National Conference
Towards Leaded Gasoline
Replacement in Yemen

Acknowledgement:

Eng. Mahmoud Shidiwah (Chairman, Environment Protection Authority)
Dr. Lia Carol Sieghart (Ministry of Water and Environment)
Mr. Helal Al-Reiashi (Environment Protection Authority)
Jawid Ahmed Al-Jailani (SFD)
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Mr. Mike Walsh.
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Foreword

Human exposures to hazardous agents in the air, water, soil, and food and to physical hazards in the environment are major contributors to illness, disability, and death worldwide. Furthermore, deterioration of environmental conditions in many parts of the world slows sustainable development. Poor environmental quality is estimated to be directly responsible for approximately 25 percent of all preventable ill health in the world.

A serious and hazardous environmental toxin is lead. The use of lead in gasoline is the prime source of airborne lead pollution in Yemen. More than 85% lead emissions from automobiles consists of highly toxic inorganic lead, which is easily absorbed into the body due to the small size of combustion derived lead particles. Children's health is most vulnerable to lead because their nervous systems are not fully developed. Epidemiological studies of children show that those exposed to lead, at even lower levels may have a lower IQ, learning disabilities, behavioural abnormalities and kidney damage. Cognitive and growth defects may also occur in infants whose mothers are exposed to lead during pregnancy.

In our country the average age of the population is under 16. The younger a population, the more years of life of exposure and accrual of physiological damage from pollution that population will experience. In addition, children of low-income families are at special risk because nutritional deficiencies may exacerbate lead toxicity. There is no lead level that is safe for children.

The use of leaded fuel prevents the use of catalytic converters. Catalytic converters can be instrumental in improving the air quality in Yemen's cities as they reduce vehicle emissions by more than 90%. Lead in gasoline also increases vehicle maintenance costs and reduces the life of automobile engines. Because of the progress in refining technology, lead additives are no longer required to achieve gasoline octane specifications. High gasoline octane ratings can be achieved without lead.

Yemen is one of the last few countries in the world still using leaded gasoline. The elimination of these additives is the most important single step toward reducing lead exposure and the resulting damage to public health.

Although lead phase-out is expected to be a highly cost-effective measure - particularly in terms of the impact on health and the environment - strong commitment, the appropriate policy intervention, public awareness and understanding forms part of a broad, consensus-building effort. 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.

In supporting this aim we have joined the Global Partnership for Clean Fuels and Vehicles. Furthermore, we have implemented in cooperation with the United Nations Environment Programme a project aiming at national commitment building to phase out leaded gasoline. During which we conducted a campaign on blood lead level testing, the results demonstrated an alarmingly increased lead level.

In March 2007 we hosted the conference and the workshop on 'National Commitment Building to Phase out Leaded Gasoline in Yemen'. The results of which - the primary framework for the national strategy to phase out leaded fuel - are presented in this booklet.

The publication of this booklet is the result of dedicated efforts of all those involved in its production, in particular representatives of line ministries, staff of the Ministry of Water and Environment and the Environment Protection Authority, the Social Fund for Development, the United Nations Environment Programme, Toyota-Representation in Yemen and numerous practitioners engaged in phasing out leaded gasoline and cleaner technologies.

We are determined to address the issue of phasing out leaded gasoline for the benefit of our present and future generations. I am confident, phasing out leaded gasoline must be considered as crucial step towards cleaner air and consequently a healthier way of living.

Abdul-Rahman F. Al-Eryani
Minister of Water and Environment

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Conference on:

“National Commitment Building to Phase out Leaded Gasoline in Yemen”

14 March 2007
(08:30-16:00)
Sheraton Sana’a - Hotel
PROGRAMME

8:30	Registration	
9:00	The Holy Qur’an	
9:00	Welcome Note	Eng. Mahmoud Shidiwah – EPA Chairman
9:15	Opening * Mr. Mahfoud Ba Shamakh. Chairman of the Sana’a Commerce of Comer * Dr. A. Basel Al-Yousfi, UNEP/-ROWA * HE Abdulkarim Al-Arhabi Minister of MoPIC, SFD Director * HE Abdul Rahman F. Al-Eryani, Minister MWE	
9:45	Break	
9:50	Objectives and Expected Results	Dr. A. Karim Thabet Facilitator
10.00.- 10.20	Overview on Yemen’s Activities to date	Eng. Helal Al-Reiashi EPA
10.20- 10.40	Evaluation and results of blood lead testing in Sana’a And the data analysis	Mr. Tariq Saeed Saleh Al-Madhaji, SFD-Consultant and Dr. M. Al Mansoob, Prof. at Sana’a Uni. and Dep. Ass., MF
10.40 – 11.00	Health Impacts by Leaded Gasoline	Dr. Michael P. Walsh International Consultant
11.00 – 11.20	Question/discussion session	Chaired by Abdul Wahab SFD)
11.20 – 11.40	Coffee Break	
11.40 – 12.10	Obtaining High-Performance Unleaded Gasoline- Solutions and Techniques	Dr. Eng. Yaha Ali Albadwi Ministry of Oil and Minerals

12.10 – 12.30	Downstream Petroleum Sector in Yemen and local alternatives for unleaded gasoline	Dr. Abdo Saleh AL Subari SFD-Consultant
12.30 – 12.50	Introduction to the Partnership for Clean Fuel and Vehicles	Dr. Shoa Ehsani UNEP
12.50 – 13.10	Phasing Out Lead from Gasoline	Dr. A. Basel Al-Yousfi UNEP/-ROWA
13.10 – 13.30	Cleaning Up Gasoline Fueled Vehicles	Dr. Michael P. Walsh International Consultant
13.30 – 13.50	First CNG-converted Car in Ras Al Khaimah: An experience	Mr. Michael Themel Salzburg AG Utilities UAE
13.50 – 14.10	Economical impacts and unleaded gasoline	Mr. Aidrous Bazara Toyota
14.10 – 14.45	Question/discussion session	Chaired by Dr. Lia Sieghart (MWE)
14.45 – 15.45	Lunch	
15.45 – 16.45	Working – Groups: Definition of Recommendations Refineries – Chair: Eng. Abdo Saleh AL Subari Vehicles – Chair: Dr. Michael P. Walsh Regulation/Enforcement – Chair: Dr. Basel Al-Yousfi Economical Aspects – Chair: Mr. Helal Al Reiashi Public Awareness on unleaded and clean fuels – Chair: Dr. Shoa Ehsani	
16.45 -17.00	Presentation of Recommendations by the Chairs	
17.00	Closing	Eng. Mahmoud Shidiwah – EPA Chairman

Conference on National Commitment Building to Phase Out Leaded Gasoline in Yemen

On March 14, the Minister of Water and Environment, Mr. Abdul-Rahman F. Al-Eryani and the Minister of Planning and International Cooperation and Director of the Social Fund for Development, Mr. Abdulkarim Al-Arhabi jointly inaugurated the conference. The participants included representatives from various stakeholder authorities, academia, international organizations, Embassies, oil and private sector. The conference was organized by the Ministry of Water and Environment, the Social Fund for Development and the United Nations Environment Programme (UNEP).

"Human exposures to hazardous agents in the air, water, soil are major contributors to illness, disability, and death. Deterioration of environmental conditions slows sustainable development tremendously in our country. A serious and hazardous environmental toxin is lead. The single most important source of human exposure to lead is lead aerosol formed by the combustion of lead antiknock additives in gasoline. Yemen is one of the remaining 18 countries worldwide still using leaded gasoline. With January 1^{st} this year also all Sub-Saharan African Countries went unleaded. We need to change the path by going unleaded, for our country and the future of our children" said Mr. Al-Eryani in his opening speech.

"Lead is a hazardous heavy metal and a known neurotoxin. Lead phase-out is expected to be a highly cost-effective measure, strong commitment and an appropriate policy intervention is required. Raising awareness and understanding are major tools in the process of phasing out leaded gasoline. I will raise the issue with my colleagues at the Cabinet," expressed Mr. Al-Arhabi.

There is no save exposure to lead and even low levels can cause serious and persistence damage to the nervous system. Scientifically, it is one of the best understood and widely studied environmental toxins. It severely damages many human organs, most notably the nervous system, the blood-forming system, the kidneys, the cardiovascular system, and the reproductive system. Children's health is most vulnerable to lead because their nervous systems are not fully developed. Ambient lead from vehicle exhaust may also travel a long distance and spread widely, although much lead is deposited on the soil in areas nearby heavily traveled roads, where it persists for a prolonged period.

According to Mr. Mike Walsh, Board Chairman of the International Council on Clean Transportation, more than 800 infants and 10,000 adult deaths were caused annually in Cairo by this problem. Fortunately Egypt phased leaded gasoline out recently.

"Poor environmental quality especially caused by air pollution is directly responsible for approximately a major portion of preventable ill health in our country. The economic costs of air pollution are in the range of 1-4% of the GDP. This is the most important meeting I have been to in the last fours years and we will support this momentum," expressed the Chairman of Chamber of Commerce, Mr. Mahfoud Ba Shamakh.

"In supporting our aim to phase out leaded gasoline in Yemen we have joined in 2005 the Partnership for Clean Fuels and Vehicles. Furthermore, we have launched in cooperation with UNEP a project aiming at building awareness thereby supporting commitment building within all stakeholder groups to phase out leaded gasoline," informs Mr. Mahmoud Shidiwah, the Chairman of the Environment Protection Authority. "In January we finalized a series of testing to assess the concentration of lead in blood from risk groups in Sana'a. The results of which are reflecting the concern of the present situation," the Chairman added.

"I am pleased", said Dr. Basel Al-Yousfi, Deputy Regional Director of UNEP/ROWA, "on having the opportunity to share with you the Ministerial Resolution passed during the 18^{th} session of the Council of Arab Ministers Responsible for the Environment in last December, on appreciating the efforts exerted by Arab States that have been using Unleaded Gasoline; and inviting other Arab states to achieve this goal by

Year 2008, utilizing the support provided by UNEP vis-à-vis the Partnership of Clean Fuels and Vehicles; as well as inviting all Arab States to reduce sulfur contents in Diesel."

The use of leaded fuel prevents the use of catalytic converters. Catalytic converters can be instrumental in improving the air quality in Yemen's cities as they reduce vehicle emissions by more than 90%. Lead in gasoline also increases vehicle maintenance costs and reduces the life of automobile engines. Because of the progress in refining technology, lead additives are no longer required to achieve gasoline octane specifications. High gasoline octane ratings can be achieved without lead.

Introduction of clean fuels and vehicle technologies not only benefits the health and environment in the cities, but also contributes to addressing regional and global environmental issues such as transboundary air pollution and global warming.

Although lead phase-out is expected to be a highly cost-effective measure - particularly in terms of the impact on health and the environment - strong commitment, the appropriate policy intervention, public awareness and understanding forms part of a broad, consensus-building effort.

The conference was followed the next day by a technical workshop resulting in the development of a framework for a country strategy to phase out leaded fuel which is technically feasible, legally viable, equitable, and acceptable to decision makers and the public including actions to be taken and recommendations.

Conference Outputs

Contents

Introduction on Importance of Workshop and Main Results

This workshop was held within the framework of the concern shown by the Ministry of Water and Environment and under its sponsorship to formulate a General Program for the Strategy to Phase out Leaded Fuel in Yemen. The conference and the consultative workshop were held for two days, from 14 – 15 March 2007, with the support of the Social Fund for Development, the United Nations Environment Programme (Partnership for Clean Fuel and Vehicles), and the Environment Protection Authority. Specialists in their respective fields participated in the workshop. On day one, ten specialist working papers were presented by local and foreign experts from Arab countries and regional and international organizations.

The workshop was inaugurated by His Excellency the Minister of Planning and International Cooperation and by His Excellency the Minister of Water and Environment. More than 100 participants from line Ministries, private, public and international organizations participated actively in this two days event.

Workshop Execution Procedure

On the first day working papers were presented and discussed by participants throughout the day, resulting in the formation of themes based on inputs of presenters and on the presented working papers. These theme formations constituted the primary areas of the strategy. These were discussed on the second day by fourty participants (technical experts and researchers) which led to the completion of the 'Initial Strategy' of the matrix and is expected to be augmented by a technical team of experts after its initial documentation. On the second day a matrix of priorities and steps to be taken / expected to be executed were formulated for the period up to end of 2008.

Methodology and Approaches Applied in the Workshop:

The method used in the workshop was based mainly on encouraging the participants to express their opinions and to actively participate in the discussion .The use of metaplan tools and visualization steps was very successful and it greatly assisted in organizing and orienting the discussion towards the desired objectives. The metaplan method relies on using visual tools such as cards, boards etc. The Objectives Oriented Project Planning GOPP method was used within adaptation of the need of such workshop style and expected results.

MAIN RESULTS OF THE WORKSHOP & CONFERENCE

The main results of the workshop/conference can be summarised as follows:

1-Participants formed an initial general framework for the strategy, which included six basic axes, constituting the main aims of the national strategy. Work and time required to attain each goal were planned. The organisations concerned with the development of the implemented general frameworks' contents were also designated.

2-Participants analysed problems and put priorities for the activities to be executed within the work plan to 2008 from the matrix of the strategy. Within the framework the participation of the end consumer and the civilian community during the various phases of the strategy were discussed; this led to a debate on the root causes of the problems and obstructions and to its proposed solutions.

3-From the discussions when presenting the working papers, participants arrived at the gravity of the health risks resulting from the use of leaded fuel. Importance was laid on the urgency to issue the strategy of phasing out leaded fuel and the initiation of its execution as formulated in the general framework of the strategy.

I would like to use this opportunity to thank the workshop organisers on providing me with me the opportunity of participating in the workshop and thanking the participants on their frankness in the discussions and their interaction, which led to the success of this conference & workshop.

Dr. Abdul Karim Thabet

Primary Framework for the "Strategy to Phase Out Leaded Fuel in Yemen"

Primary Framework for the "Strategy for Phasing Out Leaded Fuel in Yemen"

AIMS	ACTIVITIES	ORGANISATIONS RESPONSIBLE FOR DEVELOPING THE STRATEGY	TIME / PERIOD
Phase out leaded fuel and replace with unleaded fuel of grade 83 by the end of 2007 & of grade 91 by the end of 2008	Production and supply of lead free fuel at Aden Refinery (Grade 83 Octane)	Ministries of Petroleum (Minister – Corporation), Finance, Environment, Planning, Health	End of 2007
	Import lead free kerosene of level 1 and 2		
	Expedite renovations and development of catalytic reforming units at both refineries		
	Critical options: a- Choose the best fuel quality improvers instead of using lead compound b- Import high octane gasoline of level 70% c- Ideal option – Partial import of high octane fuel level 5 and mixing with the refinery product; gradual decrease of leaded compound		
	Create an infrastructure for supply of high octane fuel (fuel stations and oil companies)		
	Near future: a- Renovate refining unit at Aden Refinery b- Expand and renovate Marib Refinery		End of 2008
	Study economic, environmental and technical capabilities for producing fuel substitutes		
	Practical substitutes for supplying lead free fuel: - Near and middle future (3years) a- Construct a fuel oil catalytic cracking unit b- Encourage experienced and serious private investment		End of 2009
	Study health and environmental costs in case of implementation or opting for substitutes		
Allow, in limited ratios, the private sector and citizens to purchase shares in oil installations			

AIMS	ACTIVITIES	ORGANISATIONS RESPONSIBLE FOR DEVELOPING THE STRATEGY	TIME / PERIOD
	Encourage use of economical low emission vehicles		
	Activate vehicle technical check-up by the Traffic Dept. and implement environmental control		
	Establishing of incentives for exchange of old vehicles with new (modern) vehicles by the concerned departments (Customs, etc.)		
Clean non-environment polluting vehicles	Introduce CNG in public transport vehicles (buses, mini-buses)	Ministries of Oil and Minerals, Water and Environment, Transportations, Finance (Customs); Traffic Dept.	End of 2008
	Encourage use of public transport and the use of clean fuel, e.g., natural gas, bio-diesel		
	Improve and control traffic and activate role of traffic policemen in controlling vehicle movement and limit congestion		
	Think of unconventional means of transport in Yemen, e.g., trams, the underground railway, etc.		
	Limit emission by use of renewed sources of energy		

