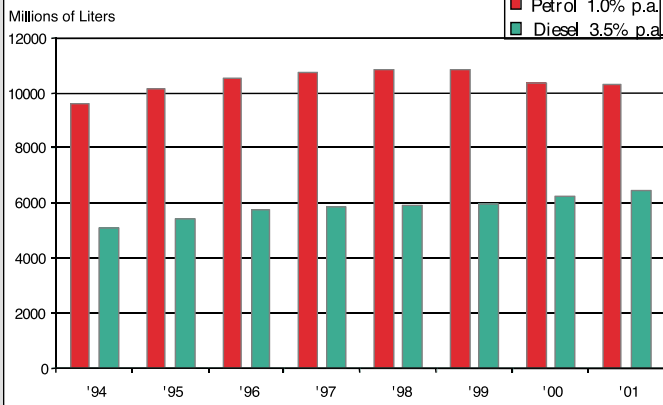
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### RSA Demand Evolution



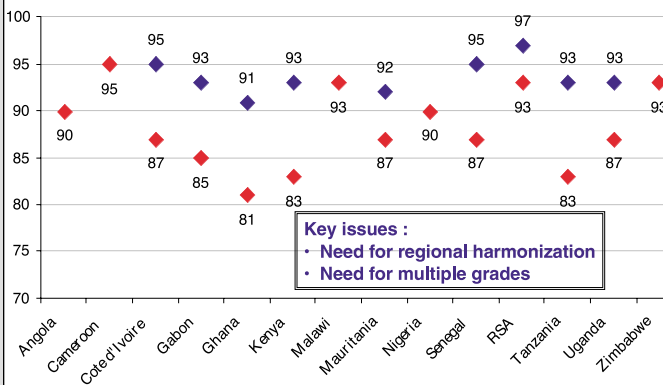
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### Product Quality Specifications

- Quality spec's lagging 10-15 yrs
- Specifications often not regulated – set by industry
- Wide range of octane ratings
- Unleaded starting to make small inroads
- Diesel
  - high sulfur content
  - Cetane ranging from 45 to 52
- Fuel oil – high sulfur content

-12-

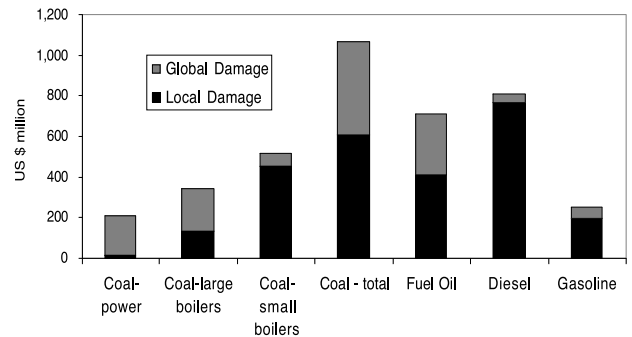
### Gasoline Octane Ratings



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### Cost of Pollution

Differentiation in the utilization of fuels and the differences between types of fuels are equally important with regard to damage to the environment



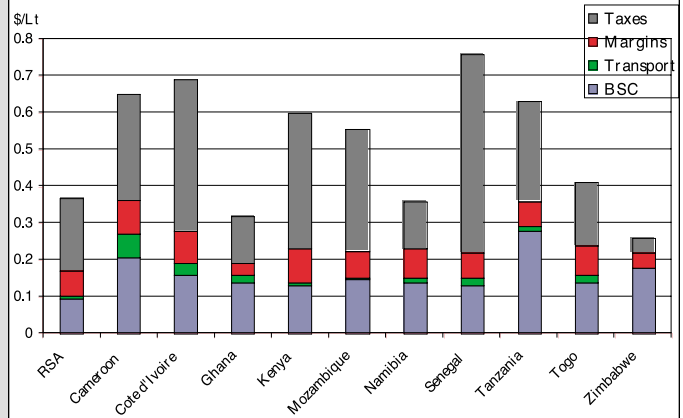
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### Product Pricing

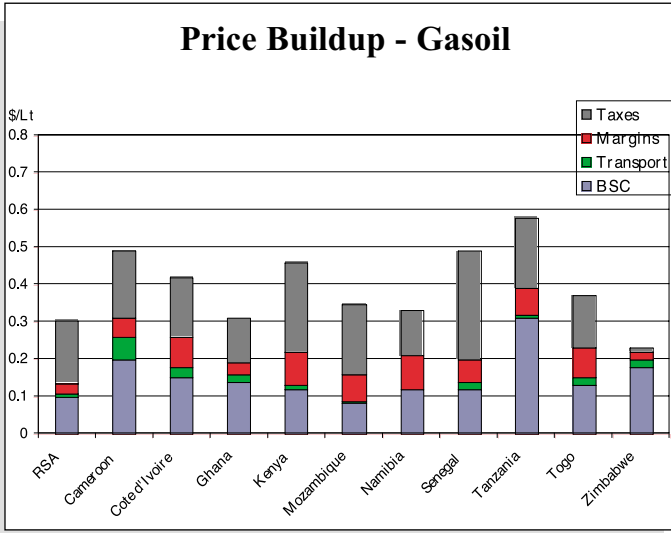
- Very wide ranging in pricing
- Significant differences in Base Supply Cost
- Tax harmonization lacking
  - Between products
  - Between countries
- Few outliers on retail and distribution margins