AIMS	ACTIVITIES	ORGANISATIONS RESPONSIBLE FOR DEVELOPING THE STRATEGY	TIME / PERIOD
Issue a national legislation banning the use of leaded fuel throughout the Republic and reducing the levels of octane diesel	Amend traffic, transport, environmental protection and Information regulations to limit pollution resulting from use of leaded fuel and raise the octane number and take into consideration the previously mentioned while issuing laws for the petroleum industry	Relevant Parliamentary Committees (Health, Housing, Water and Environment, Transport and Information)	Up to the end of 2007 (issue of legislations)
	Improve vehicle and fuel specifications with the aim of improving the environment	- Public Authority for Specifications and Measures (Industry and Trade) - Environment Protection Authority - Min of Oil and Minerals - Min of Interior and Ministry of Transport (Traffic Dept.)	
	Benefit from regulations issued to decrease emissions		
	Implement strict control on vehicle check-ups		
Improve the quality of water, air, soil and environmental systems to protect the environment and public health	Old vehicles: - should be included with catalytic converters - perform periodic maintenance to check for emission levels - remove dilapidated vehicles from service	- Min of Interior (Traffic Dept. and Ministry of Transport) - Environment Protection Authority - Private sector	
	Activate periodic check ups of vehicles and develop these to include levels of pollutants resulting from them and adhere to specified levels (safety and environment)		
	Provide instruments for measuring emission levels		
	New vehicles: - adopt approved Gulf specifications - ban over four year old vehicles	- Customs Authority - Public Authority for Specifications and Measures	

<table>
<tr><th>AIMS</th><th>ACTIVITIES</th><th>ORGANISATIONS RESPONSIBLE FOR DEVELOPING THE STRATEGY</th><th>TIME / PERIOD</th></tr>
<tr><td rowspan="15">Awareness campaign

Raise level of awareness on all levels with emphasis on laid on decision makers</td><td>Establish Information Platforms</td><td rowspan="15">- Min of Education & Higher Education & Min of Information.
- Min of Water & Env., EPA.
- Car Dealers + Importers.
- SFD.
- Min. of Health.
- Min of Planning.
- Universities + Academic Orgs.
- Min of Oil and Minerals.
- Min of Finance.
- Min of Interior (Traffic Dept).
- NGOs.
- Min of Youth.</td><td rowspan="15"></td></tr>
<tr><td>Identify & specifying of Target Groups</td></tr>
<tr><td>Collect & establish database</td></tr>
<tr><td>Hold conferences, seminars, workshops, lectures, courses</td></tr>
<tr><td>Place executive policies for the strategy</td></tr>
<tr><td>Find the appropriate mechanism for spreading awareness</td></tr>
<tr><td>Distribute awareness material</td></tr>
<tr><td>Assess existing situation</td></tr>
<tr><td>Suitable conversion techniques</td></tr>
<tr><td>Create technical opportunities for experts</td></tr>
<tr><td>Develop and exploit scientific skills</td></tr>
<tr><td>Involve relevant targeted parties</td></tr>
<tr><td>To find a donor for the campaign</td></tr>
<tr><td>Provide technical and organisational program</td></tr>
<tr><td>Set up time frame</td></tr>
</table>

1st General Program for the "Strategy for Phasing Out Leaded Fuel in Yemen

TABLE 3 / 1 Research

<table>
<tr><th>AIMS</th><th>ACTIVITIES</th><th>ORGANISATIONS RESPONSIBLE FOR DEVELOPING THE STRATEGY</th><th>TIME / PERIOD</th></tr>
<tr><td>Find the best technology suitable to Yemen for ridding lead pollution</td><td>Cooperate with partner ship for clean fuels</td><td rowspan="12">-Geological Survey Board central labs environmental studies section.
- Financial support.
- Private sector.
- International Organisations support.
- Min of Water & Env. EPA-MWE.
- Academic community.
- Min of Health.
- Min of Higher Education.
- Specifications and Measurements Authority.</td><td rowspan="12"></td></tr>
<tr><td>Health Effects</td><td>Worn out information for target groups</td></tr>
<tr><td>Define the level of pollution</td><td>Provide academic staff</td></tr>
<tr><td>Reduce cost of treatment bowman health</td><td>Determination of pb pollution in soil, water & air «Environmental Geochemistry</td></tr>
<tr><td>Sustainable Development</td><td>Environmental Geochemical studied</td></tr>
<tr><td>Keep Yemen in a clean environment</td><td>Study and select suitable research</td></tr>
<tr><td>Decrease of Pollution</td><td>Analyse previous work</td></tr>
<tr><td></td><td>Review previous work</td></tr>
<tr><td></td><td>Select suitable experience</td></tr>
<tr><td></td><td>Prepare technical studies</td></tr>
<tr><td></td><td>Data base for the pollutant</td></tr>
<tr><td></td><td>Establish data base for awareness campaign</td></tr>
</table>

Action Plan up to end of 2008

GROUP 1 DISCUSSION RESULTS ON ENVIRONMENTAL AND TECHNICAL PROBLEMS AND SOLUTIONS; DISCUSSION OF ECONOMIC, FINANCIAL LEGAL AND SOCIAL ASPECTS

TOPIC 1: Vision of preliminary plans up to end of 2008 to phase out leaded fuel in Yemen

What are the major obstacles relative to the subject which can be confronted up to the end of 2008? Mention only three obstacles.	What are the major solutions which can be adopted to minimise or eliminate these obstacles? Mention only 2-5 solutions, not more!	How much time is required to solve these problems during 2007 and before the end of 2008?
1- Indifference of government to bear costs of solution finding 2- Bureaucracy in the mechanism of implementation of solutions 3- Incapability of comprehending the magnitude of the problem by decision makers	1- Seek the help and expertise of international organisations to arrive at the solutions 2- Involve local social community organisations and authorities in disseminating awareness and information 3- Emphasise the urgency of achieving solutions on decision makers	End of 2007

TOPIC 1: Vision of preliminary plans up to end of 2008 to phase out leaded fuel in Yemen

Who should be responsible for resolving this problem and crises?		Which obstacles could affect in resolving this problem and crises?	How can assessment and follow up be undertaken to resolve this problem and crises?
- Min of Finance. - Min of Transport. - Min of Ministry of Oil and Minerals. -Min of Interior (Traffic Dept).	- Min of Water and Environment. - Min of Planning and International Cooperation. - Min of Health.	1- Financial capability - summoning experts - disseminating information - broaden awareness	

TOPIC 2: How do you visualize the end consumer's and the social community's participation in adapting to the vision of the preliminary program up to the end of 2008 for the "Strategy for Phasing Out Leaded Fuel in Yemen"?

What are the major obstacles relative to the subject which can be confronted up to the end of 2008? Mention only three obstacles.	What are the major solutions which can be adopted to minimise or eliminate these obstacles? Mention only 2-5 solutions, not more!	How much time is required to solve these problems during 2007 and before the end of 2008?
1- Weak financial capabilities and reduced individual income of the consumer 2- Difficulty in convincing and influencing because of low standard of education	1- Find government support for unleaded fuel 2- Find encouraging incentives for citizens to discard old environmentally unfriendly vehicles 3- Join efforts of all concerned to raise level of environmental education	End of 2008

TOPIC 2: How do you visualize the end consumer's and the social community's participation in adapting to the vision of the preliminary program up to the end of 2008 for the "Strategy for Phasing Out Leaded Fuel in Yemen"?

Who should be responsible for resolving this problem and crises?		Which obstacles could affect in resolving this problem and crises?	How can assessment and follow up be undertaken to resolve this problem and crises?
- Min of Finance - Min of Oil and Minerals - Min of Min of Water and Environment - Min of Health - Min of Information	- Min of Transport - Min of Interior (Traffic Dept) - Min of Planning and International Cooperation - Min of Culture - Private Sector	1- Indifference of concerned parties 2- Incompatibility in purchasing ability of the citizen and high price	

GROUP 2 DISCUSSION RESULTS ON ENVIRONMENTAL AND TECHNICAL PROBLEMS AND SOLUTIONS; DISCUSSION OF ECONOMIC, FINANCIAL LEGAL AND SOCIAL ASPECTS

TOPIC 1: Vision of preliminary plans up to end of 2008 to phase out leaded fuel in Yemen

What are the major obstacles in relation the subject which can be confronted up to the end of 2008? Mention only three obstacles.	What are the major solutions which can be adopted to minimize or eliminate these obstacles? Mention only 2-5 solutions, not more!	How much time is required to solve these problems during 2007 and before the end of 2008?
1-Lack of awareness to dangers of pollution resulting from lead emission of vehicles 2- Limitation in the laws and its application 3- Absence of financial priorities for expenditure on this 4- Lack of sufficient national abilities for coping 5- Absence of private sector participation	1- Raise awareness 2- Update regulations 3- Grant financial priority to issues of environmental protection 4- Activate private sector participation 5- Qualify national abilities	One full year

TOPIC 1: Vision of preliminary plans up to end of 2008 to phase out leaded fuel in Yemen

Who should be responsible for resolving this problem and crises?	Which obstacles could affect in resolving this problem and crises?	How can assessment and follow up be undertaken to resolve this problem and crises?
- Information with related parties: Oil and Minerals, Petroleum Sector, Environment, Health - Legislative authorities with related parties: Petroleum, Environment, Health - Finance authorities: Finance, Planning, Environment, Oil and Minerals (incl. PEPA), Health	1- Bureaucracy 2- Non-existence of budget	- A joint committee of concerned parties

TOPIC 2: How do you visualize the end consumer's and the social community's participation in adapting to the vision of the preliminary program up to the end of 2008 for the "Strategy for Phasing Out Leaded Fuel in Yemen"?

What are the major obstacles relative to the subject which can be confronted up to the end of 2008? Mention only three obstacles.	What are the major solutions which can be adopted to minimise or eliminate these obstacles? Mention only 2-5 solutions, not more!	How much time is required to solve these problems during 2007 and before the end of 2008?
1-Lack of awareness of the consumer 2- Weak participation of social community 3- Absence of controls to prevent cheating	1- Raise awareness 2- Involve social community 3- Establish an active surveillance mechanism - Supply deviation measurement instruments - Impartiality of inspectors	One year six months

TOPIC 2: How do you visualize the end consumer>s and the social community>s participation in adapting to the vision of the preliminary program up to the end of 2008 for the “Strategy for Phasing Out Leaded Fuel in Yemen”?

Who should be responsible for resolving this problem and crises?	Which obstacles could affect in resolving this problem and crises?	How can assessment and follow up be undertaken to resolve this problem and crises?
- Min of Information - Party Committee, Min of Social Affairs, Social Community Organisations, Measurements and Specifications Authority, National Women>s Committee, vehicle production companies	1- Non-provision of sustained encouragement to these sections 2- Weak financial mechanisms of easy installments and loans 3- Weak policies of lending and financing 4- Limitation of commercial courts in relation to loans problems	Establishing of joint work groups and committees

GROUP 3 DISCUSSION RESULTS ON ENVIRONMENTAL AND TECHNICAL PROBLEMS AND SOLUTIONS; DISCUSSION OF ECONOMIC, FINANCIAL LEGAL AND SOCIAL ASPECTS

TOPIC 1: Vision of preliminary plans up to end of 2008 to phase out leaded fuel in Yemen

What are the major obstacles in relation the subject and which can be dealt with till the end of 2008? to the end of 2008? Mention only three obstacles.	What are the major solutions which can be adopted to minimise or eliminate these obstacles? Mention only 2-5 solutions, not more!	How much time is required to solve these problems during 2007 and before the end of 2008?
1- Specify local production 2- Financing of replacement (an economic problem and expenditure to the government) 3- Society + Awareness – Decision makers	1- Import unleaded fuel + use available natural gas 2- Produce unleaded fuel of high specification 89 3- Renovate the refinery taking into consideration other issues and feasibility	From one to two years

TOPIC 1: Vision of preliminary plans up to end of 2008 to phase out leaded fuel in Yemen

Who should be responsible for resolving this problem and crises?	Which obstacles could affect in resolving this problem and crises?	How can assessment and follow up be undertaken to resolve this problem and crises?
- Min of Oil and Minerals (+PEPA) - Min of Water and Environment - Min of Information (Awareness)	- The dynamics of decision making	- Formation of a technical committee possessing powers of supervision and follow up assisted by a team of academics and researchers

TOPIC 2: How do you visualize the end consumers and the social communitys participation in adapting to the vision of the preliminary program up to the end of 2008 for the "Strategy for Phasing Out Leaded Fuel in Yemen"?

What are the major obstacles relative to the subject which can be dealt with till the end of 2008? up to the end of 2008? Mention only three obstacles.	What are the major solutions which can be adopted to minimise or eliminate these obstacles? Mention only 2-5 solutions, not more!	How much time is required to solve these problems during 2007 and before the end of 2008?
1-Environmental and health awareness	1- Dissemination of awareness 2- Coordination and cooperation of related parties in disseminating awareness appropriately	One to two years

TOPIC 2: How do you visualize the end consumers and the social communitys participation in adapting to the vision of the preliminary program up to the end of 2008 for the "Strategy for Phasing Out Leaded Fuel in Yemen"?

Who should be responsible for resolving this problem and crises?	Which obstacles could affect in resolving this problem and crises?	How can assessment and follow up be undertaken to resolve this problem and crises?
- Min of Oil and Minerals (+PEPA) - Min of Finance - Min of Water and Environment - Min of Information - Min of Health - Min of Planning and International Cooperation	1- Financial obstacles 2- Dynamics of decision making	- Specialised technical, academic and economic committees , involve private sector and social community organisations and other related sections

Lead

review Of scientific information on lead (UNEP)

prepared by Eng.Helal Ali AL-Raishi

- Fuel and Vehicles

Discovering fuel and its derivatives was a worldwide breakthrough in several fields development particularly industrial and automotive sect oral paving the way for various countries to freely exploit this new source in inventing and improving thousands of industries in a fierce competition .

One of the most prominent inventions at the time was the vehicle engine which operates by internal combustion of fuel and went under a series of improvement throughout the decades to take its current shape.

Since the invention of the engine a strong bond formed between man and vehicles to the point that the car became an integral part of any household .Estimates show that vehicles outnumber world population making the car engine the number one cause of pollution worldwide.

Fuel of all kinds mainly consists of fossil fuel (hydrocarbon compounds .When burnt it produces heat different kinds of gases and solid waste .full combustion of fuel produces carbon dioxide while incomplete combustion produces carbon monoxide and hydrocarbons both of which are the main sources of pollution from fuel combustion .

Pollutants resulted from fuel combustion very according to the type of fuel and the nature of its components .Gases like sulphur dioxide ate mainly generated from diesel and from other kinds of fuel containing sulphur in general .

Lead produced from combustion is one of the most hazardous and toxic pollutants on both health and environment as it inflicts serious illnesses and other harmful impacts upon humans , animals and plants .lead compounds are added to fuel to improve its quality and prevent cracking during the combustion process and to lubricate engine valves .

Pollutants Generated from vehicle fuel combustion

The following are the main reasons why vehicles are the main source of air pollution .

- Type of fuel and substance (lead compounds) added to improve engine performance .
- Incomplete combustion of fuel inside the engine
- Irregulars maintenance of the engine to check its performance and internal fuel combustion

Impacts of air pollutants

Pollutants	Health and Environmental Impacts
Coarbon monoxide Co	Reducing the blood `s abilitry to carry oxygen Serious impacts on the respiratory system and sometimes fatal in cases of high exposure
Hydro carbons (HC)	Irritation and allergy of eyes and mucous membrane Formation of smoky fog that inflicts serious damage on plats and animals
Nitrogen oxide (NOx)	Inflammation of the eye ,nose and throat Infection of the lungs and fibrosis
Sulfur oixides (SOx)	Throat inflammation cough and tightness of breath Windpipe inflammation and asthma Yellowness of plant leaves (obstruction of photosynthesis)
Lead (Pb)	Damage of the brain and the neurological system Mental retardation in children Damage of the immune system

Methods Applied to Mitigate Air Emissions Pollution or air Pollution from Vehicle fuel

Giving up cars is obviously not the perfect solution for mitigation the harmful pollutants emitted from vehicle exhaust system just as there is no radical or magical solution that could make theses emissions disappear Yet .There could be some other helpful ways to mitigate this type of pollution

-Regular maintenance of the vehicle engine to chick for tits ability to burn fuel effectively .

Encouraging the use of public transportation systems over personal cars to reduce the overgrowing number of vehicles .

Speed limitation to the point that ensures minimum emission of pollutants.

Using unleaded fuel.

Using fuel with low percentage of sulphur

Using catalytic converters for vehicles using unleaded gasoline

Encouraging the use of vehicles that operate with environmentally friendly energy, such as electricity or solar energy.

Increasing vegetation by growing more plants and trees., especially alongside main roads and highways to help absorb air pollutants

Issuing regulations on the standard of emissions allowed from vehicles.

Measures Taken by the Environmental Protection Authority to mitigate vehicle pollutants

- Regular performance checkups of old vehicles by Traffic police
- Increasing greenery that absorb large amounts of pollutants
- Collaboration between concerned authorities in using unleaded fuel .
- Implementing programs by crowded areas and close to main roads to determine the concentrations of pollutants emitted from vehicles and compare them to the permissible limits which they haven t exceeded so far.

Chemistry

2. Elemental lead is silvery-white and turns blue-grey when exposed to air. It is dense, malleable, readily fusible, and has a low melting point. It is soft enough to be scratched with a fingernail. Because of these characteristics, lead has been one of the most widely used metals in the history of mankind. The first uses of lead date back to 4000 BC, and toxicological effects have been linked to lead since antiquity. Lead is known to bio accumulate in most organisms, whereas it is generally not biomagnified up the food web.

3. In the atmosphere, lead will deposit on surfaces or exist as a component of atmospheric aerosols. In the atmosphere, lead exists primarily as lead compounds. The residence time ranges from hours to weeks. Transport of atmospheric lead is linked to the characteristics of aerosols.

4. In the aquatic environment, lead can occur in ionic form (highly mobile and bio-available), organic complexes with dissolved humus materials (binding is rather strong and limits availability), attached to colloidal particles such as iron oxide (strongly bound and less mobile when available in this form than as free ions) or to solid particles of clay or dead remains of organisms (very limited mobility and availability). The speciation of lead differs in fresh water and seawater: in fresh water, lead primarily exists as the divalent cation (Pb^{2+}) under acidic conditions, and forms $PbCO_3$ and $Pb(OH)_2$ under alkaline conditions. Lead speciation in seawater is a function of chloride concentration and the primary species are $PbCl_3^- > PbCO_3 > PbCl_2 > PbCl^+ >$ and $Pb(OH)^+$. In surface waters, residence times of biological particles containing lead have been estimated at up to two years.

5. In soil, lead is generally not very mobile. The downward movement of elemental lead and inorganic lead compounds from soil to groundwater by leaching is very slow under most natural conditions. Clays, silts, iron and manganese oxides, and soil organic matter can bind lead and other metals electrostatically (cation exchange) as well as chemically (specific adsorption). Soil pH, content of humic acids and amount of organic matter influence the content and mobility of lead in soils. Though lead is not very mobile in soil, lead may enter surface waters as a result of erosion of lead-containing soil particles.

Human exposure and health effects

6. Lead is a non-essential element for human biological function

7. Lead is absorbed in humans and animals following inhalation or ingestion. Absorbed lead is rapidly taken up by blood and soft tissue, followed by a slower redistribution to bone. Bone accumulates lead during much of the human life span and may serve as an endogenous source of lead that may be released slowly over many years after the exposure stops.

8. The main target for lead toxicity is the nervous system, both in adults and children. Long-term exposure of adults to lead at work has resulted in decreased performance in some tests that measure functions of the nervous system.

9. Impairment of neurodevelopment in children is the most critical lead effect. Exposure in uterus, during breast feeding, and exposure in early childhood may all be responsible for the effects. Lead accumulates in skeleton and its mobilisation from bones during pregnancy and lactation causes exposure to foetus and breast fed infant. Epidemiological studies show consistently that effects in children are associated with lead levels in blood (Pb-B) of about 100-150 µg/L. There are indications that lead is harmful even at blood lead concentrations considerably below 100 µg/L and there may be no threshold for these effects. Prospective studies support hypothesis that changes are irreversible or at least long lasting up to adulthood. For infants and young children, lead in dust and soil often constitutes a major exposure pathway. In particular, dust in homes painted with paint containing lead pigment, and soil around lead-emitting industries may contain very high lead levels. When tap water systems with leaded pipes are used, lead intake via drinking water can also be an important source.

10. Lead exposure also causes small increases in blood pressure, particularly in middle-aged and older people.

11. The International Agency for Research on Cancer (IARC) has determined that inorganic lead is probably carcinogenic to humans (Class B). The US Department of Health and Human Services has determined that lead and lead compounds are reasonably anticipated to be human carcinogens based on limited evidence from studies in humans and sufficient evidence from animal studies.

12. Present data on the concentration of lead in air, daily intake of lead with food and Pb-B (blood lead level) suggest a decreasing trend of environmental lead exposure mainly due to the elimination of lead from gasoline. Reduced blood lead levels correlating with reduced use of leaded gasoline have been demonstrated in a number of countries. As an example, blood lead levels in children and leaded petrol sales in Australia from 1979 to 1999 are shown in Figure 1.

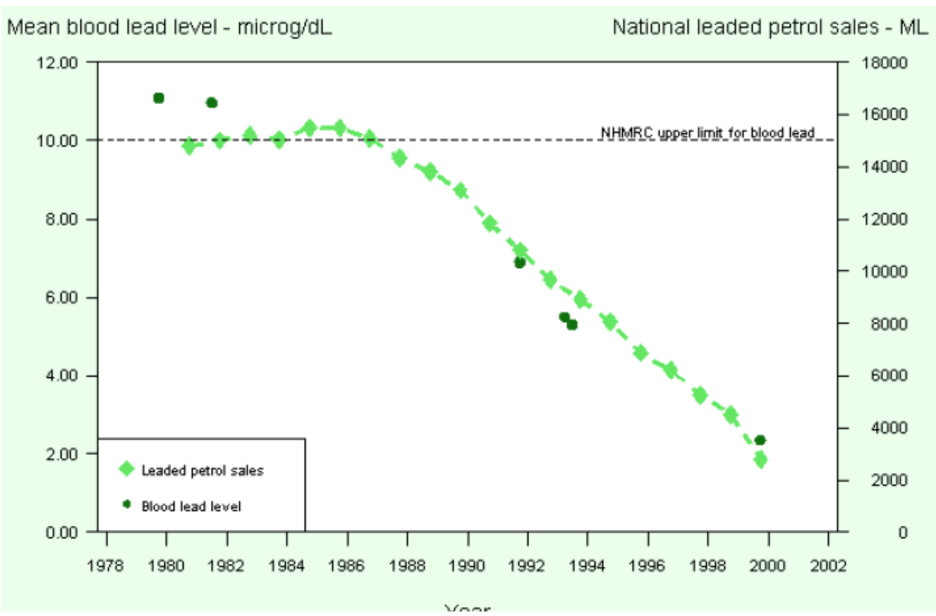


Figure 1 Blood lead levels in children and leaded petrol sales in Australia 1979 to 1999 (Australia submission)

Impacts on the environment

13. In the environment, lead tends to be mainly particulate-bound and has relatively low mobility and bioavailability, though highly soluble ionic forms are also known, particularly in the marine environment. Lead bioaccumulates in most organisms, but biomagnification from one trophic level in the food web to the next is not a characteristic feature of this metal.

14. Environmental exposure to lead is greatest near smelters or other point sources, or from lead shot and sinkers used for outdoor shooting and fishing. General atmospheric deposition from remote sources is also an input to local environments (see Chapter 5 on release sources and Chapter 7 on long-range transport). Generally - i.e. away from specific point sources - effects on terrestrial organisms and plants are not observed, and in the aquatic environment lead concentrations are normally below known effect levels.

15. The most prominent adverse impact of lead in the environment is the widespread contamination and poisoning of waterfowl that ingest shot or sinkers, as well as the contamination of their predators (secondary poisoning). The poisoning of migrating waterfowl has a transboundary aspect which is the background for addressing the use of lead shot in wetlands in the Agreement on the Conservation of African-Eurasian Migratory Waterbirds. Parties to the Agreement shall endeavour to phase out the use of lead shot for hunting in wetlands

Sources and releases to the environment

16. The important releases of lead to the biosphere might be grouped into the following categories:

- Natural sources - releases due to mobilisation of naturally-occurring lead in the Earth's crust and mantle, such as volcanic activity and weathering of rocks;
- Current anthropogenic (associated with human activity) releases from the mobilisation of lead impurities in raw materials such as fossil fuels – particularly ores, coal and other extracted, treated and recycled minerals;
- Current anthropogenic releases resulting from lead used intentionally in products and processes, due to releases by manufacturing, use, disposal, recycling, reclamation or incineration of products;

17. In addition to these categories may be considered re-mobilisation of lead deposited in soils, sediments, landfills and waste/tailings piles from historic anthropogenic releases as well as translocation of lead naturally occurring in the biosphere.

Sources of lead emissions to the atmosphere

18. The major natural sources for mobilisations of lead from the Earth's lithosphere to the biosphere are volcanoes and weathering of rocks. In addition, insignificant amounts of lead enter the biosphere by meteoritic dust. The atmospheric emission from volcanoes in 1983 is estimated at 540-6,000 tonnes, and in a more recent study from 2001 at 1,000-10,000 tonnes. The weathering of rocks releases lead to soils and aquatic systems. This process plays a significant role in the global lead cycle, but estimates of the total amount released by weathering of rocks have not been available.

19. Within the biosphere, lead is translocated by different processes. The major natural sources of emissions to air are volcanoes, airborne soil particles, sea spray, biogenic material and forest fires.

20. Very different estimates on total releases of lead to the atmosphere by natural processes have been reported. A frequently-cited study from 1989 estimates the total emission in 1983 at 970-23,000 tonnes/year, whereas a new study estimates the total emissions from natural sources at 220,000 - 4,900,000 tonnes/year. The large disparity is mainly due to different estimates on the amount of lead moved around with soil particles. Compared to this, the most recent study of total anthropogenic atmospheric emission estimated the total emissions in the mid-1990s at 120,000 tonnes, of which 89,000 tonnes originated from the use of petrol additives.

21. The significance of anthropogenic versus natural emission for long-range transport of lead has been indicated by ice core studies from Greenland and Antarctica (see Figure 2).
22. The data show that the lead levels in the ice cores increased significantly following the industrial revolution in the 19th century, and that the extensive use of leaded gasoline from 1950 to 1990 is reflected in the ice cores as a distinct peak.
23. A recent study of ice and snow from the Canadian Arctic concludes that while the elimination of leaded gasoline additives in Europe, North America and Japan has helped to reduce Lead emissions during the past two to three decades, aerosols in the Arctic today are still highly contaminated by anthropogenic lead.

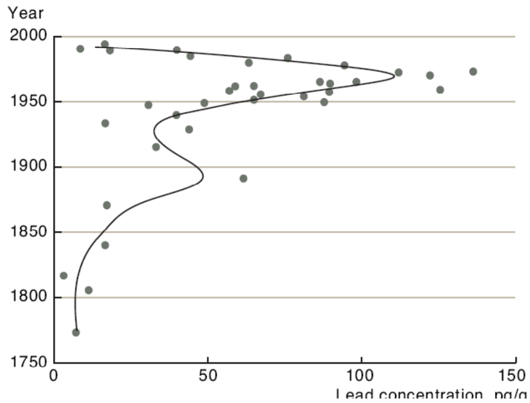


Figure 2

Lead concentration in a Greenland ice core (Boutron, 1995 as cited by AMAP, 2005). Original figure presented courtesy of AMAP, Norway

24. From 1983 to the mid-1990s, the quantified global anthropogenic emission of lead decreased from about 330,000 tonnes to 120,000 tonnes. In 1983, the main source was by far leaded fuel additives, and by the mid-1990s fuel additives still accounted for 74 percent of global lead emission to the atmosphere. Besides fuel additives, non-ferrous production and coal combustion were the major sources. No recent comprehensive studies of global emissions have been identified.
25. The total emission and distribution by sources vary considerably among countries; the latter is illustrated in Figure 3 by data for Europe (2000) and Australia (2003). The large difference in the contribution from gasoline additives would not be seen today, as the use of leaded gasoline for vehicles is now phased out in both Europe and Australia. Australia is the world's second largest producer of lead and zinc, and metal-ore mining and non-ferrous production account for more that 90 percent of the anthropogenic atmospheric releases in that country. In Europe, releases are more evenly distributed, withsectors with iron and steel production comprising the major industrial source category.

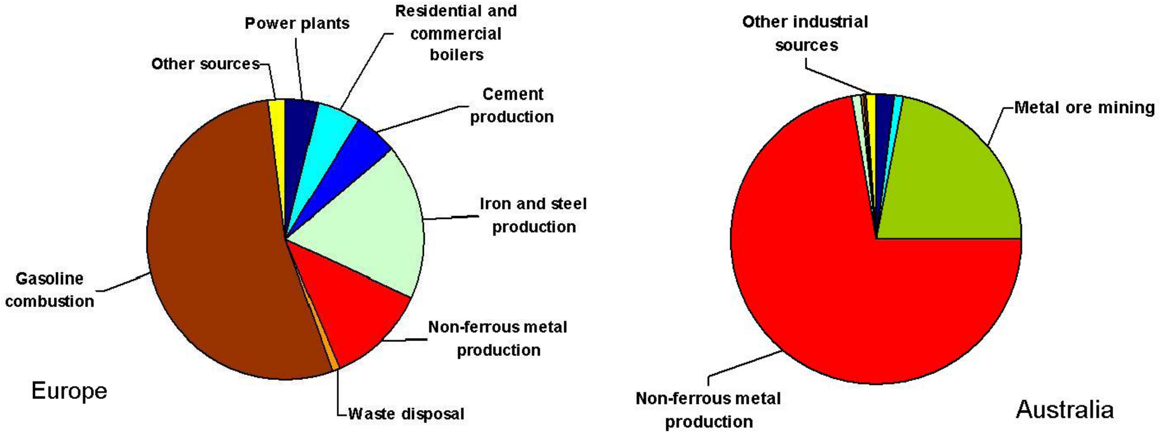


Figure 3 Distribution of atmospheric lead emissions in Europe 2000, based on expert estimates from Norwegian Institute for Air Research, NILU (ESPREME, 2006) and point source emissions in Australia 2003/4 (Australia submission, 2005).

26. As of June 2006, only two countries worldwide used leaded gasoline solely, while 26 countries are using both leaded and unleaded gasoline. Since Sub-Saharan Africa completely eliminated the import and production of leaded gasoline in January 2006, the majority of countries still using leaded gasoline are in the Asia-Pacific region. The global consumption of lead for manufacturing of gasoline additives decreased from 31,500 tonnes in 1998 to 14,400 tonnes in 2003. In 1970, when the use of leaded gasoline was peaking, about 310,000 tonnes lead was used for gasoline additives in OECD countries.
27. The trend in emissions in the industrialised countries is illustrated in Figure 4, showing the decrease

in total atmospheric emission of lead in Europe from 1990 to 2003. During that period the lead emission in Europe decreased by about 92percent. The significant reduction of lead emissions was mainly due to restrictions and bans of the usage of leaded gasoline for vehicles, but also implementation of improved air pollution controls. As an example, in eight European countries the reported emission from ferrous and non-ferrous production was on average reduced by about 50 percent during the period from 1990 to 2003, whiles emission from waste incineration and public electricity and heat production on average were reduced by 98 percent and 81 percent, respectively.
28. Data on lead emission and the trend in the emission in developing countries have not been available for this review.

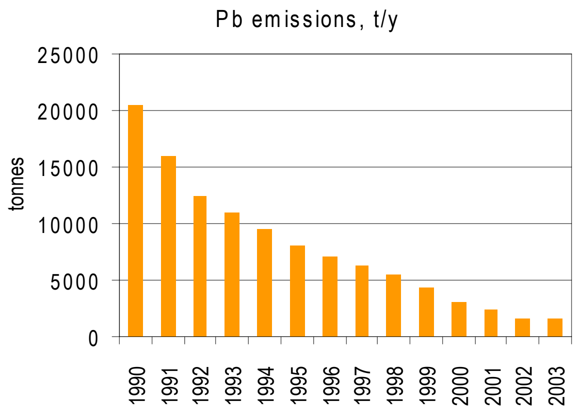


Figure 4

Trends in atmospheric emission of lead in Europe (24 countries within the EMEP area) 1990- 2003(UNECE, 2006)

Anthropogenic sources of lead releases to land

29. Human activities significantly influence the global cycle of lead. In 2004, an estimated 3.15 million tonnes of lead were extracted from the Earth's crust by man and brought into circulation in society. Besides this, a significant amount of lead ended up in metal extraction residues or was mobilised as impurity by extraction of other minerals like coal and lime. In 1983, a total of 0.4-1.0 million tonnes of such mobilised lead was disposed of with waste from mining, base metal production and from the use of coal.
30. The only comprehensive assessment of global anthropogenic lead releases to soil and waste deposits dates back to 1983. It was estimated that in total about 600,000-1,660,000 tonnes of lead were directed to waste deposits or released to soil at that time. To this it is added an atmospheric deposition to land of about 200.000-260.000. The three major categories were: waste/loss of commercial products (mainly ammunition lost by hunting), mine tailings and smelter slag and waste. Apart from atmospheric deposition, which has decreased due to the reduced use of lead as a fuel additive, the magnitude of these releases to land may still be valid.
31. The major source of direct lead releases to soil is the use of ammunition. The total global consumption of lead for ammunition was about 120,000 tonnes in 2003. Ammunition is partly used for hunting and lost to the environment, and partly used in shooting ranges, where the lead is either accumulated at the range or collected for recycling. A study of ammunition use in the EU estimates that about half of the ammunition was released to the environment by hunting activities, but that the percentage lost may vary among countries and regions. Studies indicate that in the long term lead lost with ammunition may increase the lead content of soils in some countries. Moreover, lost lead shot may poison waterfowl and other birds ingesting the shot.
32. Other products lost to the terrestrial environment, which might be of concern in some countries, are paints with lead pigments, lead balancing weights for vehicles, lead sheathing of cables left in the ground and lead batteries (loss by breakage and recycling).
33. Large amounts of lead are directed to landfills and waste dumps with discarded products and residues from mining and base metal production.
34. Studies from Denmark and the Netherlands indicate that about 10 percent of the total flow of lead with products is ending up in landfills. As lead compounds (which in most countries are hardly recycled) account for about 10 percent of global consumption, it is highly probable that at least 10 percent of

the consumption is accumulated in landfills. With a global consumption of about 7 million tonnes, the amount of lead ending up in landfills with discarded products could be 500,000-1,000,000 tonnes. The concern in some countries in this regard is the fate of the disposed lead over the long term.