-15-

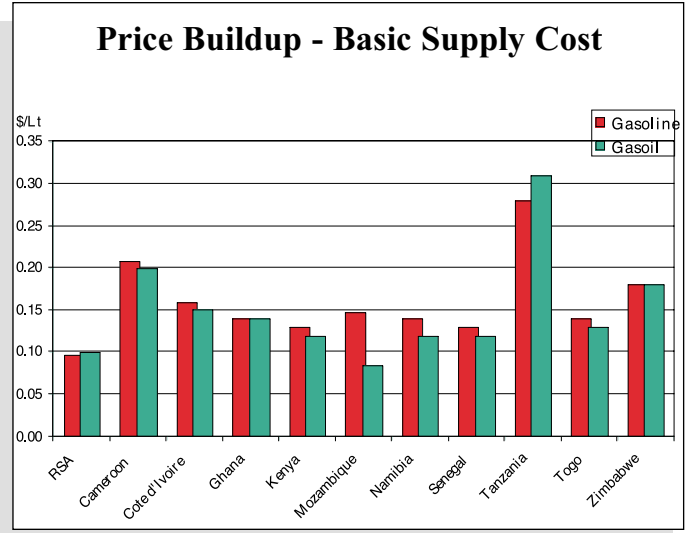
### Price Buildup - Gasoline



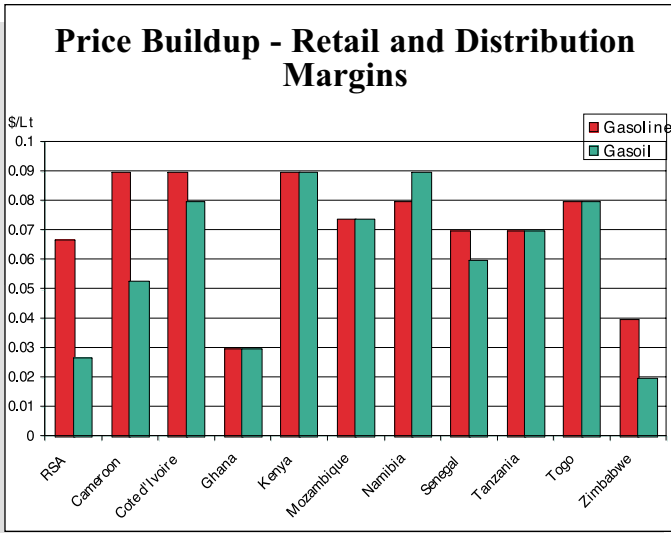
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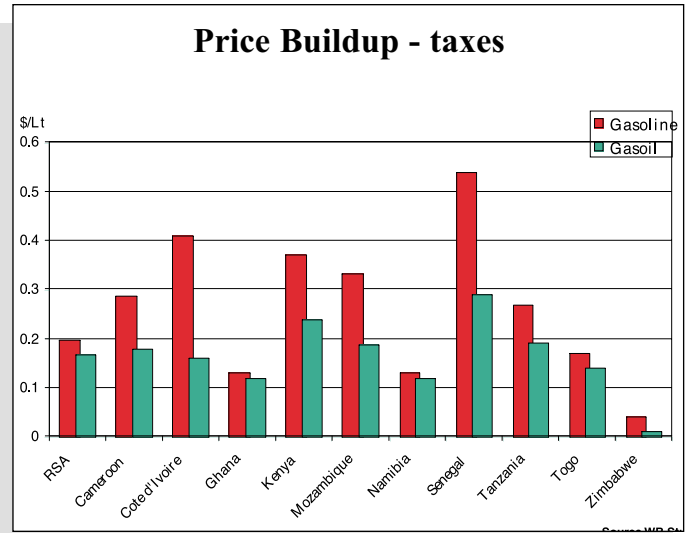
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-18-



-19-



-20-

### Refining Industry in SSA

**Scatter of very small to world scale refining**

- 15 refineries < 50 kBd
- RSA and Nigeria represent 68% of total capacity
- Performance worrisome
- Sustained role of the public sector inhibits consolidation and investments

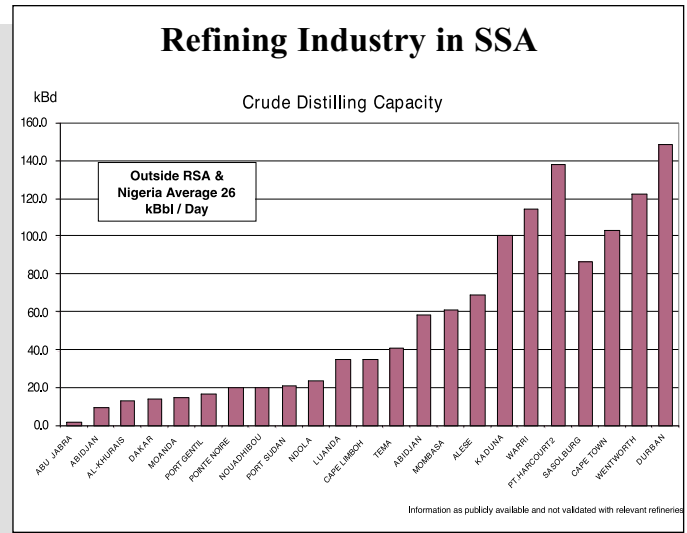
**Refining configuration**

- Light ends upgrading (reforming, isom, alkyl) 16% of CDU capacity
- Excl. RSA & Nigeria, light ends upgrading only 84 kBd
- Low octane pool (primarily semi-rcgen reforming)
- High penetration of diesel governs crude runs and configuration

**Regional supply options**

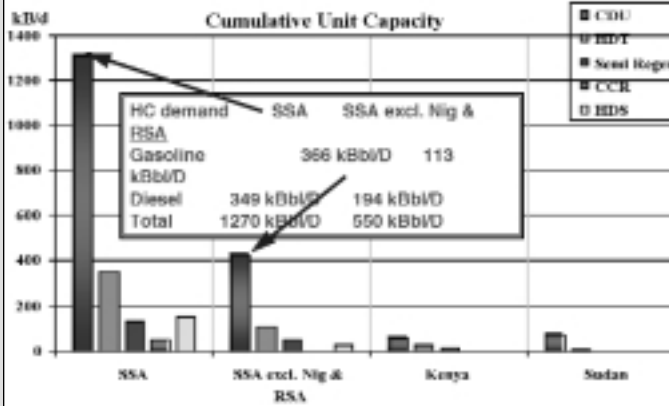
- Short in octane
- Growing dependence on imports

-21-



-22-

### Refinery Configuration



-23-

### Refining Issues



Limited options for refineries :

- De-bottleneck semi-regen
- Upgrade to CCR (world scale 20-30 kbb/d)
- Isomerisation (front end boost)
- Blending of high quality components
- Gasoil hydrodesulphurization

Critical issues are

- small scale and configuration of the refinery
- ownership and control
- regulatory regime
- crude diet, product yields and qualities
- demand shifting to diesel at the expense of gasoline
- investment in product quality gives inadequate returns
- ability to recoup investments through product pricing
- complex cost – benefit analysis

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### Import Countries

- Few if any constraints to phase out lead, improve product quality
- Economic cost is small and relatively simple to assess
- Timing / Phasing within own control

Critical issues are

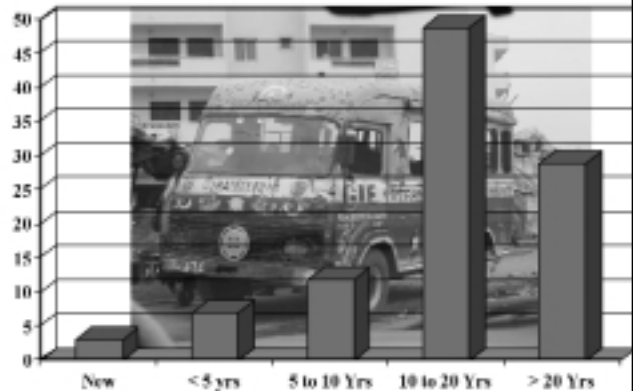
- regional supply options
- import terminal and distribution flexibility
- landlocked countries supply options
- limited competition / entrenched positions
- vehicle fleet (current and future)
- public outreach / education
- commitment to environment & health



-25-

### Automobile park in Benin

Relative proportion of the car population



-26-

### A Few Suggestions .....

Determine priorities vis-à-vis fuels and vehicles

- Who and what pollutes more?
- Should the polluter pay?

Product specifications for gasoline and diesel

- Short term vs. medium term
- Fit for purpose (vehicle fleet, driving conditions)
- Reduce octane pool to avoid or delay investments
- It's not only about lead, octane or sulphur

Taxation and Pricing

- Diesel favored compared to gasoline
- Impact on economy
- How to account for externalities

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### A Few Suggestions (cont'd)

Import options

- Regional supply options
- High octane / Low sulphur components

Refining options

- Operational measures (incl. feedstock selection)
- Investment options
- Cost / Benefit analysis
- Pricing or regulatory structure to ensure economic viability

Market structure

- Open access / deregulated market
- Entrenched positions / sunk costs

Rules of the Game : Clear and Stable !

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### Role of the World Bank Group

- **Multi-sectoral and regional organisations**
  - Transport
  - Environment
  - Oil & Gas
- **Policy support and capacity building**
  - Product quality
  - Pricing regimes and fuel taxation
  - Regulatory structures
- **Risk management**
  - Limited recourse financing
  - Equity
  - Partial Risk Guarantees

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### Clean Air Initiative

#### Downstream Petroleum Sector in Sub Saharan Africa



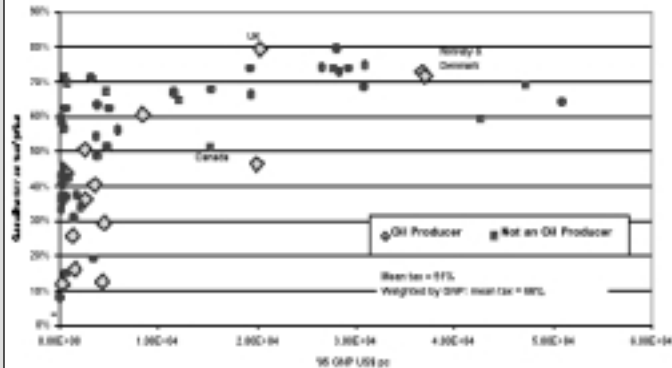
Many thanks for  
your attention!

Michel S. Muylle  
Nairobi Sub regional Workshop, June 2002

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### Taxation as a function of GNP

GNP per Capita and Gasoline Tax Rates



-31-

### Product Specifications - Gasoline

Specification	Regular	Premium
Research octane number (RON), min.	91	95
Motor octane number (MON), min.	82	85
Reid vapor pressure (RVP), psi, max.	9.0 to 11.5	
T50, °C, max.	120	
T90, °C, max.	190	
Sulfur, wt ppm, year 2001, max.	1,000	
Sulfur, wt ppm, year 2005, max.	400	
Aromatics, vol%, max.	45	
Olefins, vol%, max.	25	
Benzene, vol%, max.	2.5	
Oxygen, wt%, max.	2.7	
Lead, g/l, max.	0.013	

Note: Unless otherwise stated, the specifications should be applied by the year 2005.

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### Product Specifications - Diesel

#### Specification

Cetane number for year 2001, min.	45
Cetane number for year 2005, min.	47
T90, °C, max.	360
Sulfur, wt ppm, year 2001, max.	5,000
Sulfur, wt ppm, year 2005, max.	2,000
Sulfur, wt ppm, year 2015, max.	500
Density, kg/m <sup>3</sup> at 15°C	820-860
Aromatics, vol%, max.	30

Note: Unless otherwise stated, the specifications should be applied by the year 2005.

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# 4.5

## Challenges and Opportunities for Lead Phase-Out in East Africa: A Government Perspective

Jane Wanjiru Akumu, Ministry of Energy, Government of Kenya

### CHALLENGES AND OPPORTUNITIES FOR LEAD PHASE OUT IN EAST AFRICA: A GOVERNMENT PERSPECTIVE

The paper will give a brief background of the petroleum sector in Kenya as well as its relationship with the neighboring countries. I will then look at the main issues in implementing lead phase out in the region, options available and conclude with recommendations on the way forward.

#### I. Background

The petroleum industry in Kenya was deregulated in October 1994. Prior to this period, oil marketing companies involved in the importation and marketing of petroleum products were required by the Government to meet all their domestic supplies from the country's refinery. Most of the products consumed in the neighboring countries of Uganda, part of Tanzania, Rwanda, Burundi and part of Democratic Republic of Congo (DRC) were also sources from this refinery. Tanzania also operated a refinery that has since been shut down.

At the onset of the liberalization of the sector in Kenya, the Government did reach into an agreement with the oil companies to continue to process at least 1.6 million tones of crude oil in the country and the balance of their requirements would be met either through refining crude oil or direct importation of refined products. This minimum allocation still exists.

Kenya's current consumption of petroleum products stands at roughly 2.4 million tones annually and the refinery's contribution to the total demand varies from year to year, for example, in 1999 the refinery contributed about 73% of the country's consumption while in 2000 and 2001 the proportion from the refinery was roughly 82 and 71% respectively.

The bulk of the country's supply of petroleum products is transported by the Government-owned oil pipeline, the Kenya Pipeline Company (KPC), which also plays a big role in the products supply chain to the neighboring countries. Over 80% of petroleum products consumption in Uganda is transported via KPC and most of the consumption in North-Eastern Tanzania, Northern DRC, Rwanda, Burundi and to a lesser extend Southern Sudan. The balance of the supplies to these regions is by the railway system both in Kenya and Tanzania. The major oil companies (multinationals) do own storage facilities in Nairobi and Mombasa but the bulk of the country's storage facilities are situated in the refinery and the KPC.

The Government has introduces some regulations which though aimed at the addressing problems facing the sector in the country, will also affect the marketing of lead free gasoline in the neighboring countries. One such regulation is that exports of petroleum products to neighboring countries can only be transported via the pipeline, in which case the exporting companies load products at the Kisumu or Eldoret terminals or the railway from Mombasa. This was geared towards addressing the problem of dumping of petroleum products meant for the neighboring countries back into Kenya.

It is noted that oil companies in the country have already introduced in the market the unleaded brand of gasoline. There is however need for the Government to take the lead in the phase out programme especially in view of the various legal requirements in the importation and marketing of petroleum products in the country. Currently, oil companies involved in sale of unleaded gasoline are transporting their products either by road or the rail system.

## II. Main Issues in Lead Phase Out

The refinery in Kenya plays a crucial role in the lead phase out programme in the country. This is because it is viewed to be a strategic investment in the country. The refinery in its current state is not able to produce unleaded gasoline unless it is upgraded.

There is concern with the vehicle age population in the country. Unlike many countries in the west where vehicles are driven for a few years before being disposed of, the situation in the region is different as cars are not easily disposed. The impact of selling only unleaded fuels therefore needs to be determined. For the country to get the full benefit of unleaded gasoline especially in as far as emissions to the environment is concerned vehicles will need to be installed with catalytic converters. There is therefore need to have an integrated programme to cover the introduction of newer vehicles with catalytic converters while the older vehicles are phased out with the introduction of lead free gasoline.

As mentioned above, the bulk of the country's inland supplies and those to the neighboring countries are transported through the KPC system. Since KPC operates a multi products pipeline and handles products both from the refinery and direct imports, it would be difficult to move to total lead phase out without the upgrading of the refinery.

It will be noted that currently, the oil companies marketing unleaded gasoline are transporting these supplies either by road or the railway. It is recognized that the pipeline system while not only being the most efficient mode of transporting petroleum products in the country also has added benefits of reducing road carnage in the country. Thus from the Government's perspective, the pipeline mode of transporting fuels will continue to be encouraged.