35. If not managed in an environmentally sound fashion, the large amounts of lead ending up in tailings and other residues from mining and base metal production represent a significant threat to local water resources and soil.

Sources of lead releases to aquatic environments

36. Direct releases to aquatic environments are considered relatively small compared to releases to the atmosphere and land. Total releases to water in 1983, excluding atmospheric deposition, were estimated at 10,000-67,000 tonnes. In addition, atmospheric deposition to aquatic environments was estimated at 87,000-113,000 tonnes; a figure that most likely is considerably lower today.

37. The major industrial sources are mining and non-ferrous metal production. It is uncommon to include loss of lead in fishing sinkers and scuba diving weights in inventories of lead releases, but this release may be of significance. A study estimates the total loss of lead with fishing equipment for angling and commercial fishing in the EU at 2,000-8,000 tonnes. Of particular concern in some countries is the loss of small sinkers in inland waters, which (like the situation regarding lead shot) may be ingested by birds or dissolved in waters through corrosion.

Production, use and trade patterns

38. Lead is mined in more than 40 countries, the major producers being China and Australia, which represent 30 percent and 22 percent of global mining production, respectively. Lead-rich minerals most often occur together with other metals, and about two-thirds of worldwide lead output is obtained from mixed lead-zinc ores (Figure 5).

39. The total global mine production of lead has decreased slightly during the last thirty years, from 3,600,000 tonnes in 1975 to 3.1 million tonnes in 2004. During the same period, global refined lead production and metal consumption have increased from about 4,700,000 tonnes to about 7,100,000 tonnes.

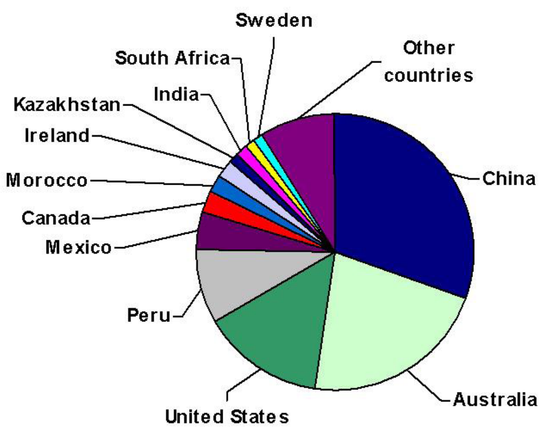


Figure 5 Global mine production by country (based on USGS, 2006)

40. The reason for the difference between mine production and lead consumption is that recycled lead increasingly accounts for a larger part of the supply. Recycled lead accounted for 45 percent of global lead supply in 2003. Most of the recycled lead comes from used lead batteries, with the remainder coming from other sources such as lead pipes, sheets, cable sheathing and wastes from fabricating/ processing operations.

41. The different steps from mining to manufacturing of final products often take place in different countries and there is extensive trade in ores, concentrates, unrefined and refined metallic lead and final products between countries and continents. Main importers of raw materials (ore, concentrate and unrefined lead) are Europe and Asia; main exporters are Australia and South America.

42. Lead is used for a large number of applications. The review lists more than 50 application areas; some of the areas consist of a number of different specific sub-applications. The useful properties of lead include: a low melting point, ease of casting, high density, low strength, ease of fabrication, acid resistance, corrosion resistance, electrochemical reaction with sulphuric acid and the ability to attenuate sound waves, ionising radiation and mechanical vibration.

End-uses of lead

43. The major end-use of lead is lead batteries, accounting for 78 percent of reported global consumption in 2003. Other major application areas are lead compounds (8 percent of the total), lead sheets (5 percent), ammunition (2 percent), alloys (2 percent) and cable sheathing (1.2 percent). The most significant change in the overall use pattern during the period 1970 to 2003 is that batteries account for an increasing part of the total, whereas cable sheathing and petrol additives have decreased.

44. Some differences among countries concerning "first uses" are apparent: consumption patterns to some extent reflect the countries' industry structures as regards the manufacturing of lead-containing products. Two examples are shown in Figure 6. In the Republic of Korea, with an extensive car industry, batteries accounted for 87 percent of total consumption, whereas in the United Kingdom, rolled/extruded lead accounted for 46 percent of lead consumption. The latter may also indicate regional differences in end-use patterns, as lead is extensively used in the building industry in the United Kingdom and other northern European countries (for lead roofing and roof flashing).

45. Whereas the unintentional mobilisation of lead is of high significance as a source of releases of lead to the environment, the present data indicate that the lead content as an impurity in traded coal and other commodities is less than 1 percent of the total intentional lead content of end products.

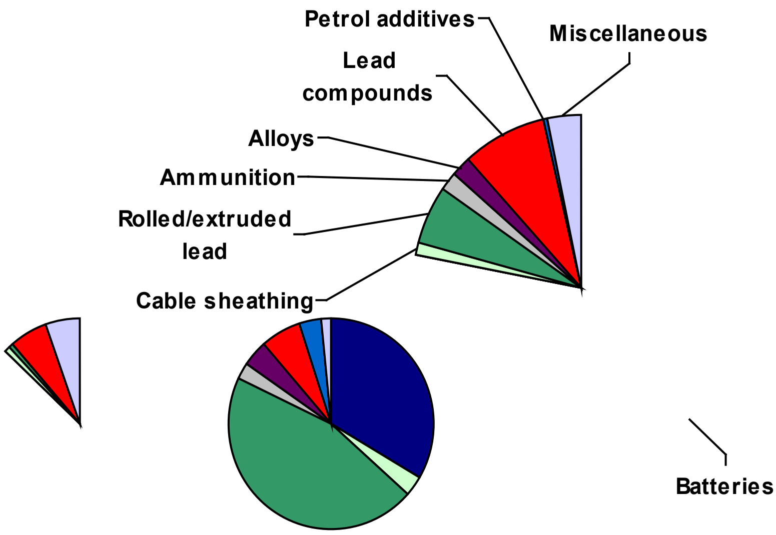


Figure 6

Intentional lead consumption by end-uses in 2003 as reported by member countries of the International Lead and Zinc Study group (ILZSG) representing about 86 percent of the total global consumption of lead. (ILZSG, 2006)

Two country examples of distribution of lead for "first uses" i.e. use of lead for manufacturing processes, by application area. (ILZSG, 2005)

Lead compounds

46. During the period from 1970 to 2003, lead compounds, apart from petrol additives and lead compounds in batteries, have accounted for about 10 percent of total lead consumption. Glass for cathode ray tubes and plastic additives represented the single largest uses of lead compounds in 2001 (Figure 7). Some major changes within this category, however, have taken place. A breakdown of consumption in "Western World" countries is shown in the following figure. Formerly, lead pigment for paints and ceramics took up a greater share, but the consumption of pigments for these applications has decreased over the last decades, partly due to regulation in some countries.

47. The reported use of lead for petrol additives was 14,400 tonnes in 2003, corresponding to about 5 percent of the consumption of lead in petrol in 1970. Consumption of leaded petrol for vehicles is steadily decreasing, but leaded petrol is still used in most (if not all) countries for some types of propeller-driven aircraft.

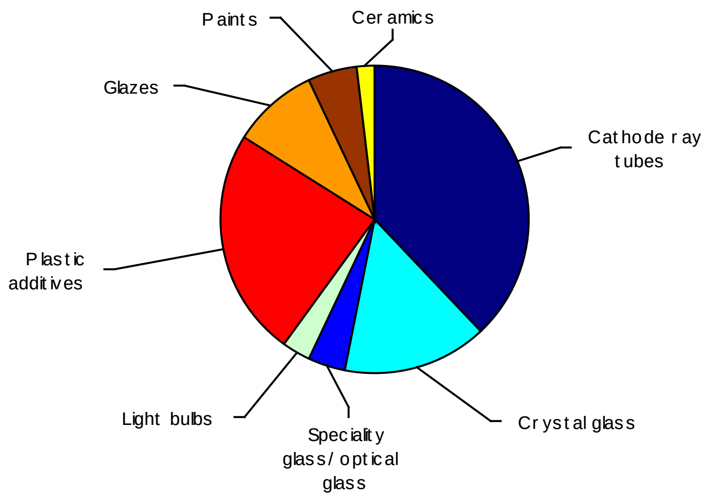


Figure 7

Consumption of lead compounds by end uses in 2001 as reported by "Western World" member countries of the International Lead and Zinc Study group (ILZSG, 2005).

Blue colours indicate the use of lead in glass.

Lead compounds in batteries and petrol additives are not included.

Long-range transport in the environment

48. Environmental transport pathways explored in this review include atmospheric transport, ocean transport, river transport and transport in large, transboundary lakes. These are considered the most important pathways for environmental transport of lead beyond the local scale.

49. Long-range transport in the environment here refers to transport in air or water of substances (e.g. cadmium) whose physical origin is situated in one country and which are transported and deposited to another country at such a distance that it may not generally be possible to distinguish the contribution of individual emission sources. Regional transport here refers to such transport within a geographical region such as for example Africa or North America, whereas intercontinental transport refer to such transport from one continent to another, for example between Asia and North America.

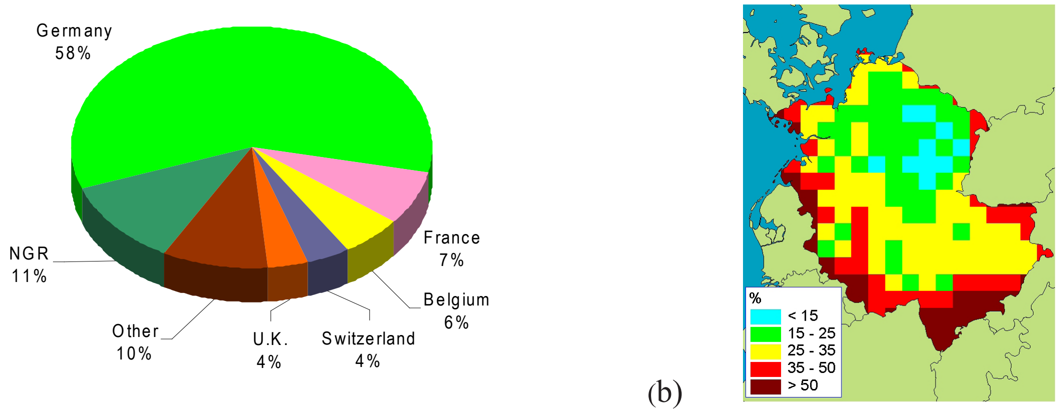
Atmospheric transport of lead

50. Atmospheric transport is currently considered the most important mechanism of long-range lead dispersion in the environment. Once emitted to the atmosphere, lead may be transported locally, regionally, or intercontinentally depending on various factors, including particle size, stack height, and meteorology. Under certain conditions, lead can be transported by airflows over hundreds or even thousands of kilometres, and can contribute to impacts on human health and ecosystems far away from the emission source.

51. Various human activities result in elevated lead concentrations in the environment. Measurements of lead concentration in ice cores, fresh water sediments and peat bogs demonstrate a significant increase in airborne lead depositions compared to the pre-industrial period (e.g. Candelone and Hong, 1995; Farmer et al., 1997; Coggins et al., 2006). Lead mass concentrations measured in atmospheric aerosol were much higher (up to 1000 times) than its natural content in the Earth crust because of lead anthropogenic emissions to the atmosphere. This kind of enrichment has been observed even in such remote locations as Greenland, the Bolivian Andes, New Zealand and Antarctica.

Regional scale atmospheric transboundary pollution

52. Lead pollution is primarily transported atmospherically over regional distances; that is, within the region or continent where the pollution was originally emitted. Figure 8 (a and b), for example, illustrates the contributions of transboundary lead pollution in Germany. Generally speaking, about 30 percent of total lead depositions in Germany are the result of atmospheric transport from anthropogenic sources in other countries (such as France and Belgium), and 10 percent from natural sources and re-emission. In regions close to national borders, contributions from external sources can exceed 50 percent, whereas in the central part of Germany it can be less than 15 percent.

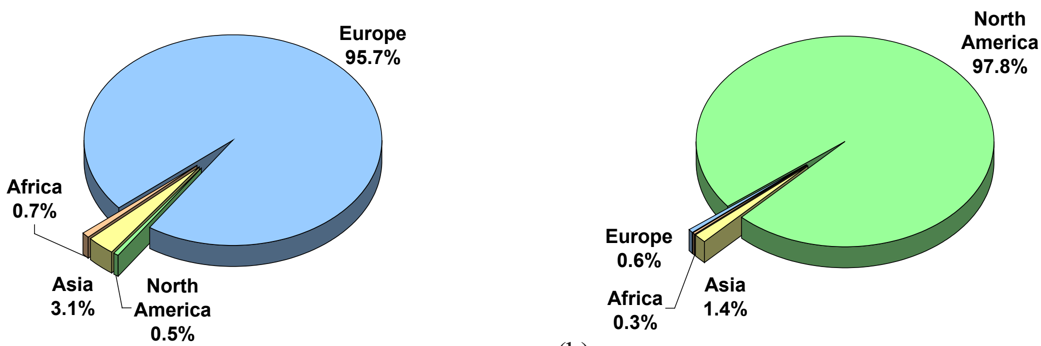


(a) (b)

Figure 8 *Main contributors to deposition of lead in Germany (a) (NGR - natural, global sources and re-emission); Spatial distribution of contribution of external anthropogenic sources to lead depositions in Germany (b) (calculated with the MSCE-HM model, Ilyin et al., 2005).*

Intercontinental atmospheric transport

53. Lead is transported by air masses on an intercontinental scale, yet due to the relatively short residence time of lead in the atmosphere (days or weeks), intercontinental transport results in only minor average contributions to the regional pollution in industrially developed regions. According to modelling results, the annual contribution of external emission sources to the total lead deposition in Europe does not exceed 5 percent, and in North America it is even lower (Figure 9 a,b). However, episodically, the contribution of intercontinental transport can be significantly higher at certain locations on these continents. Calculated model examples illustrate that daily contributions from lead transported from one continent to the other can exceed 35 percent of total deposition during these episodes.



(a) (b)

Figure 9 *Relative contribution of different continents of the Northern Hemisphere to annual lead deposition in Europe (a) and North America (b)(calculated with MSCE-HM-Hem model).*

54. Since lead is transported in the atmosphere in composition aerosol particles, evidence of its intercontinental transport can also be obtained from measurements of stable isotope signatures of the airborne dust in combination with air-mass back trajectories (trace back or air movements). These measurements indicate the origin of dust particles transported by air masses, and thereby provide evidence that aerosols carrying lead are transported intercontinentally, as well as from industrialised regions to remote regions with few local emission sources such as the Arctic.

Main principles of lead atmospheric transport

55. The main factors affecting behaviour, fate and deposition of lead emitted to the atmosphere during its long-range atmospheric transport include:

- Characteristics of emission sources (higher outlets and higher emission temperatures lead to higher emission plumes and longer transport ranges);
- Physical and chemical forms of lead in the atmosphere:
- Lead is emitted to the atmosphere as a component of aerosol particles; large particles are deposited

within short ranges, small particles may be transported over thousands of kilometres;

- Wet deposition of lead-containing particles also depends on particle hydrophoby (water repellence), meteorology, and other factors;
- Dry deposition is most effective for large particles due to gravitational settling. Ultrafine particles are also easily deposited on ground surfaces due to their high mobility;

• Atmospheric stability: stable atmospheric conditions keep pollution near the ground, resulting in short transport ranges and low dispersion; unstable conditions lead to the pollution plume rising to altitudes with stronger winds, which in turn transport pollution over longer distances;

• Wind speed: high wind speeds lead to long transport ranges;

• Precipitation intensity: wet deposition is enhanced by high precipitation rates (rain, snow);

• Earth's surface characteristics: the highest dry depositions take place over rough terrain, such as areas of significant vegetation (forest, shrubs, etc.) and urban areas; the lowest dry depositions occur over smooth terrain (desert, snow cover) and water bodies.

Atmospheric transport models

56. Atmospheric transport models can add to the description and prediction of heavy metal pollution as provided by actual measurements of lead concentrations in ambient air and precipitation. Notably, transport models can help explain the origins and pathways of transboundary atmospheric lead pollution. A number of models for atmospheric transport of heavy metals cover Europe and North America. Two of the identified transport models cover lead transport in the Northern Hemisphere. No models covering other regions of the world have been identified.

57. Atmospheric transport models are normally compared with measured data. Some of the identified transport models have also been evaluated in inter-comparison studies where the modelling results obtained by each transport model are compared to other models and available measured values. The ability of different models to predict actual situations is summarised in these studies. Based on such evaluations, it appears that the accuracy and availability of emission estimate inputs are of key importance to the models' ability to predict transport outputs. Most assessed models exhibit a good prediction of actually measured values, when emission input data are based on (or supplemented with) independent expert estimates. When officially reported emission estimates are used alone as input to the models, the models tend to show lower results than actually measured in the field. Other possible uncertainty elements are natural emissions and re-emission of former lead depositions.

Monitoring of air concentrations and atmospheric deposition

58. Most identified monitoring data for atmospheric lead concentrations and deposition is from Europe and the U.S.A.; results from Japan, Antarctica and New Zealand are, however, also described.

Aquatic transport of lead

59. Extensive data regarding lead concentrations in the water column exist for specific locations in the world's oceans, and for different years over the last two to three decades. Through the literature search performed for this review, however, no examples were identified of modelling or other attempts to quantify the general horizontal transport of lead - or any other heavy metals - with ocean currents. Only two non-modelling examples were found that quantified the exchange of heavy metals (lead and cadmium) by ocean currents between one specific ocean - the Arctic Ocean - and neighbouring oceans. These examples suggest that ocean transport may be an important pathway.

60. In addition, the nature of ocean currents indicates their potential for the transport of pollutants on a global scale. Global, deep-sea ocean currents are (with varying strength) connected to one big, dynamic system, the so-called thermohaline circulation or "global conveyer belt", which transports enormous water masses through the Atlantic Ocean, the Southern Ocean around Antarctica, and the Pacific Ocean. The existence of ocean transport modelling of other pollutants (such as persistent organic pollutants, or POPs) demonstrates that ocean modelling for heavy metals may be relevant.

61. Lead entering the ocean by atmospheric transport, by direct discharges or via river transport will normally be in the particulate state, and will be bound to other particulate material and sink to ocean

sediments. General oceanic residence time (in the water column) of scavenge-type metals like lead is characterised as short - in the range of 100-1000 years - which is about equivalent to the overall mixing time of deep-sea ocean waters (around 600 years). The concentrations of metals such as lead normally decrease with distance from the sources, and concentrations generally tend to decrease along the flow path of deep water due to continual particle scavenging.

62. Rivers are important transport media for heavy metals on a national and regional scale. The same may be the case for large lakes, which may also be implicated in transboundary transport of lead.

Prevention and control technologies and practices

63. This chapter summarizes information about prevention and control technologies and practices, and their associated costs and effectiveness, which might reduce and/or eliminate releases of lead, including the use of suitable substitutes, where applicable.

64. Releases due to natural mobilisation of lead and re-mobilisation of anthropogenic lead previously deposited in soils, sediments and water bodies are not well understood and are largely beyond human control. These are therefore not addressed here.

65. Reducing or eliminating anthropogenic lead releases may require:

- Investments in controlling releases from processes or substituting the use of lead-contaminated raw materials and feedstock, the main source of lead releases from unintentional uses;
- Reducing or eliminating the use of lead in products, enhancing recycling, or using other effective disposal methods to reduce releases for lead-containing products, the main source of releases caused by the "intentional" use of lead.

66. The methods for controlling lead releases from these sources fall generally under the following four groups:

- Reducing consumption of raw materials and products that include lead as an impurity;
- Substitution (or elimination) of products, processes and practices containing or using lead with lead-free alternatives;
- Controlling lead releases through low-emission process technologies and cleaning of off-gases and wastewater;
- Management of lead-containing waste.

Reducing consumption of raw materials and products that include lead as an impurity

67. Reducing the consumption of raw materials and products that include lead as an impurity is a preventive measure for reducing lead releases. This group of measures might potentially include the choice of an alternative raw material, such as using natural gas for power generation instead of coal, but the reduction of lead emissions would most probably not be the main driver for such a shift. No measures specifically addressing substitution of lead-containing raw materials have been identified.

Substitution of products and processes containing or using lead

68. Substitution of products and processes containing lead with lead-free products and processes are preventive measures which may influence the entire flow of lead through the economy and environment. It may substantially reduce lead in households, releases to the environment, the waste stream, incinerator emissions and landfills.

69. In this review, possible lead-free alternatives for a large number of different applications of lead are listed. The drivers for substitution of lead have typically been legal regulation, voluntary agreements with industry and trade, and for a few applications, development of technically or economically better alternatives.

70. Applications for which alternatives have been introduced in some countries include (with examples of alternatives in parentheses):

- Cable sheathing (alternative: polyethylene/cross linked polyethylene plastic);
- Flashing (zinc, aluminium combined with rubber/polymer, rigid metal profiles);
- Lead shot (steel, soft iron, wolfram, bismuth and tin);
- Solders (tin alloyed with, e.g., silver, copper, bismuth or indium);
- Fishing sinkers (e.g., iron, tin or zinc);

- Tubes and joints (iron, copper and plastic);
- Yacht keels/ballast (steel);
- Balancing weights for vehicles (steel, copper);
- Pigments (organic or inorganic pigments, e.g. tin-zinc-titanate or bismuth-vanadate);
- PVC stabilizers (calcium/zinc or organotin stabilizers);
- Rust-inhibitive primer (zinc phosphate or zinc oxide combined with iron oxide);
- Siccatives (drying agents) in paint (siccatives based on, e.g., zirconium, cobalt and barium);
- Gasoline additives (Refinery operating changes, high-octane gasoline components and/or additives (including oxygenates and others);
- Brake linings (graphite and other alternatives);
- Glazing and enamels (alkali boro-silicate glazing, zinc/strontium and bismuth glazing);
- Crystal glass (for semi-crystal glass: use of barium, potassium and zinc).

Controlling lead releases through low-emission process technologies and cleaning of off-gases and wastewater

71. Controlling lead emissions through end-of-pipe techniques, such as exhaust gas filtering, may be especially appropriate to raw materials with trace lead content, including fossil-fuelled power plants, cement production, the extraction and processing of primary raw materials such as iron and steel, ferromanganese, copper, zinc, and other non-ferrous metals and the processing of secondary raw materials such as iron and steel scrap. Existing control technologies that reduce SO2, NOx and PM for coal-fired boilers, incinerators and other facilities also yield a high level of lead control due to particle retention. However, end-of-pipe control technologies, while mitigating the problem of atmospheric lead pollution, still result in lead containing residues that are potential sources of future releases. Appropriate environmentally sound methods of disposal and/or reuse may be needed to prevent potential future releases of lead from these residues.

72. In non-ferrous metal operations, releases may be further reduced by the use of low-emission process technologies and fugitive emission control. According to European experience, fugitive emissions in many processes are very high, and they may greatly exceed those that are captured and abated. The hierarchy of gas collection techniques from all of the process stages is 1) process optimisation and minimisation of emissions; 2) sealed reactors and furnaces; 3) targeted flue gas collection; and as the last and least optimal option: 4) roofline collection of gaseous effluents, which is a very energy consuming option.

73. Applied dust emission control systems are generally the same across sectors. The reduction efficiencies of different abatement systems are presented in Table 1 with control measures for waste incinerators.

Table 1. Emission sources, possible control measures and reduction efficiencies for waste incinerators

Emission source	Control measure	Reduction efficiency for lead
Municipal, medical and hazardous waste incineration	High-efficiency scrubbers	> 98%
	Dry Electrostatic precipitator	80-90%
	Wet electrostatic precipitator	95-99%
	Fabric filters	95-99%

Lead waste management

74. Lead wastes, including those residues recovered by end-of-pipe technologies, constitute a special category of lead releases, with the potential to affect populations in the future. The current main principle for responsible lead waste management is separate collection and recycling of products and process waste containing lead, and stabilisation of residues from the various waste treatment procedures. Most countries accept disposal of lead-containing products in ordinary landfills except for a few product categories, e.g. lead batteries.

75. A number of options exist for the treatment and disposal of solid waste, depending on the waste

types in question and the characteristics of the waste. The dominant waste management practices relevant to lead cover recycling, incineration, biological treatment and dumping/landfilling. The overall input of heavy metals to waste streams in society is indicated in Figure 10 below. It should be noted that in practice, each step in the figure may consist of several minor steps, and that steps related to the treatment of wastewater, for instance, are not indicated in the figure.

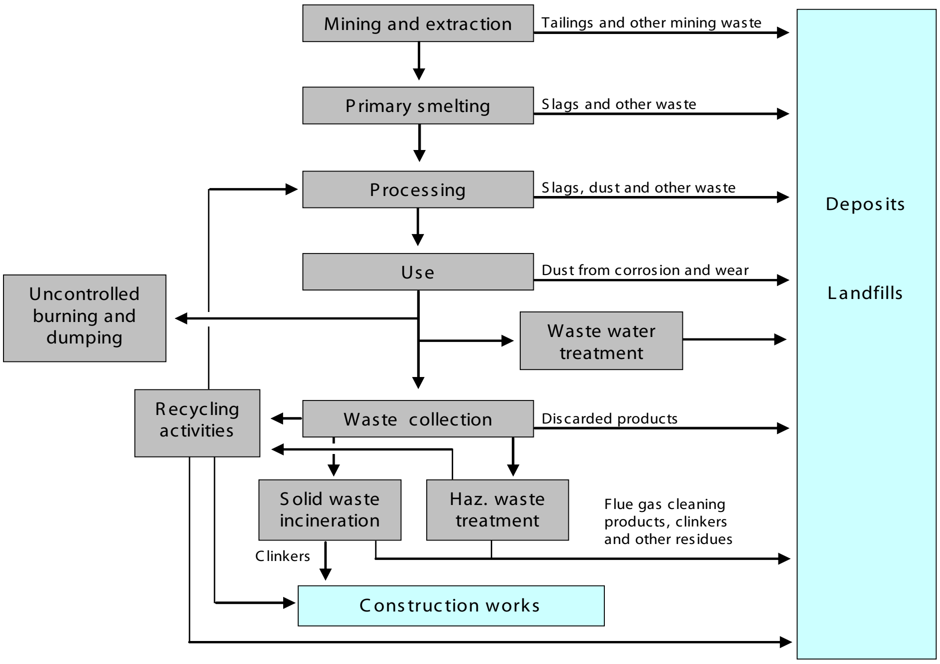


Figure 10 Schematic illustration of the overall flow of heavy metals to waste

76. **Separate collection and recycling** - Approximately 45 percent of present lead consumption worldwide is estimated to be recovered by recycling, with spent lead-acid batteries constituting the dominant input source. High collection rates close to 100 percent for lead batteries are reported in some countries. Other recycled products include lead pipes, sheets, cable sheathing and process wastes from manufacturing. By applying best available techniques for recycling, less than 0.1 percent of the lead is lost by the recycling activities. In many countries, however, breakage of the batteries and re-melting of the lead result in significant exposure of workers and local contamination of soil and surface water.

77. **Landfilling** is a waste management option that can be used for all types of waste. In the global context, landfills range from unlicensed simple dumpsites without any leachate control to highly controlled landfills for hazardous waste. Compared to the total amount of heavy metals disposed of in landfills, the content of heavy metals in leachate is relatively low. In developed countries, leachate is typically collected and directed to wastewater treatment, from which sludge is generally redirected to landfills, at least for a period of time. The main concern is that landfills can be considered a long-term source of releases of lead and other hazardous substances to the environment. Over time, landfills will be abandoned and may become a highly contaminated areas of the environment or they may be exposed to construction works, erosion by flooding, or other disruption.

78. **Waste incineration** - Combustible waste will in many cases be directed to incineration in order to reduce the volume of waste and recover the energy contained in the waste. By use of best available techniques, the emission of lead to air from modern incineration plants is usually less than 1 percent of the lead in the waste. Lead is collected with clinker (bottom ash) as well as with air cleaning residues which must be managed carefully to avoid future releases. Application of clinkers for unpaved road construction and other construction work, may be a route of releases of lead to the surroundings.

79. **Uncontrolled burning and dumping** - Uncontrolled burning and dumping of waste is known to take place in many countries worldwide, although the amount of waste disposed of and the emissions caused are generally not quantified. Lead present in the waste e.g. in pigment and stabilisers in plastics or in batteries must be expected to some extent to be released to the atmosphere by uncontrolled burning of waste, primarily attached to particulate matter.

Initiatives for preventing or controlling releases and limiting exposures

National initiatives

80. A number of countries have implemented national initiatives and actions, including legislation, to manage and control releases, and limit use and exposures of lead within their territories.

81. The overall aims of existing initiatives on lead are to reduce or prevent the release of lead to the environment, and to avoid direct/indirect impacts on human health and the environment. Many common features can be found among countries from which information is available. The initiatives can generally be grouped as follows:

- Environmental quality standards, specifying maximum acceptable lead concentrations for different media such as drinking water, surface waters, air, soil, and for foodstuffs and feed;
- Environmental source actions and regulations that control lead releases into the environment, including limits on air and water point sources, promoting the use of best available technologies and waste treatment, and waste disposal restrictions;
- Product related actions and regulations for lead-containing products, such as petrol, ceramic glazing, ammunition, paints, vehicles, electrical and electronic equipment, etc.;
- Other standards, actions and programmes, such as regulations or guidance on exposures to lead in the workplace, requirements for information and reporting on uses and releases of lead in industry, and consumer safety measures.

82. Table 2 gives a general overview of types of implemented measures that are of importance to the management and control of lead, as related to its production and use life-cycle, including an indication of their status of implementation. As can be seen from the table, existing measures cover most phases in the life-cycle of lead products and processes from which lead is emitted.

Table 2 Overview of implemented measures of importance to lead, as related to its production and use life-cycle, and an indication of status of implementation, based on information submitted for this report.

TYPE AND AIM OF MEASURE		STATE OF IMPLEMENTATION
Production and use phases of life cycle and/or releases from sources that mobilize lead from raw materials		
POINT SOURCES	Apply emission-control technologies to limit emissions of particulate matter (dust) and adhered pollutants (including lead) from combustion of fossil fuels and processing of mineral materials	Implemented in many countries
	Prevent or limit the release of lead from industrial processes to the wastewater treatment system	Implemented in many countries
	Require use of best available techniques to reduce or prevent lead releases	Implemented in some countries, especially OECD countries
PRODUCTS	Prevent or limit products containing lead from being marketed nationally	General bans implemented in a few countries only. Bans or limits on specific products are more widespread, such as gasoline and paint.
	Limit the allowed contents of lead in commercial foodstuffs and feed.	Implemented in some countries, especially OECD countries. WHO guidelines used by some countries.
Disposal phase of life-cycle		
Prevent lead in products and process waste from being released directly into the environment, by efficient waste collection		Implemented in many countries, especially OECD countries

TYPE AND AIM OF MEASURE	STATE OF IMPLEMENTATION
Prevent lead in products - especially batteries - and process waste from being mixed with less hazardous waste in the general waste stream, by separate collection and treatment	Implemented in many countries
Prevent or limit lead releases to the environment from treatment of household waste, hazardous waste and medical waste by emission control technologies	Likely implemented in all countries where organised waste treatment is taking place.
Set limit values for allowable lead content in sewage sludge and other organic waste products used for land application	Implemented in a number of countries
Set limit values for lead in solid incineration residues used for road-building, construction and other applications	Implemented in some OECD countries

International conventions and treaties

A number of international agreements have been established that enhance the management and control of releases of lead and other hazardous substances to the environment, and limit human and environmental exposure to lead. An overview of internatioal initiatives specifically addressing lead identified in this project,

International organizations and programmes

A number of international organizations and programmes also have activities that address the adverse impacts of lead on health and the environment. An overview of such international organizations and programmes

Sub-regional and regional initiatives

Finally, a number of governments have found it beneficial to cooperate across national borders in order to address the adverse impacts of lead and other hazardous substances on health and the environment in a specific sub-region or region. An overview of such sub-regional and regional initiatives identified in this project that have activities relevant to lead

Reference :-

Untied Nation Environment Programme (UNEP)

review Of scientific information on lead

Alternatives of the Provision of Pb-free Gasoline in the Local Market

Dr. Eng. Abdo Al Subari
Yemen Oil Refining Com.
Email: sabbari67@yahoo.com

Foreward (why phase out Lead in gasoline?):

It has become clear that Pb constitutes real risk on human and environment. Many countries took the necessary steps to get rid of using this substance and spend much money/big investments to achieve this objective, as they built new units able to produce Pb-free gasoline with an octane rating above 90 (between 91 and 98).