## III. Options Available

While the Government recognizes that lead phase out is not only inevitable but also beneficial to the country and region as a whole, the need to have an implementation schedule spearheaded by the Governments of the region is necessary if lead is to be phased out in the region.

It will be noted that the Ministry of Energy did recognize the dangers of high lead levels in gasoline to the country and in liaison with the Kenya Bureau of Standards (KEBS), which is the body responsible for legislation on minimum standards, effected a new standard on unleaded gasoline in 1999. The Government's intention was to have all imported gasoline into the country to be lead free thus reducing the lead levels in gasoline nationally given that the country imports close to half of her domestic gasoline requirements. A waiver was however asked by some oil companies and neighboring countries to allow them time to either analyze the financial implications, in the case of the countries, or make new proposals for adjusting some of the specifications of the unleaded gasoline in the case of the companies.

Presently, a new specification has been proposed and is before the standards authority for approval. The KEBS has indicated that by end of July 2002 the specification would be ready and that the country's imports of gasoline would be unleaded.

The KPC is also enhancing its capacity to handle unleaded gasoline through segregating their tanks and also scheduling their transportation to cater for the unleaded gasoline. This is scheduled to be effective end of July 2002 when the new standards are legislated.

From the above, it would appear that the Government has three options for the phase out programme as follows:

- Option 1: Total phase out of leaded gasoline and immediate conversion to unleaded gasoline.
- Option 2: Rapid phase out of unleaded gasoline through reducing lead concentrations in gasoline sold in the country followed by eventually total ban of lead in gasoline.
- Option 3: Phase in unleaded gasoline to coincide with importation of newer vehicles and phase out leaded gasoline with retirement of older vehicles.

#### IV. Way Forward

For the case of Kenya, a combination of options two and three would be the most ideal. This is because, as stated before, the refinery plays a critical role in the supply chain of petroleum products. The upgrading of the refinery is anticipated though the Government is currently looking at its economic viability with a view of determining its future. The upgrading is scheduled to take a few years to complete hence supplies of gasoline of unleaded grade in the country are expected to change after this period.

In view of the introduction of the unleaded grade of gasoline in the country by some oil marketing companies, it is anticipated that the newer cars being imported will benefit from the introduction of the unleaded grade while the older cars would continue to run on leaded gasoline while they are gradually retired from the market.

For the neighboring countries, the switch to lead free gasoline is easily attainable now that the pipeline system is able to segregate supplies from the refinery and those imported directly. The bulk of the supplies to the neighboring countries that pass through Kenya are imported hence the switch to unleaded could be attainable within a short period. Other countries in the region like Ethiopia and Tanzania could also easily switch to unleaded gasoline as they rely on imports.

There is also need to inform the public on the benefits of lead free gasoline if it is to be acceptable nationally. The Ministry intends to co-ordinate sessions with all the stakeholders and especially from government departments aimed at mapping out a strategy towards implementation of lead phase out in the country. This is expected to take place once the Government is clear as to the future of the refinery as it is key to the programme.





# 4.6

## Phasing Out Leaded Fuel: The Role of Civil Society Organizations

Nyaguthii Chege, Attorney, International Program,  
Natural Resources Defense Council

Phasing Out Leaded Fuel: The Role of  
Civil Society Organizations  
East Africa Regional Workshop  
June 5-7, 2002  
Nairobi, Kenya

Nyaguthii Chege, Attorney, International Program  
Natural Resources Defense Council

### Overview

- Lead in gasoline is a major source of urban air pollution and has significant health and environmental impacts
- More people are being exposed to lead poisoning because of substantial increase in number of vehicles and growth of urban populations
- Most countries in sub-Saharan Africa continue to use leaded gasoline
- Major regulatory efforts can open the door to cleaner fuels
- Civil society organizations play a crucial role in the phase-out campaign

-1-

-2-

### Environmental and Health Impacts of Leaded Gasoline

- Leaded gasoline is the single largest source of lead pollution in urban areas
- Lead is a cumulative toxin that builds up in the body's soft tissue e.g., kidneys, liver, brain
- Lead inhibits oxygen and calcium transport and affects nerve transmission in the brain
- In children, lead poisoning can cause permanent brain damage and obesity, and stunt growth
- In adults, lead poisoning leads to hypertension, heart disease, and premature death

-3-

### The Global Phase-Out Campaign

- 1992 Rio Earth Summit – governments commit to reducing air pollution from cars and trucks
- NRDC's 1994 report, Four in '94: Two Years After Rio – Assessing National Actions to Implement Agenda 21, examined the use of leaded gasoline in 82 countries around the world
  - Only 7 nations had completely eliminated leaded fuel
  - All countries were capable of phasing-out leaded gasoline by 2000
  - Findings endorsed by the UN Commission on Sustainable Development
- UN CSD (1994) and World Bank (1996) call for a global phase-out of leaded gasoline
- 2002 WSSD preparatory meetings propose complete global elimination of leaded fuel as a summit goal

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### Lead Commitments in Other International Fora

- UN CSD Second Session, 1994
  - Notes “the severe health impacts of human exposure to lead, endorses the ongoing work on that issue in several international forums and encourages further efforts to reduce human exposure to lead.”
- Earth Summit +5, UN Special Session, 1997
  - “[I]t is important to accelerate the process of eliminating unsafe uses of lead including the use of lead in gasoline worldwide...”
- Habitat II Agenda, 1996
  - Signatories express their commitment to phase out leaded gasoline as soon as possible
- Habitat Seventeenth Session, 1999
  - Calls on all governments to incorporate leaded gasoline phase-out initiatives in their national agendas and to provide publicly accessible information on the progress of phase-out programs

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### What Role for Civil Society Organizations?

- Information gathering and dissemination to generate political and social consensus
  - Facilitate broad consensus among the main stakeholders, and understanding and acceptance of the phase-out campaign by the public
    - Four in '94 widely distributed and its findings broadly accepted
  - Dispel the myths and tell the facts about leaded fuel
    - The health impacts of lead poisoning are severe and have economic costs
    - There is a direct relationship between the use of leaded gasoline and blood lead levels
    - All cars can use unleaded gasoline
    - Technical solutions and safe alternatives to lead are available
    - Phasing out leaded fuel makes economic sense

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### What Role for Civil Society Organizations?

- Advocacy
  - Use informal and conventional methods to petition governments to act
  - Build public awareness and conduct media outreach to generate domestic demand for unleaded fuel and support for the campaign
  - Provide information, knowledge, expertise
  - Facilitate transfer of technical resources from international organizations, businesses, governments

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### What Role for Civil Society Organizations?