Therefore, it has become necessary to cope with the technological progress in oil industry and improve the international specifications of oil products to get them reach the internationally accepted levels, and make them meet health and environment requirements and requirements of technological progress in making vehicle motors which operate on high-octane gasoline (92-97). This will lead in the near future to make companies stop making motors and vehicles of Pb-accompanied gasoline and make an end to their access to Yemen.

This study is written for officials or investors who are responsible for implementing the phaseout of lead additives in gasoline, it assumes that Yemen government have already made the dicision to eliminate the use of lead additives.

Technical Study for Environment Protection General Authority
Overview on the Yemeni Oil Refineries Situation

1) ADEN Refinery

-Located in the city of Aden in an area known as littlie Aden on a coastline approx. 350 km. south of Sana'a.
- Current operating capacity is approx .90.000 bpd based on Marib crude.
- The refinery was built by BP Oil Company in the 1954.

Refinery products comprise the following:

- LPG (Liquefied Petroleum Gas).
- Motor Gasoline's (Regular & Premium).
- Diesel Oils.
- ATK (Aviation Turbine Kerosene)
- Fuel Oils.
- Waxy Gas Oils.
- Asphalt.

Industrial Units in Refinery comprise the following:

- LPG Production Unit
- Fractional Atmospharic Distillation Unit
- Vacum Distillation Unit
- Hydrotreating Unit
- Gasoline Reforming Unit
- Merox Unit (sweetening Unit for Gasoline+Kerosine)
- Deasphalting Unit

(2) Marib Refinery

-The refinery is situated in the historical province of Marib approx – 260 km. north - east of the capital Sana'a.
- Refinery capacity is 10.000 bpd on based Marib crude.
- Refinery operation commenced in 1986.

- Refinery products are as follows:

- Light Naphtha
- Gasoline
- Diesel
- Fuel oil

Industrial Units in Refinery comprise the following:

- Fractional Atmospharic Distillation Unit
- Gasoline Reforming Unit
- Power Plant Production Unit

(3) New Refineries Projects:

a- Al- Dhaba Refinery Project – Hadramout Governorate.

-Republican decree (No.38) was issued in 2002 approving the construction of a refinery unit in Hadhramout governorate by the private sector.
- Represented by the Hadhramout Oil Refinery Co. in close coordination with the government represented by the Ministry of Oil & Minerals.
- The foundation stone was laid down by His Excellency the President of the Republic Ali Abdallah Saleh.
- Projected capacity is 50.000 bpd of crude oil.

b- Ras Issa Refinery Porject Hodiedah Governorate

- Release of the related Republican Decree (No.59) was in the year 2003
approving the construction of the refinery in accordance with an Agreement that was signed between the government represented by the Ministry of Oil & Minerals and Hood Oil Ltd.
- Planned refinery capacity is 45.000 bpd.

Trends & current plants for Existent refineries & top authorities concerned

The expansion and modernization of the existent governmental refenerries (Aden, Marib Refineries) come at the top of priorities in strategies of these refineries, as it is planned to encounter market challenges including provision of Pb-free gasoline, this requires the government support since the refineries aim at renewal for along time as following:

1) Modernization of Aden refinery project:

The top of priorities to modernizate of Aden refinery comprise the following:

- An agreement is to be made with an international company to conduct a detailed study for modernizition of reforming unit.
- Construction of hydrocracking unit of Gas Oil to produce light products, an understanding letter has been signed for its construction between Ministry of Oil and Gulf-Yemen Refining Company, this company in last time has made the technical and economical prefeasibility study for this unit.
- Modernization of both destillation units.

2) Expansion and modernization of Marib refinery project:

The phases which has been achieved:

- An agreement has been signed for financing the technical and economical feasibility study as a donation from the (TDA).
- An agreement for achieving feasibility study of expansion and modernization of the refinery with the American company (VECO). By the end of 2004, the company finished preparation of the study.
- Communication with specialized consultant companies to prepare the (feed) study.
- Currently, the company is carrying out promotion for investment in the project and searching for financing resources.

Knock and Octane Rating :

Definitions: The octane number of a fuel is a measure of its resistance to detonation and “knocking” in a spark-ignition engine.
Knock reduces engine power output, and severe or prolonged knock will likely result in damage to the pistons and/or overheating of the engine. The tendency for a fuel to knock increases with increasing engine compression ratio. Higher-octane fuels are more resistant to knocking, and can thus be used in engines with higher compression ratios. This is desirable, as higher compression ratios result in better thermodynamic efficiency and power output. Engines designed for use with high-octane fuels can thus produce more power and have lower fuel consumption than engine designed for lower-octane fuels. For a given engine design, however, there is no advantge in using a higher-octane fuel than what the engine requires.

Current Supply & Demand of Gasoline in Yemen

Gasoline is produced in Aden Refinery as fuel for vehicles with 80 thousand ton/month. It is distributed to all branches of Yemen Oil Co. throughout the Republic. The needed quantities, however, for 2005 are about 90 thousands metric ton per month. The octane rating of this type of Pb-contained gasoline does not exceed 83. The remaining quantity is covered by Marib Refinery, which produces 10 thousand metric tones per month without adding Pb, with an 83 octane rating.
In Yemen, the refining industry in Aden and Marib Refineries supplies products of vital importance

in refreshing the economic life in general. Therefore, it is important to keep developing this refining industry in order to cover the local market with oil derivatives and encounter the increasing demand on them. Based on the 1991-2001 statistics, we find that the demand on oil derivatives is increasing and this goes in harmony with the increasing population and economic growth in the last six years- as presented in the below diagram (fig. 1) .

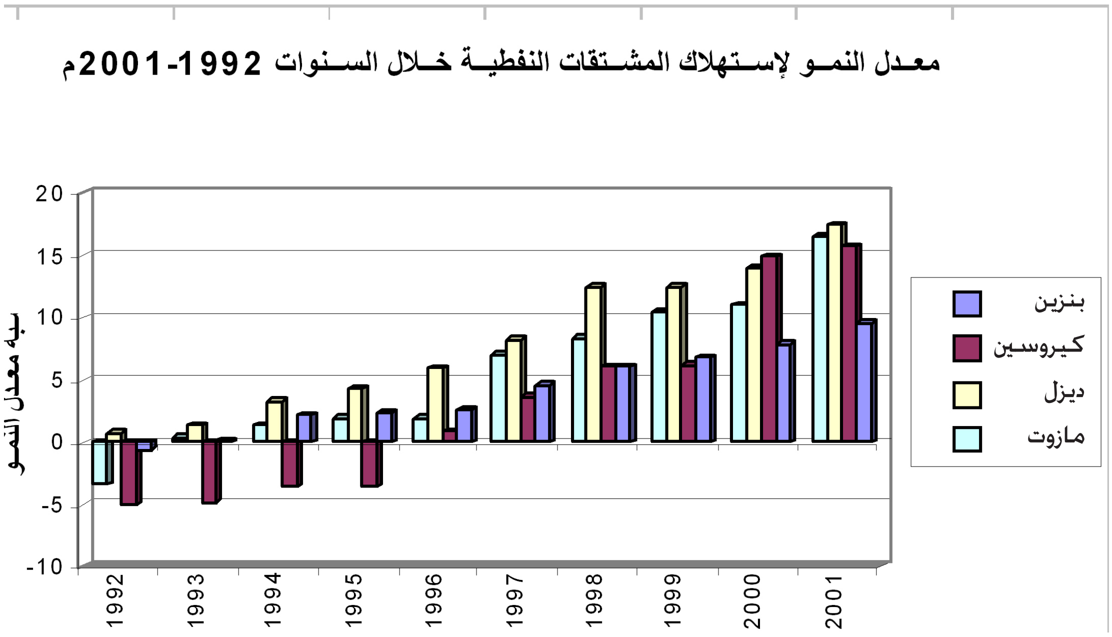


Fig. 1: Increase Rate of Consumption of Oil Derivatives during 1992 – 2001

In comparison to the last ten years since the average annual increase the consumption oil derivaties for the period from 1991-2001, It is expected that demand on derivative was increasing with 5% annually as presented in the below diagram (fig. 2) :

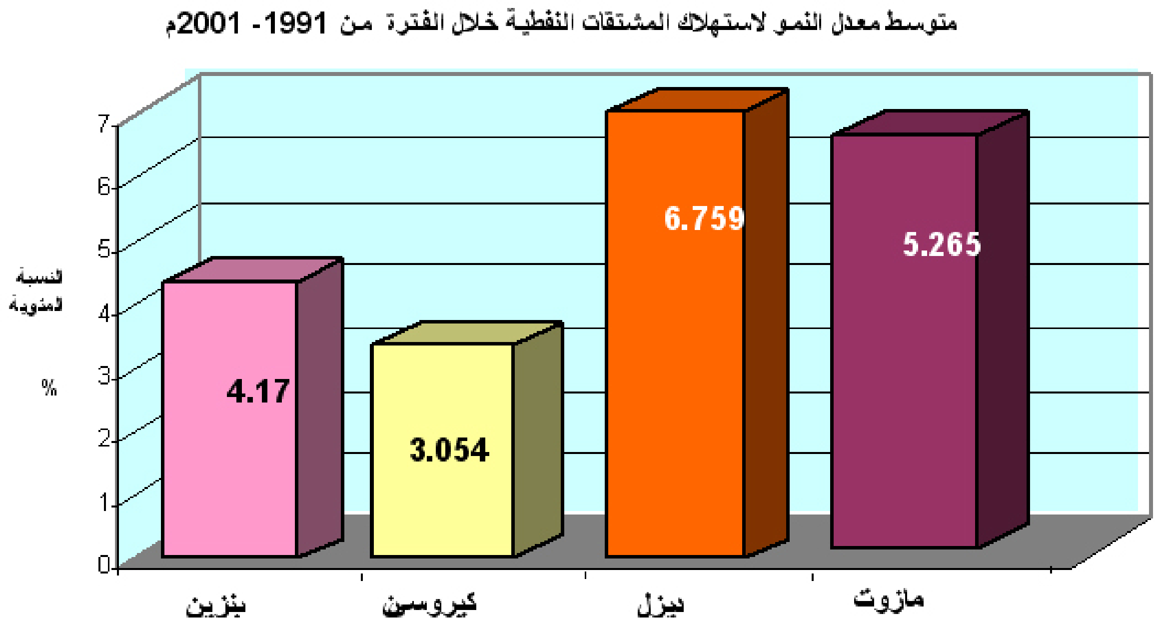


Fig. 2: Average annual increasing of consumption of Oil derivatives.

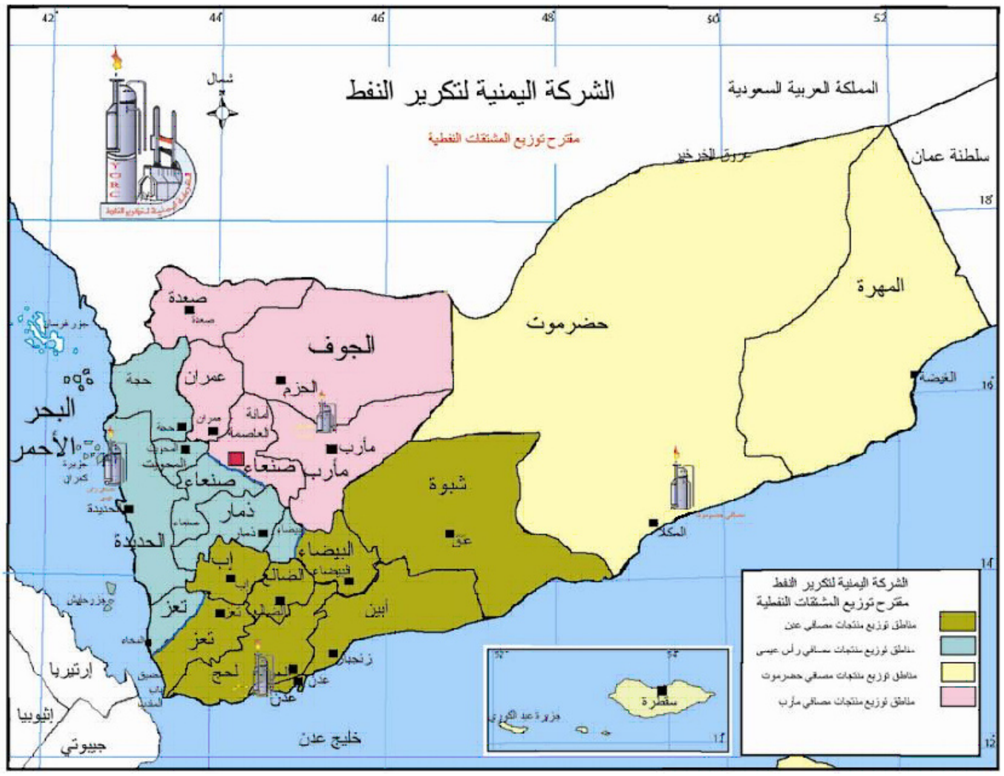


Fig. 3: Proposal for marketing of Oil derivatives in Yemen.

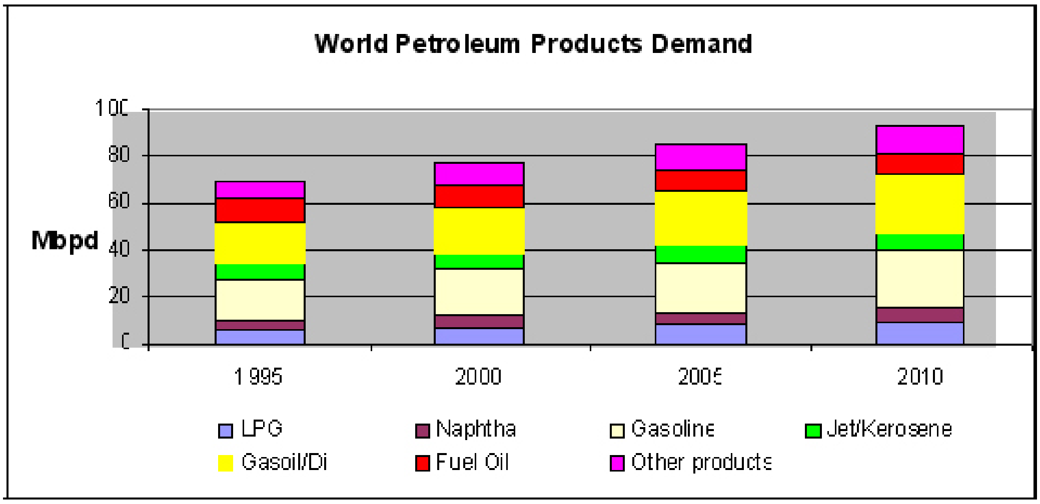


Fig. 4: World demand on Oil derivatives

Figure No. 4 shows the demand on transport (non-sea) fuel such as gasoline, airplane fuel and diesel increased with 37, 5 million barrel /day in 2005 with 900thousand barrel/day increase in comparison to 2005. This increase is counted high in comparison to the last five years since the average annual increase for the period from 2000 to 2005 did not exceed 646 thousand barrel /day. It is expected that demand on derivative will continue increasing with **2,2%** annually. It is expected that the volume of demand will reach 41,5 million barrel per day in 2010 with about 800 thousand barrel/year as an annual increase.

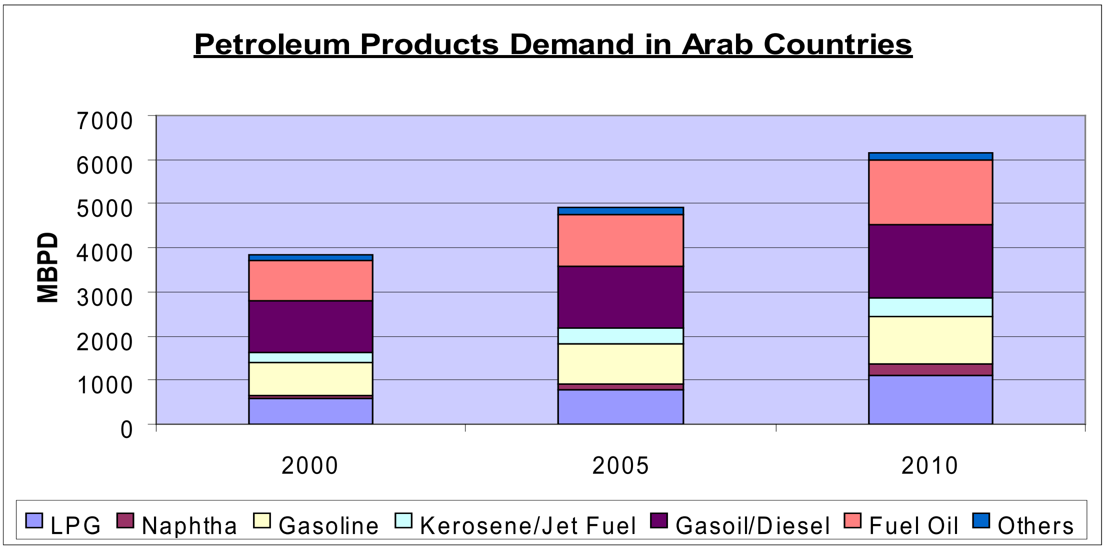


Fig. 5: Petroleum Products demand in Arab Countries.

Figure No. 5 shows the demand on transport fuel such as gasoline, airplane fuel and diesel increased with 2,6 million barrel /day in 2005, It is expected that demand on derivative will continue increasing with 4,6% annually. It is expected that the volume of demand will reach 3,2 million barrel per day in 2010 with an annual increase 4,1%..

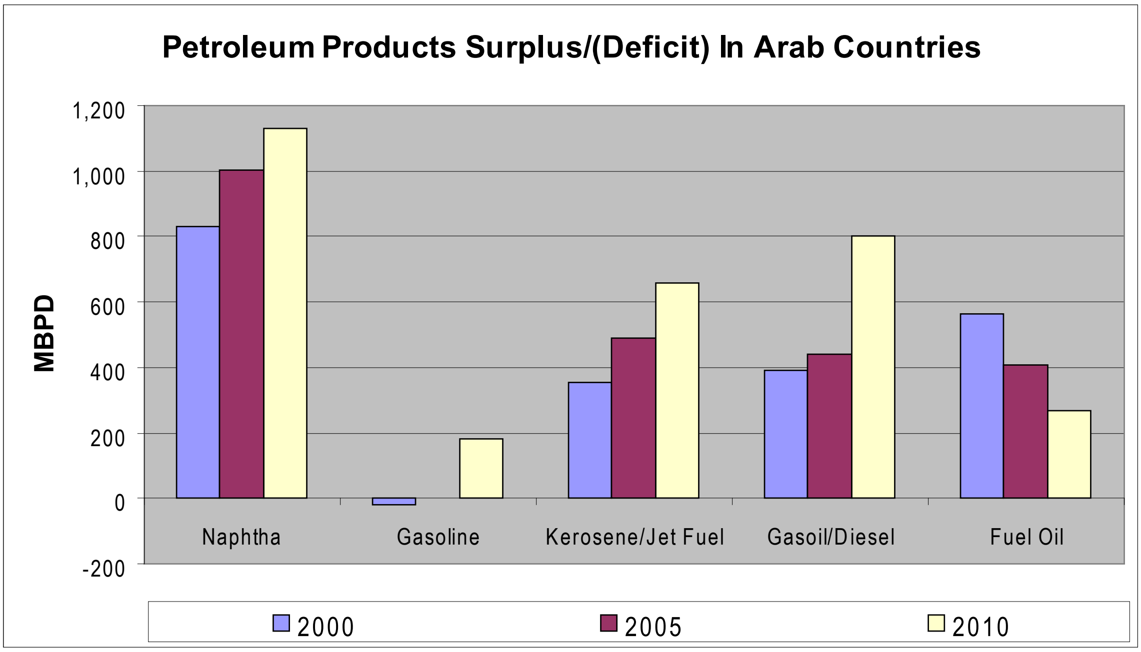


Fig. 6: Petroleum Products Surplus/ Deficit in Arab Countries.

Table 1: Supply and demand of petroleum products in Arab countries for year 2010.

	Production			Demand	Surplus / (Deficit)
mbpd	Refinery	Non Refinery	Total		
LPG	425	1,623	2,048	1,104	944
Naphtha	945	431	1,376	248	1,128
Gasoline	1,285		1,285	1,101	184
Kero/Jet Fuel	1,075		1,075	416	659
Diesel/Gasoil	2,468		2,468	1,667	801
Fuel Oil	1,712		1,712	1,443	269
Others	189		189	185	4
Total	8,099	2,054	10,153	6,164	3,989

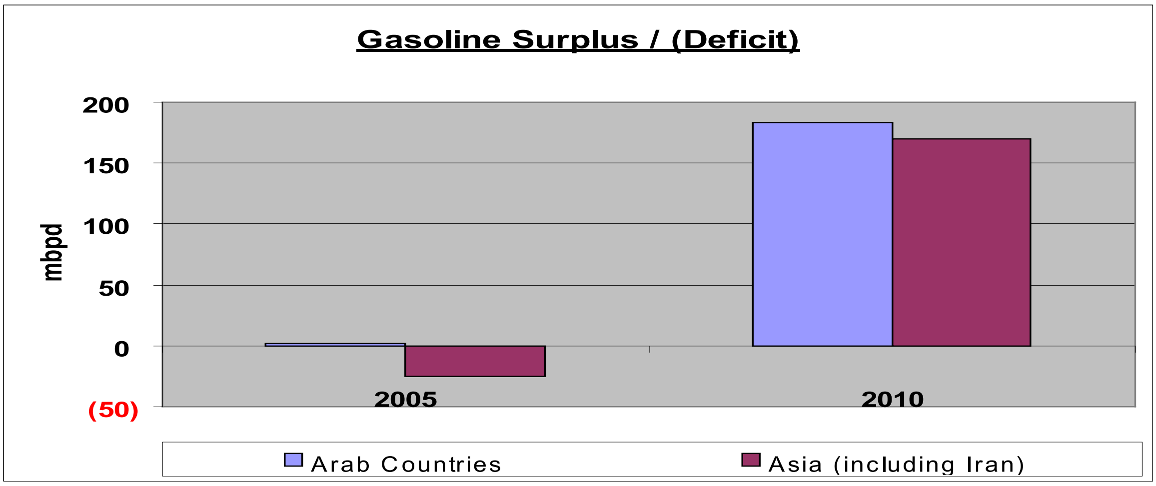


Fig. 7: Gasoline Surplus/ Deficit in Arab Countries, comparsion with Asia Markets.

Gasoline specifications in Yemen

Table 2 : Properties of Gasoline in Yemen.

Carbon number	Paraffins	Naphthenes	Aromatics
C_4	0.8	0	0
C_5	6.6	0	0
C_6	21.2	4.2	3.3
C_7	20.8	3.5	7.6
C_8	13.5	2.1	5.5
C_9	5.9	1.8	1.3
C_{10}	1.0	0.4	0.1
Total	69.8	12.0	17.8

Property	Local Gasoline		European Specification	
	Distributed	Specification	2002	2005
RON	83	90-98	91-95	91-95
Sulphur,wt. ppm	20	2000	150	50
٪.Aromatics,vol	17.8	.No spec	42	35
٪.Benzene, vol	3.3	.No spec	5	1
Lead, g/l	0.41	0.55	-	-

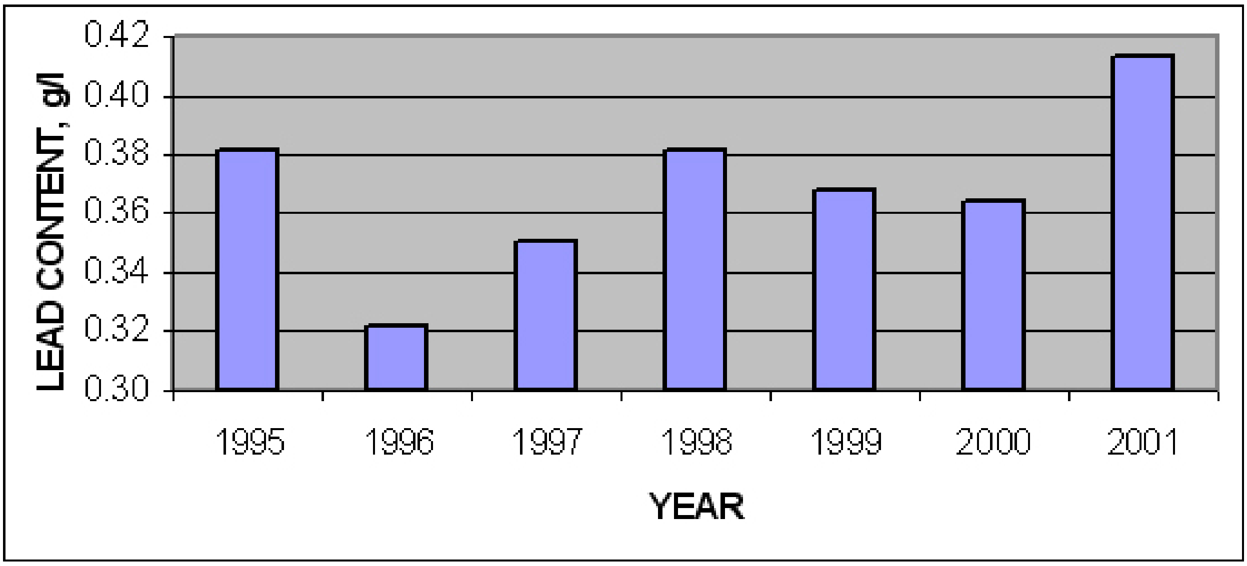


Fig. 8: Recent levels of lead content to Gasoline in Yeme.

Table 3: Middle East Octane Standards

Country	RON	MON	AKI
Bahrain	91/95	84/-	-
Iran	87/95	87/-	-
Iraq	91	-	-
Jordan	88/91/96/98	-	-
Kuwait	91/95/98	81/85/87	-
Lebanon	95	-	-
Oman	90/95	-	-
Qatar	90/97	-	-
Saudi Arabia	95	-	-
Syria	76/90	-	-
U.A.E	95/98	85/87	-
Yemen	83	-	-
Egypt	80/90/95	-	-

Table 4 : ROW - Octane Standards

Country	RON	MON	AKI
EU	91/95	81/91	-
USA	-	-	87/89/94
China	90/93/95	-	85/88/90
India	88/93	-	84/88
Japan	89/96	-	-
South Korea	91/94	-	-
Taiwan	95	-	-
Australia	91/95/96	-	-
Indonesia	88/91/95	-	-
Thailand	91/95	80/84	-
WWFC	91/95	82.5/85	-

Table 5: Properties of Gasoline in Arab Countries

	UAE	Bahrain	Algeria	S. Arabia	Syria	Iraq	Qatar	Kuwait	Libya	Egypt
RON	98/95	95/91	95/95	95	90/90	91	97/90	95/91	98/88	95/90
MON	87/85	85/--	85/--	--	--	--	--	85/81	--	--
Sulphur wt%	0.05/0.05	0.15/0.15	0.01/0.01	0.1	0.1/0.15	0.05	0.03	0.05/0.05	0.08/0.08	0.05/0.05
RVP KG/cubic cm: Summer	0.6/0.6	0.68/0.68	0.63/0.65	0.61	0.7/0.7	0.45/0.84	0.65/0.65	0.6/0.6	0.7/0.7	0.63/0.63
Winter	0.7/0.7	0.73/0.73	0.77/0.80	0.78				0.7/0.7		0.7/0.7
Benzene, vol%, Max	3.5/3.0	3.0/3.0	5/-	3	.	.	3.0/3.0	.	.	.
Aromatics, vol%, Max	50/50	.	.	.	.	.	.	.	.	.
Olefins, vol%, Max	10/10	30/--	.	.	.	.	.	.	.	.
Oxygenates, vol%, Max	15/15	.	.	10	.	.	.	10	.	2.7/2.7

Gasoline Requirements Table 6: Worldwide fuel

Worldwide Fuel Charter: Some Gasoline Requirements				
	Category 1	Category 2	Category 3	Category 4
	Minimum Requirements	US Tier 0&1 Euro 1 & 2	US Cal LEV & ULEV Euro III & IV	US Cal LEV-II US EPA Tier 2 Euro IV
Lead	0.013g/l*	0	0	0
Sulphur wppm	1000	200	30	50 to 10
Olefins %vol	-	20	10	10
Aromatics % vol	50	40	35	35
Benzene % vol	5.0	2.5	1.0	1.0

* No Intentional Addition

How to get in the world gasoline with high octane number (Octane Replacement Options):

1) Refining Industrial Processes:

- Catalytic Cracking Units:specially (CC, HCC, FCC) and others.
 higher octane product, require high capital.
- Catalyic Reforming – Increase severity (higher octane product), revamp capacity to allow higher severity operations Moderate cost, may require capital, increased benzene/aromatics, loss of volume, overall net producer of hydrogen.
- Isomerization - moderate cost, requires capital, lower octane addition than reforming, volatility impact, reduced benzene, requires small amount of hydrogen, capital requirement
-Alkylation - high cost, capital requirement, requires high purity of IC4 feedstock, favorable benzene/aromatics dilution, high MON octane contribution to gasoline pool.

2) High Octane Blend Purchases :

- MTBE – High octane, low volatility, no sulfur, benzene or aromatics, widely traded on international market. Moderate to high cost

Ethanol – High octane, no sulfur, benzene or aromatics- Limited availability, high volatility, higher cost.

Other oxygenate (ETBE, TAME) - High octane, low volatility, no sulphur, benzene or aromatics, moderate to high cost, limited availability.

Toluene - high octane, low volatility, no sulfur or benzene, widely traded on international market Moderate to high cost (variable), 100 percent aromatic

Other refinery components (reformate, alkylate, isomerate) - High octane, low volatility (except isomerate), no sulphur, no benzene (alkylate and isomerate), low or no aromatics (alkylate and isomerate), Relatively high cost, limited availability, high benzene and aromatics for reformate.

Table 6: Oxygenates - Octane Numbers

	RON	MON	AKI
MTBE	118	101	110
ETBE	118	102	110
TAME	109	99	104
Ethanol	130	96	113
Methanol	133	105	119
Alkylate	95	93	94

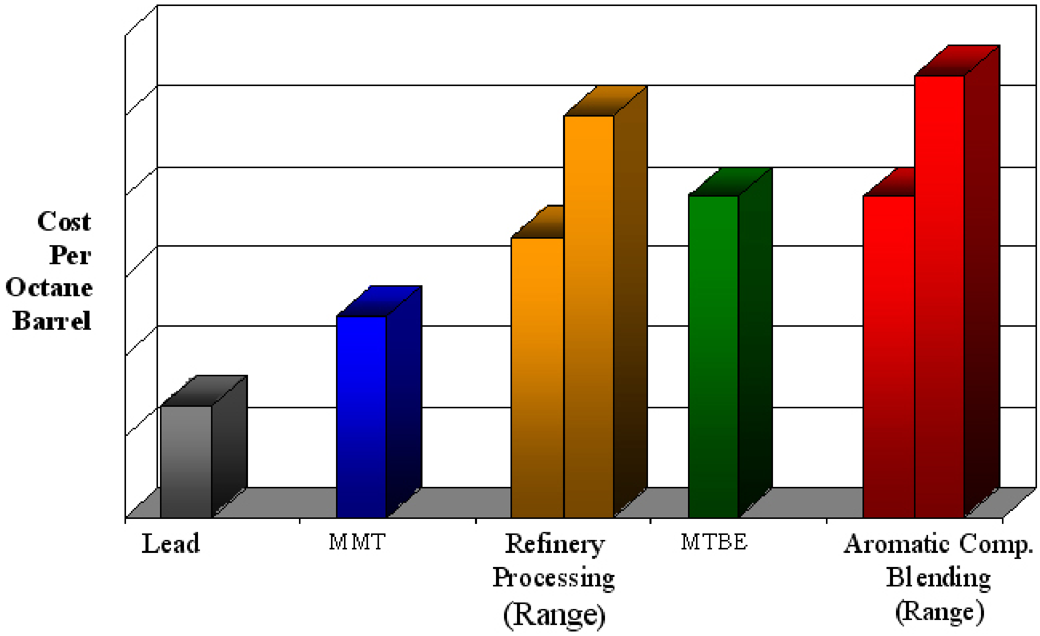


Fig. 8 : reflects the average world prices of the above mentioned alternatives

Table 6: Costs Of Phasing Out Lead In Gasoline — Hypothetical Case

	1998 Prices	Contribution of Gasoline Cost		
		Existing	Near Term	Long Term
Regular Gasoline 85 RON				
Gasoline 73 RON $/liter	$0.066	$0.066	$0.056	
Gasoline 85 RON $/liter	$0.090			$0.090
MTBE $/liter	$0.183		$0.027	
TEL $/gram Pb	$0.021	$0.015	$0.002	
High octane imports $/liter	$0.138		$0.011	
Total Cost		$0.080	$0.096	$0.090
Increase US$/liter			$0.015	$0.009
Premium Gasoline 93 RON				
Gasoline 84 RON $/liter	$0.088	$0.088		
Gasoline 87 RON $/liter	$0.094		$0.080	
Gasoline 93 RON $/liter	$0.106			$0.106
MTBE $/liter	$0.183		$0.027	
TEL $/gram Pb	$0.021	$0.015		
High octane imports $/liter	$0.138		$0.007	
Total Cost		$0.102	$0.114	$0.106
Increase US$/liter			$0.012	$0.003

Source: USEPA

Table 7: Hypothetical Maintenance Cost Savings With Low-Lead And Unleaded Gasoline

	Gasoline Type		
Maintenance Item	**High Lead**	**Low Lead**	**Unleaded**
Vehicle life (km)	200,000	200,000	200,000
Spark Plugs			
Change interval	15,000	25,000	30,000
Change cost	$20	$20	$20
Lifetime cost	$247	$140	$113
Oil Change			
Change interval	4,000	6,000	8,000
Change cost	$12	$12	$12
Lifetime cost	$588	$388	$288
Engine Overhaul			
Total overhauls	1.0	0.8	0.8
Overhaul cost	$500	$500	$500
Lifetime cost	$500	$400	$400
Exhaust System Replacement			
Total replacements	3	3	1
Replacement cost	$80	$80	$80
Lifetime cost	$240	$240	$80
Valve Repairs			
Total number	0.5	0.2	0.2
Cost/repair	$500	$500	$500
Lifetime cost	$250	$100	$100
Cylinder Head Replacements			
Total number	0.1	0.1	0.3
Cost/repair	$300	$300	$300
Lifetime cost	$30	$30	$90
Total lifetime cost	$1,855	$1,298	$1,071
Saving compared to leaded		$557	$783
Total fuel used (l)	16,667	16,667	16,667
Saving per liter		$0.033	$0.047

Source: USEPA

How to prepare the gasoline with Pb-Contained at Aden Refinery:-

The vehicles Pb-contained gasoline is only prepared at Aden Refinery by mixing the product obtained from the refining unit with light naphtha, which is obtained from the first distillation unit in the atmospheric pressure. If we suppose that the quantity of the locally consumed gasoline is 36 thousand barrel per day, the quantity of the gasoline produced by the refinery for covering the local consumption can be as follow:

1- 15 thousand barrel per day from light naphtha, which is obtained from the first distillation unit in the atmospheric pressure with 74 octane rating.
2- 6 thousand barrel per day: reformat; it is produced by the benzene refining unit with 87 octane rating.
3- 15 thousand barrel per day: naphtha with 55 octane rating

All these three compounds are mixed with adding the relatively toxic $(C_2H_5)_4Pb$ to the mixture to get the requested octane rating (about 2,5 g per one gallon. By so doing, the octane rating is increased in gasoline to 83 at least and by this the local market requirement is covered.
The Pb added to the mixture is very costly that the price of a tone is about 17000 dollar. Aden Refinery spends more than 17 million dollar a year.