- Monitoring Compliance with National Implementation Action Plans
  - Implementation involves a myriad of government actions as well as the activities of NGOs, private industry, scientists, and consumers
  - Implementation requires better management of compliance problems through development of transparent information systems and strategies of response to induce compliance
  - Track compliance with international treaty obligations and international environmental governance

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# 4.7

## East Africa Vehicle Fleet Implications: Lead Phase-Out and Emission Control

Stuart Rayner, Chairman, National Association of Automobile Manufacturers of Southern Africa and Ford Motor Company



**East Africa Vehicle Fleet Implications: Lead Phase-Out and Emission Control:**

PRESENTATION BY THE NATIONAL ASSOCIATION OF AUTOMOBILE MANUFACTURERS AND ASSEMBLERS OF SOUTH AFRICA/FORD MOTOR COMPANY

STUART RAYNER  
NAIROBI, KENYA, MAY 2002

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### Index

- South/East Africa unleaded gasoline status
- 'Leaded only' states: Vehicle implications
- East Africa vehicle population/market
- Japanese Auto Manufacturers Association : Fuel Additives
- Leaded fuel phase out options
- Post lead phase out : Vehicle emission control
- Emission technology and octane requirements
- Catalytic converter contamination
- Int' Auto Industry position on lead phase out
- Conclusions/lessons learned

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### East Africa Vehicle Population 1999/2000

AFRICA	CARS	PERSONS PER CAR	COMMERCIAL VEHICLES	TOTAL VEHICLES	PERSONS PER VEHICLE
Burundi	18 800	332.3	14 600	34 200	190.0
ESIOPIA	43 900	1 291.8	30 400	74 300	622.3
<b>Kenya</b>	<b>215 000</b>	<b>117.2</b>	<b>165 000</b>	<b>380 000</b>	<b>77.6</b>
Malawi	17 900	962.2	19 200	37 100	295.7
South Africa	2 850 000	13.2	1 975 000	4 825 000	5.9
Tanzania	49 500	662.5	63 000	112 500	291.5
Uganda	28 800	740.4	64 000	92 800	291.0
<b>TOTAL AFRICA</b>	<b>11 489 500</b>	<b>66.7</b>	<b>8 882 176</b>	<b>20 371 676</b>	<b>64.0</b>

FIGURES SOURCE: IFAA/RESEARCH & STATISTICS FOR AFRICA (2000)

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### Availability of Unleaded Gasoline

• Angola	N	• Namibia	Y
• Botswana	Y	• Seychelles	Y
• DR of Congo	N	• South Africa	Y
• Kenya	Y?	• Swaziland	Y
• Lesotho	Y	• Tanzania	N
• Malawi	N	• Uganda	N
• Mauritius	N?	• Zambia	N
• Mozambique	Y?	• Zimbabwe	Y?

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### 'Leaded only' states: vehicle implications

- Cross border travel/tourism restrictions.
- Vehicle trade, new model restrictions.
- Continuation of old technology with associated negative fuel economy and performance implications.
- Common operation of catalytic converter equipped vehicles on leaded fuel.
- No emission control, High vehicle emissions.

-5-

### Lead phase out: Unleaded octane 'new' vehicle requirements

- 'US' and 'General Export' Japanese Vehicles = 91 RON minimum
- 'European' Vehicles = 95 RON minimum 'Eurograde 95'
- Japanese domestic specification vehicles (2<sup>nd</sup> hand imports) = 91 RON (90 RON minimum).

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### East Africa Vehicle Market

- Major imports of used Japanese specification vehicles. New vehicle sales growing.
- Current leaded octane rating 93/83 RON/MON.
- 93 RON ULP introduced recently in Kenya.
- Currently limited vehicle manufacturing/export and import of European Specification vehicles (though EC recycling requirements could change this).
- Octane Recommendation: 93/83 RON/MON spec to avoid distress to current fleet and to allow European, US and Japanese vehicle imports.

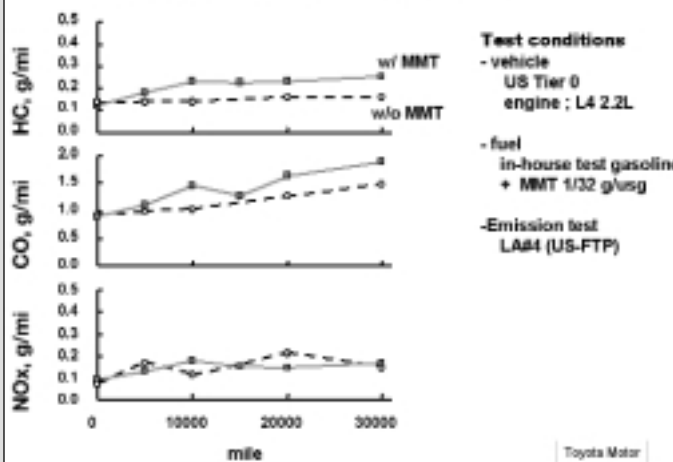
-7-

### Fuel additives: Background JAMA

1. Some countries have a plan to remove lead from gasoline. Reason : lead poisonous & influence to exhaust catalyst.
2. Historically, in most of the countries, unleaded gasoline have been introduced without octane improvement additives but with high octane components
3. Some of the other countries, MMT and the other metal type A additives are considered as candidates for octane improver. ex. Saudi Arabia, Indonesia, Philippines ---
4. In some countries, MMT is already used to commercial gasoline instead of tetra ethyl lead.
5. However, MMT and metal type additives have adverse effects on exhaust emissions and engine performance.

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### MMT effect on Exhaust Emissions



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### MMT effect on spark plug

25000Åmile with MMT 1/32 g/USG

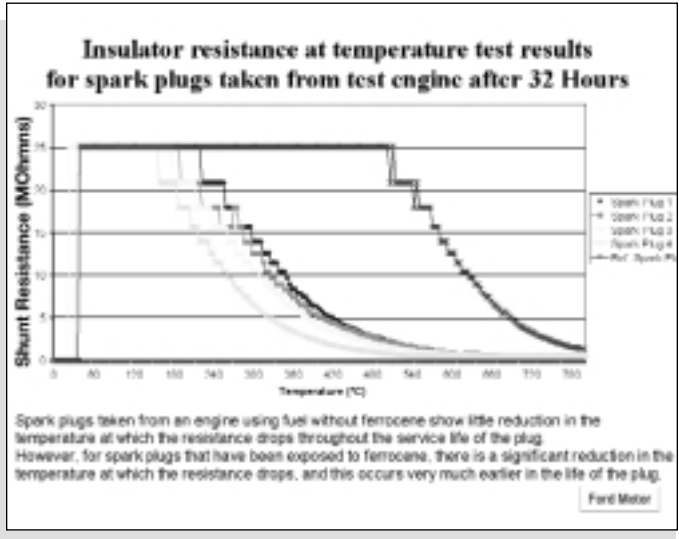
25000Åmile without MMT



Unusual spark along surface



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## MMT in South Africa

- Intro' late 2000 despite objections, to highveld unleaded supply at 18 mg/l.
- Delta (GM) tests show failure at 76, 000 kms (See right)
- Refinery fire results in partial removal July-November 2001
- Situation being monitored since reintroduction.

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## Phase out of Leaded Fuel (1)

- **Option 1: (SINGLE GRADE INFRASTRUCTURE as per most 'leaded only' SSA states)**
- Maintain/equalise octane levels in unleaded and leaded grades.
- Replace lead with a 'valve seat recession' additive\* either at distribution centre or (sold in bottles) at the pump until vehicle parc allows removal.

\*The Vehicle Manufacturers Fuel Charter recommends the use of Potassium as the least damaging additive.

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## Phase out of Leaded Fuel (2)

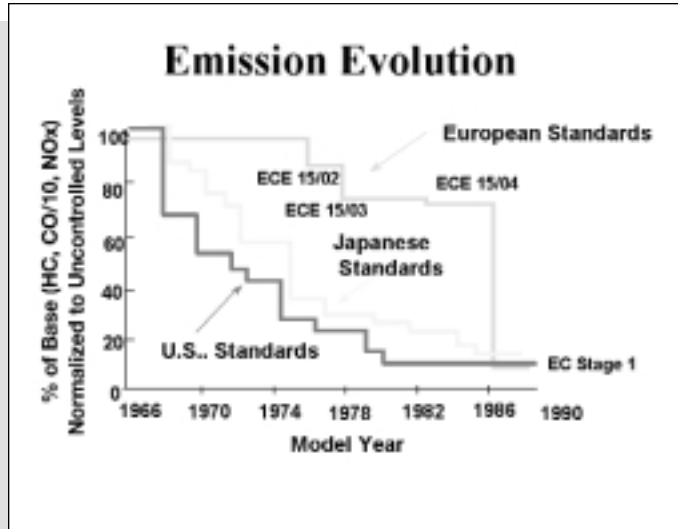
- **Option 2: (TWO GRADE INFRASTRUCTURE)**
- Maintain/equalise octane levels in unleaded and leaded grades.
- Unleaded fuel should be taxed at a lower duty as an incentive for use in unleaded compatible vehicles.
- Ban lead when vehicle population permits (10 - 15 years) and, where applicable, with sufficient notice for refinery sector to make necessary plant changes.
- Consider introduction of a '2nd grade' unleaded or LRP fuel.

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## Vehicle Emissions

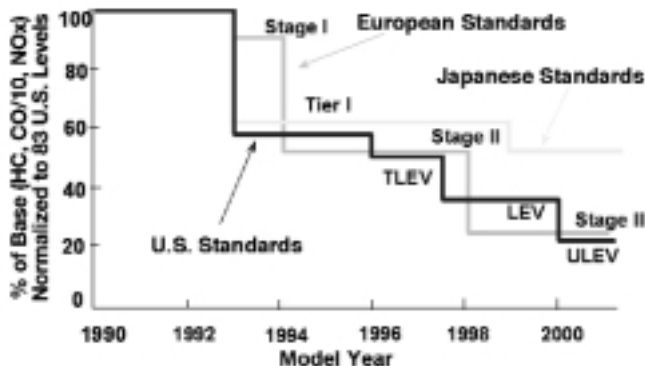
- Lead Phase Out has frequently resulted in a call for vehicle emission controls & legislation.
- Retro-fittment of catalytic converters is not effective or practical.
- While lack of unleaded fuel has resulted in specific 'leaded' models being marketed in such countries, introduction of vehicle emission controls requires such vehicles to be run out and new variants established. This takes time, particularly in small markets.

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### Emission Evolution (Cont'd)



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### EC Emission Technology levels

(Simplified)

LEVEL	Technology	ECE Regulation (EC Directive)
Stage 1	3 Way Catalyst	ECE 83.01 (91/441/EEC)
Stage 2	3 Way C/coupled Cat + Diesel Cat	ECE 83.03 (94/12/EC)
Stage 3	3 Way C/coupled Cat + Diesel Cat + OBD	ECE 83.05 (98/69/EC)

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### Emissions - Catalytic Converter Contamination

- Lead can remain in the distribution system for a long time, levels as low as 0.005g/l can damage a catalytic converter. Some recovery is however possible up to five leaded fills.
- A two tier system of both leaded and unleaded (used by Kenya, S Africa, Namibia, Botswana, Swaziland) is subject to the risk of cross contamination.
- Replacement lead additives can also damage the catalytic converter.
- The octane increasing compound MMT based on the element manganese should not be used. This can also damages catalytic converters.

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### LPO: Auto Industry Position

- The Vehicle Manufacturers World Wide Fuel Charter is currently being revised to prohibit the use of lead in gasoline.
- The International Auto Industry as represented by the World Wide Fuel Charter Committee fully supports the planned phase out of leaded gasoline by 2005.
- The Vehicle Manufacturers Fuel Charter further recommends against the use of any metal-based gasoline additive to avoid health risks and damage to catalysis.

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### Conclusions/Lessons Learned (1)

- Maintaining/introducing the unleaded grade at the "leaded" octane level or higher will remove the necessity for vehicle engine calibration changes.
- Phasing out of leaded gasoline will not restrict the import of used vehicles into East Africa.
- Manufacturers World Wide Fuel Charter Committee would support the KBS 93/83 RON/MON octane specification for East Africa/Kenya unleaded petrol
- Removal of lead provision from the World Wide Fuel Charter will tend to further reduce availability of new vehicles capable of operation on leaded fuel, particularly post 2005.

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### Conclusions/Lessons Learned (2)

- Euro Stage 1 (ECE 83.01) tailpipe emissions limits will ensure effective catalytic converter fitment and a major reduction in tailpipe emissions.
- Post lead emission legislation implementation must allow sufficient time for introduction of new (emissioned) vehicle models. 18 months from promulgation should be allowed.
- Fuel quality must at least match the emission standard and the technology of new vehicles entering the market, also applies for diesel.
- In service checks need to be introduced to ensure emission gains are realised and maintained.

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# 4.8

## Refining and Supply Options for the Introduction of Unleaded Gasoline

Chris House, Director, Kenya Petroleum Refinery Ltd (KPRL)

### Refining and Supply Options for the Introduction of Unleaded Gasoline

Chris House, Director  
 Kenya Petroleum Refinery Ltd  
 (KPRL)

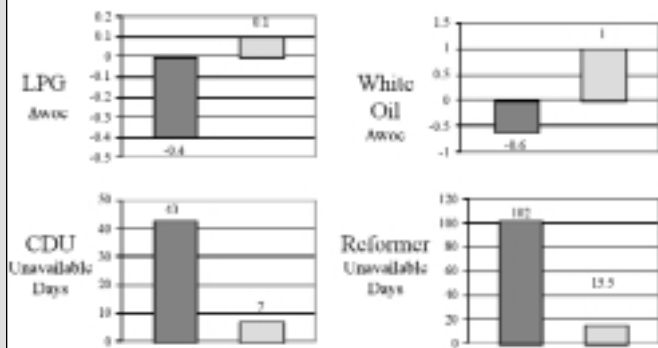
### KPRL Mombasa Refinery

- Shareholders:
  - 50% Government of Kenya
  - 50% Shell / BP / ChevronTexaco Global Energy Inc.
- Hydroskimming refinery
- 2 trains
- Capacity 70 kbbl / d (3.3 million tpa)
- Product Delivery
  - pipeline to local terminals
  - KPC pipeline to Nairobi / Kisumu / Eldoret
- 20 users with processing agreements

-

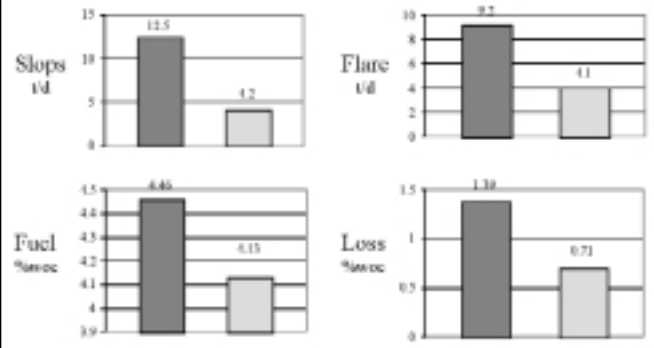
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### Performance Improvement 96 to 2001



-

### Performance Improvement 96 to 2001



-

### KPRL Benchmarking

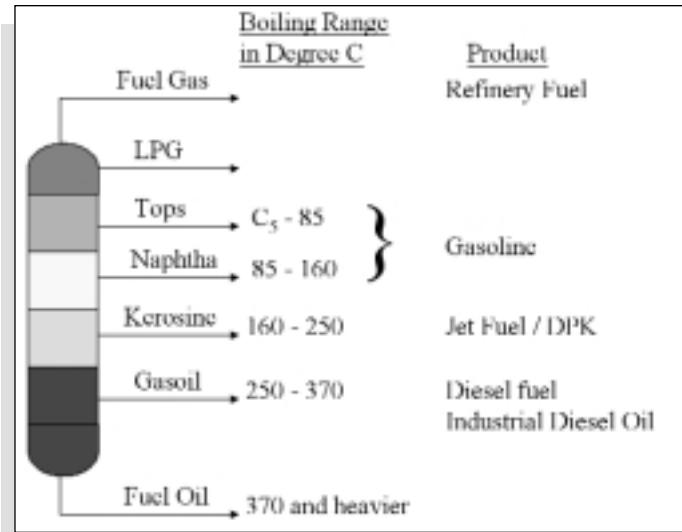
World Bank / Stork Engineering 2000 study

- lowest operating costs
- one of only three refineries with positive Net Margin - unprotected

Shell Benchmarking 44 refineries

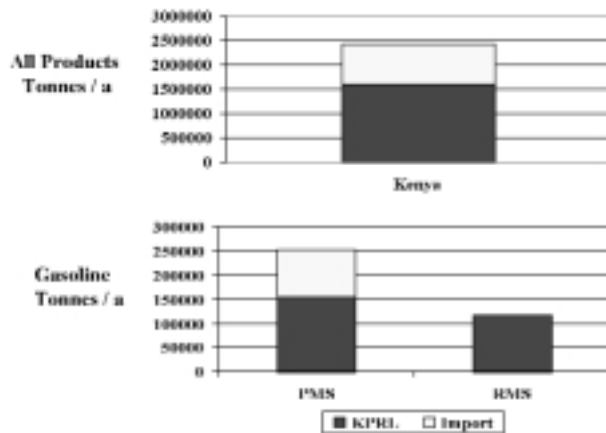
- top tercile for total costs
- lowest fixed costs for Hydroskimming refineries

-5-



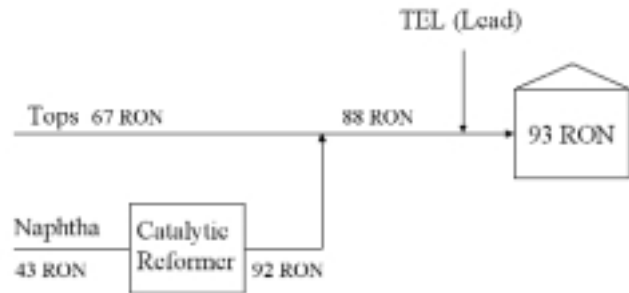
-6-

### Kenya Product Supply for 2001



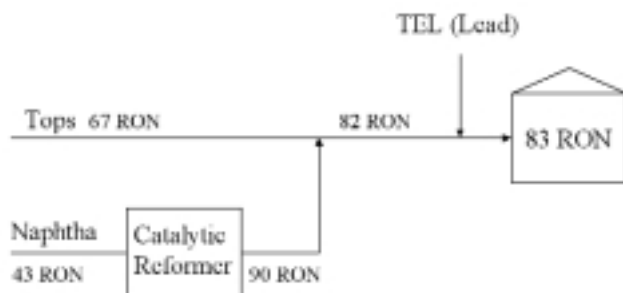
-7-

### Current Premium Gasoline Blending



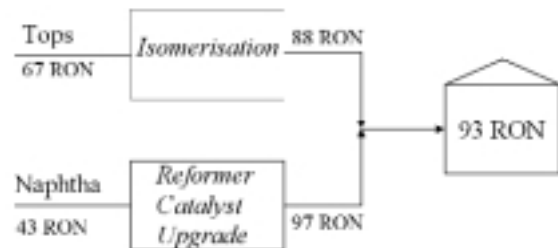
-8-

### Current Regular Gasoline Blending



-9-

### Future Unleaded Gasoline Blending



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### *Introduction of ULG*

#### Refinery Investment Required:

- Tops Upgrading
  - Isomerisation Plant
- Naphtha Upgrading
  - Catalytic Reformer Catalyst upgrade

Cost \$ 15 - 30 million

Implementation time: 3 - 4 years

-||-

### *Introduction of ULG*

Kenyan Government /  
Industry Working Group 1999.

#### Suggested Road Map:

- Grades
  - 93 octane ULG PMS
  - 88 octane low lead RMS (0.05g/l)
- Short Term
  - all imports ULG
  - approximately 50 % lead reduction
- 3 - 4 years
  - phased penetration of ULG in market
  - parallel refinery investment

-||-



# 4.9

## Lead Phase-Out Case Study: The Transition to Unleaded Gasoline in Thailand

Nazeema Abrahams, Caltex

### Lead Phase-Out Case Study: The Transition to Unleaded Gasoline Thailand

Nazeema Abrahams, Caltex

6 June 2002

#### The Transition to Unleaded Gasoline - issues

AIM: Improved Air Quality and Protection of Public Health -

- > Develop an overall plan for improving air quality

ISSUES:

- > Maintaining Fuel Properties
  - > Octane, Volatility
- > Protecting vehicle fleet
  - > Octane, Valve seat recession

-1-

-2-

#### The Transition to Unleaded Gasoline

Costs to maintain fuel properties - Octane, Volatility, Density

- > Alternate sources of octane
  - > Aromatics and other higher octane components cost more
- > Blending to maintain good volatility characteristics
  - > Aromatics can increase boiling point and affect driveability

This can turn public against using unleaded as has happened in some countries in Asia

-3-

#### The Transition to Unleaded Gasoline

- experience

##### Thailand - 1991 to 1996

- > Government mandate to phase out leaded gasoline by 1996
  - > Concern about health effects of lead
  - > Allow for catalyst equipped cars
  - > Excellent cooperation from oil companies
- > 1993 - Government mandated the fitting of catalytic converters on all new cars

-4-

### Transition to Unleaded, 1991- 2000

	1990	1991	1992	1993	1994	1996	1998	2000
				Cats				
Reg	LG 83	LG 83	Banned	Banned	Banned	Banned	Banned	Banned
	LG 87	LG 87	LG 87	LG 87	Banned	Banned	Banned	Banned
					ULG 87	ULG 87	ULG 87	ULG 87
							ULG 91	ULG 91
Lead, g/l max	0.4							

-5-

### Transition to Unleaded, 1991- 2000

	1990	1991	1992	1993	1994	1996	1998	2000
				Cats				
Phon	LG 95	LG 95	LG 95	LG 95	LG 95	Banned		
		ULG 95	ULG 95	ULG 95	ULG 95	ULG 95		ULG 95
						ULG 95 PLUS AVSR	Banned	
Lead, g/l max	0.4							

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#### The Transition to Unleaded Gasoline - experience

- > Because of specific phase-in program, problems in supply, logistics and distribution were minimal.
- > Public acceptance was fairly good, and phase in was quick, which allowed catalyst equipped cars to further improve air quality
- > Initial cold start and driveability problems
  - > Heavier blending components used in unleaded blends
  - > these were overcome with reformulation using lighter blending stocks

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#### The Transition to Unleaded Gasoline - experience

##### Thailand - 1991 to 1996

- > Unnecessary" grade with AVSR additive introduced
  - > need to be sure fuel is properly formulated for good operation
- > Communicate that leaded fuel and high octane do not mean more power !

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### The Transition to Unleaded Gasoline - summary

- ✓ Suggest that unleaded be mandated by a specific date with few or no transition steps
- ✓ Ensure cooperation, coordination and communication between all interested groups - government agencies, autos, oils, public
- ✓ Communicate benefits to gain understanding and support of the public, and to dispel myths about inferior quality of unleaded
- ✓ Do not be side-tracked by other issues like valve seat recession, benzene fears, unnecessarily high octane values
- ✓ Set fuel specifications that are cost effective, recognizing that hardware changes have much more impact on air quality than fuel changes
- ✓ Develop comprehensive plan for improved air quality

**Caltex strongly supports the elimination of lead in gasoline**

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# 4.10

## Lead Phase-Out Case Study: The Transition to Unleaded Gasoline in Bahrain

Robert Cox, Project Manager, IPIECA

### Lead Phase-Out Case Study:

### INTRODUCTION OF UNLEADED GASOLINE IN BAHRAIN

Robert T. Cox, Project Manager, IPIECA

#### DRIVERS

- CONSIDERED AS A RESULT OF A GULF CO-OPERATION COUNCIL (GCC) DIRECTIVE
- LOCAL DECISION TAKEN IN NOVEMBER 1999
- "COMPLETELY UNLEADED WITHIN 6 MONTHS"

-1-

-2-

#### BACKGROUND

- REFINERY COMMENCED OPERATIONS IN 1936
- CURRENTLY OVER 250,000 BARRELS/DAY
- ORIGINALLY BUILT BY CALTEX (ChevronTexaco) NOW 100% STATE OWNED

#### INITIAL THOUGHTS

- Time constraint meant Refinery construction solution was not possible
- Assumption that lost Octane could possibly be made up through use of MTBE, increased severity reforming.
- Alcohol and MMT not considered.
- Multiple Grades not an option either Dual grade Leaded & ULG rejected. Small Nozzles used to dispense Leaded for many years
- "No Lead No Converter - the worst environmental option" - Octel 1993

-3-

-4-

### INITIAL ACTIONS

- First actions: get refining talking to marketing. Refining-marketing, "EPA" committees
- Most time critical action was refinery platformer revamp: retube, new catalyst, new burners
- Refinery off-sites / storage also a problem: tank integrity
- Even lead time to order MTBE could be an issue! Suppliers, contracts, etc.

-5-

### OXYGENATES

- ASSUMPTION FROM VERY BEGINNING THAT MTBE WOULD BE USED (10/2.7)
  - Octane replacement
  - Dilution of Gasoline pool Sulfur
- CONCERNS REGARDING MATERIAL STORAGE, MATERIAL COMPATIBILITY
- PROGRAM TO COMPLETELY REBUILD MTBE FRT'S AND REFINERY DAY TANKS
- STORAGE TANK SECONDARY CONTAINMENT - EPOXY COATINGS etc.

-6-

### OXYGENATES – SECOND THOUGHTS

- GROWING CONCERN OVER MTBE IN US.
- REVISITED HYDROLOGY OF BAHRAIN
- LACK OF CONFIDENCE IN DISTRIBUTION INTEGRITY - ESP. 3rd PARTIES
- STRONG PRESSURE TO USE AND EQUALLY VALID REASONS NOT TO USE MTBE
- EVENTUAL CAPITULATION
- REFINING SOLUTION

-7-

### DYNAMICS OF THE CAR POPULATION

- Original (leaded) grades 90 RON & 98 RON
- Spread of uptake 60%/40% respectively 90/98
- Less than 4% of fleet needed >95 RON
- Perception that Jayyid (regular) was inferior to Muntaz (premium) - Driveability, Fuel Economy, etc.

-8-

### DECIDING ON THE GRADE

- To PULP or not to PULP?
- Most other Gulf states intended to introduce a Super Premium ULG
- The price MUST stay the same:
  - 8Regular 12.8p/KShs 14 per litre
  - 8Premium 16p/KShs 18 per litre
- Most of the 4% could tolerate 95 RON with ignition timing adjustment but with performance penalty

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### OLDER VEHICLES, VSR, and CATALYTIC CONVERTERS

- Most owners of vehicles that theoretically *couldn't* use ULG were using them on regular
- Bahrain is connected to KSA by a causeway and KSA was retaining lead until December 2001: catalysts not advisable. Actual phaseout was earlier.
- Valvemaster additive (Du Pont/Octel) added to regular at 250 ppm as a temporary measure based on NZ experience. Will be discontinued when region goes fully unleaded
- All feedback we received led us to believe that that the VSR issue overblown

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### WHAT HAPPENED?

- July 1, ULG fed into system
- Lead concentrations dropped rapidly
- Essentially Lead-free within 6 weeks
- Low - Key P.R. campaign, booklet, hotline, internet site
- A few complaints - fuel consumption

-II-

### Before and After: Premium

	<u>Before</u>	<u>After</u>
<b>RON</b>	<b>98.3</b>	<b>95.4</b>
<b>Benzene (vol%)</b>	<b>1.4</b>	<b>1.7</b>
<b>Aromatics (vol%)</b>	<b>32</b>	<b>35</b>
<b>Olefins (vol%)</b>	<b>29</b>	<b>27</b>
<b>Total Lead (g/L)</b>	<b>0.15</b>	<b>0.0013</b>
<b>RVP (kPa)</b>	<b>63</b>	<b>62</b>

-I2-

### Lessons Learned

- No substitute for research
- Get ALL stakeholders on board:
  - Public
  - Autos
  - Car Dealers
  - Service stations
- Plan actions & stick to them! Don't get hijacked by other courses of action later on

-B-







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**5.0 LIST OF PARTICIPANTS**

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- **Working Paper No. 1:** Clean Air Initiative in Sub-Saharan African Cities - Dakar Seminar, December 17 & 18, 1998 - Urban Transports 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).