The vehicle benzene is also prepared at Mareb Refinery by mixing the product obtained from the refining unit with light naphtha obtained from the first distillation unit in the atmospheric pressure. The refinery produces 10,000 metric ton per month with 83 octane rating without adding the Pb as its use has been suspended in order to contribute to covering the market requirement.

What are the practical alternatives for obtaining highly octane rating gasoline, which is free from Pb in Yemen?

1- In the medium and longer term:

a-Add new advanced refinery process units at Aden Refinery such as fuel oil catalytic cracking unit, which convert the low octane straight-chain paraffins in fuel oil to higher-octane hydrocarbon types such as branched-chain parafines, naphthenes, and aromatic compounds.

This unit can be established in the long run (3-5 years) by investing about 250 million dollars with 25-35 thousand barrel per day. This unit will produce 15 thousand barrel of gasoline per day, with an octane rating above 92. The refinery can achieve a set of objectives such as:

- Produce Pb-free gasoline to cover the local market and export.
- The government can shift rapidly at any time from using Marib crude to the highly fuel oil Masila crude oil (52%) upon depletion. Thus, the optimal economic feasibility will be achieved in case of shift to using Masila crude oil - It used to be sold at that time less than 1, 5 dollar in comparison to Mareb crude and at present more than that in world markets.

B) Encouraging of Serious Investment (Private & Mixed) in this field.

2) In the Near- term options:

a-At Aden Refinery:

- Modernization the gasoline-reforming unit: An agreement is to be made with an international company to conduct a prefeasibility study for modernizing the gasoline-reforming unit and implementing it at Aden Refinery. The cost will be ranging from 20 – 40 million dollar as per the extent to which the modernization will take place during the following phases:

§ The renewal aims at recovering the designing capacity of unit, which is 12,000 barrel per day since it has fell down to 9000 barrel per day due to refining Mareb oil which is different from Kuwaiti oil for which this unit is designed. The renewal aims also at making a radical change in the quality of the production of this unit by replacing the chemical processing systems with hydogenic processing systems, and this seeks to improve the unit proficiency and insert a new catalyst by increasing the octane rating from 90 to 100.

By these procedures, the refinery can supply Pb-free gasoline at 65% of the locally consumed quantities and take gradual steps in getting rid of the use of (C2H5)4Pb.

b-To be accompanied by expansion and renewing Marib Refinery:

- It is made an economic and technical feasibility study has been conducted by VECO in this regard. The study focused on building new units with 15 thousand barrel /day, and to get them connected to the old refinery with total productive capacity reaching then 25 thousand barrel /day to cover the demand of the regions to the refinery.

3- As to the using of Pb-free gasoline as an urgent objective, we find the following alternatives:

1) Choose the best gasoline-additives, which can be added to gasoline instead of Pb to increase octane, These include blending gasoline with such high-octane components as blending gasoline with methyl tertiary-butyl ether (MTBE), ethanol , alkylate or mixtures of aromatics compounds.
This will require the authorities concerned to make more accurate revision by specialists (technicians and financial accountants)

2) Import the Pb-free gasoline with high octane (approximately more than 70%) and export the refineries gasoline (as naphta for petrochemical industry) to cover the local requirements of international market with 37.5 million dollar per month or 453 million dollar per year - the one tone costs 540 USD.

This will entail the following:

a. either building a new scheme of reservoirs, pumps and pipes to replace the current scheme which contains Pb, and this entails big investments in this side and long period to get it implemented and waste the current scheme,

b. On the other hand, clean the current system, which deal with Pb-contained gasoline in Aden Refinery, Yemen Oil Com., Filling Station tanks and tankers, find potential sites for throwing wastes of cleaning process, and receive the new product. This, however, will totally suspend the on-going supply to the local market during the cleaning period and subsequent period needed for re-installing the new scheme. It will also lead to waste the price of the existent materials in the whole scheme, which is estimated at 40 million dollars. Besides, the re-installation of the inventory will be at the same price and the final disposal of Pb will only be achieved after passing a relative long period.

3) The optimal alternative can be implemented by gradual decrease in the rate of Pb in the gasoline used in local markets.

The Pb-free gasoline, which contains high quality of octane, can be imported and then be mixed with the local gasoline product. By this, the complete system can be cleaned automatically in three phases:

Description	Added Quantity of (OCTEL) cm3/ gallon	Added Quantity of (Pb) gm/ gallon
Current specifications	4,0	2,50
Average general use	2,66	1,66
First decrease from April to July 2007	2,40	1,50
Second decrease from July to September 2007	1,60	1,00
Third decrease: October – December 2007	0,80	0,50
Pb-free benzene from 1 January 2008	-	-

The main objective of the gradual decrease of Pb after the third phase (third decrease) is to get the whole scheme able to supply the local market with Pb-free benzene or to supply it with benzene with internationally accepted rates of Pb within one year or two.

This matter requires us to prepare the below listed things from now:

1) Determine the number of vehicles which operate on gasoline and the number of those, which operate on gas, and the year of manufacturing, to be divided as follow :

- old vehicles made before 1985
- mid-aged vehicles made in between 1986 – 2006
- new vehicles made after 2000
- Modern vehicles, which are equipped with the catalytic converter in exhaust pipes.

However, Yemen Oil Co. should implement this task in cooperation with the other governmental authorities such as traffic.

2) Yemen Oil Co. should take the preparatory and executive steps to establish two separated systems, one for Pb-free gasoline above 83 octane rating and another for Pb-free gasoline above 90 octane rating in the following:

- Premises of oil Com.
- Filling stations
- Gasoline transportation means

3) Costs of such processes in price of refinery sale to the Oil Com. are to be build as per calculations agreed by all parties. The costs should be based at the end on the governmental support for gasoline, unless price change is made in the local market to accommodate such increases in cost.

Conclusions:

It is expected that the refining industry in Yemen will continue growing with a rate excelling the market requirement because some of its refineries depend directly on exportation market. Besides, the expansion programs which are planned to be implemented by the end of this decade and aim at gradual shifting towards producing oil derivatives with more suitability to the environment will improve the margin of profitability in these refineries and will promote the quality of the environmental specifications in local markets.

If we consider that the refineries' net oil derivatives production in Yemen generates surplus in local market, it is expected that these refineries will continue covering the deficiency in the nearby markets and will supply the European markets with clean oil derivatives.

Furthermore, the expansion programs that will be implemented in refineries in the next period will qualify them to play an important role in covering the requirement of the local market with a competitive manner with Arab and Asian refineries. They will then supply the world markets with a high-quality product if demand on oil continues with the present expected rates.

Recommendations

- Provide necessary support and facilities by the government to strategical projects of modernization and expansion adopted by the govermental refineries.
- improve types of high octane-rating gasoline when the number of modern vehicles increases and when conditions of environmental control get improved;
- decrease using of vehicles and use collective transportation means and then decrease quantity of gas emitted into air;
- start with the Pb-free gasoline project; as this alternative is taken almost in all neighboring countries and in many advanced countries; the shift towards this type of gasoline has been accompanied by many incentives for citizens including the cheap price,
- prepare the catalyst-contained exhaust pipes which convert some harmful gases such as the Carbon monoxide and Nitrogen Oxides and hydrocarbonic gases into other substances which are marked by less harm such as water vapor and Carbon dioxide according to the following interactions:
- concentrate on using the natural gas since it is free from types of pollutions existent in other types of energy, and concentrate on the development of sources of gas and use it as fuel in collective transportation means, stations of energy generation, water desalination, and petrochemical projects,
- encourage scientific research which concentrate on renewal alternatives of energy and address the environment pollution,
- spread the proper environmental awareness between people to help maintain the environment; this can be done by holding conferences, symposiums and all means of press media.

THE RESULTS OF THE RESEARCH IN STUDYING AVERAGE OF LEAD CONCENTRATE IN BLOOD PILOT SURVEY

Tariq Saaid Al-Madahaji.

Preface :

In general , the cars consider the main resource of air pollution in the capital cities. Although , We implement the procedures for decreasing transportation exhaust which comes from cars . As the cars depend on burning fuel which has bad reflects on the environment and quality of air , this because of harmful gases which resuilt from operation of burning fuel .

Several results of studies which perform in number of arabic countries that capital cities suffer high rate from air pollution and the cars consider the main resource for pollution is about 60% . This thing made many countries for implementing the procedures and put lows to decrease from this pollution . As the resuilt the procedure decrease the rate of pollution and specially lead in the air in more countries which implement these procedures . There are many of counties in the world suffer from danger of lead pollution in the air and one of countries is Republic of Yemen . As the scientific studies show that lead which adds to the fuel has two effects :

1- Toxic .
2- The effect of Nervous system and stopping the ability in thinking .

From finding that every (1) µg/dl. For lead in the blood causes decreasing 7 degree in average of intelligence with children . As findings show , that there are direct relationship between the rate of lead in the air and it's concentrate in human blood . Public authority for protecting environment care with public health and to making environment clean and healthy . As it implement survey to analyze of blood of sample of people for knowledge the rate of lead in the air and then concentrate the lead in the blood .

Methodology :

Sana'a city was chosen for implementing the study because represent the all cities in Yemen and in addition to crowd in it from cars which reach it's number is more than 50% from the total of the cars in Yemen and also because of dence of population . As there are not teams between cities for polluting the air with gases which getting from remains of cars . In addition to this available of huge number of old cars which still work in Sana'a city and it has effect at measure of pollution .

Random sample was taken from Yemeni people deal in different groups and the focusing on the children , traffic men, drivers and others as following :

1- 125 students under 19 years .
2- 104 traffic men .
3- 75 drivers .
4- 6 teachers.
5- 5 high officials .
6- 7 cancer patients .
7- 10 kidney failure patients.

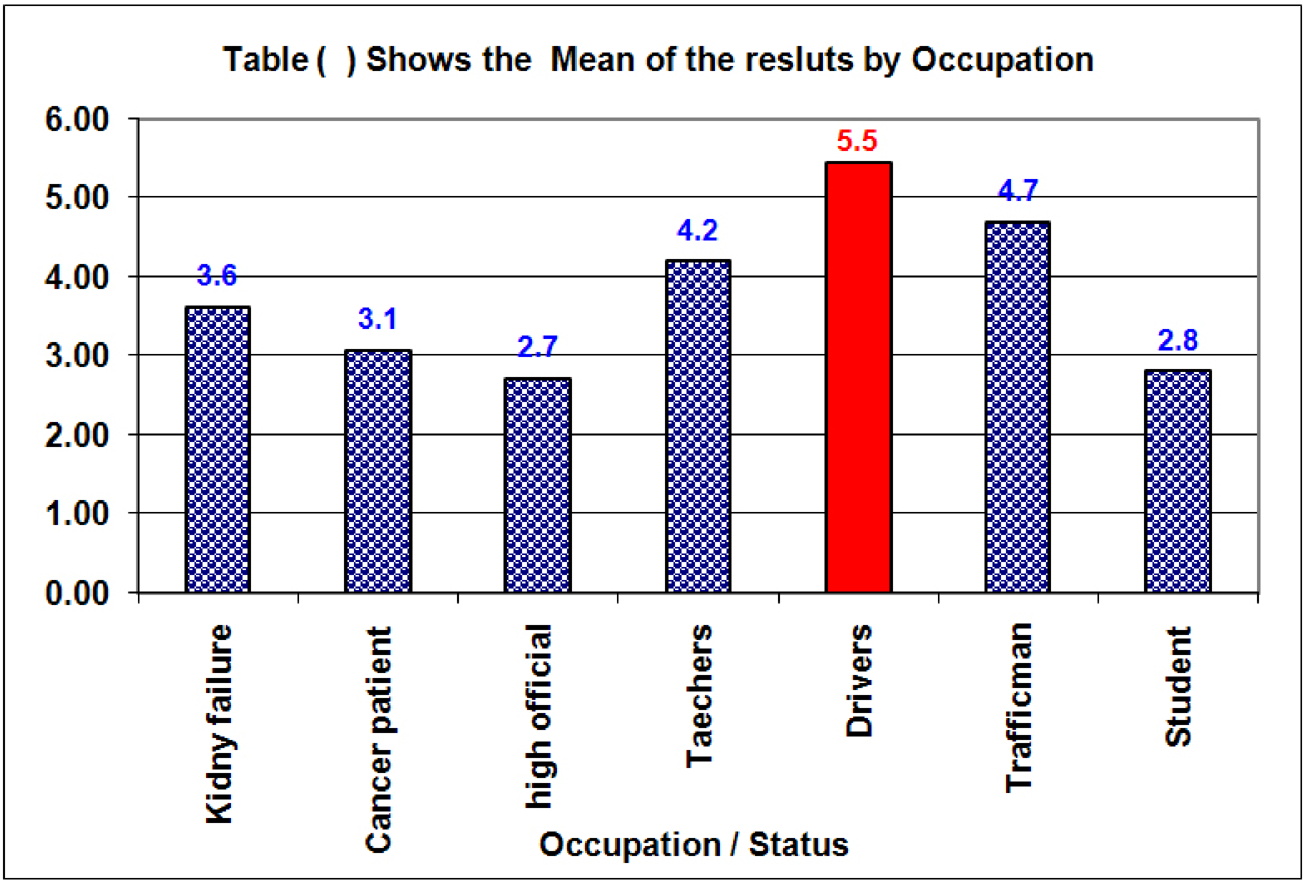
Total sample is 332 .

For analyzing the blood was used BLOOD LEAD TESTING SYSTEM (Lead Care)

DESCRIBTIVE AND STATISTICAL ANALIZING OF THE RESULTS

Table ( ) Shows the Mean , Max and Min value of the resluts by Occupation

Occupation / Status	Mean	Max	Min
Student	2.8	0.7	7.7
Trafficman	4.7	1.4	8.4
Drivers	5.5	3.4	8.5
Taechers	4.2	3.1	5.4
high official	2.7	1.5	4.5
Cancer patient	3.1	2.1	3.9
Kidny failure	3.6	0.8	6.3
Total	4.1	0.7	8.5



The result shows the rate of concentration of lead in drivers blood was higher than other groups in these research . The reason of this is because drivers spend long time breathing polluted air with lead and cars remains . The rate is 5.5 µg/dl and the Max value is 8.5µg/dl. and the lowest Min. 3.4 µg/dl. This rate shows the danger of the current position as the highest value closes to texicity rates which its 10 µg/dl . As we see the average in traffic men is closed to the average of drivers and this is ensure the previous assumption . this rate is differ from group to another according to the occupation and state this differentiate has level evidence 0.05.

Oneway

ANOVA

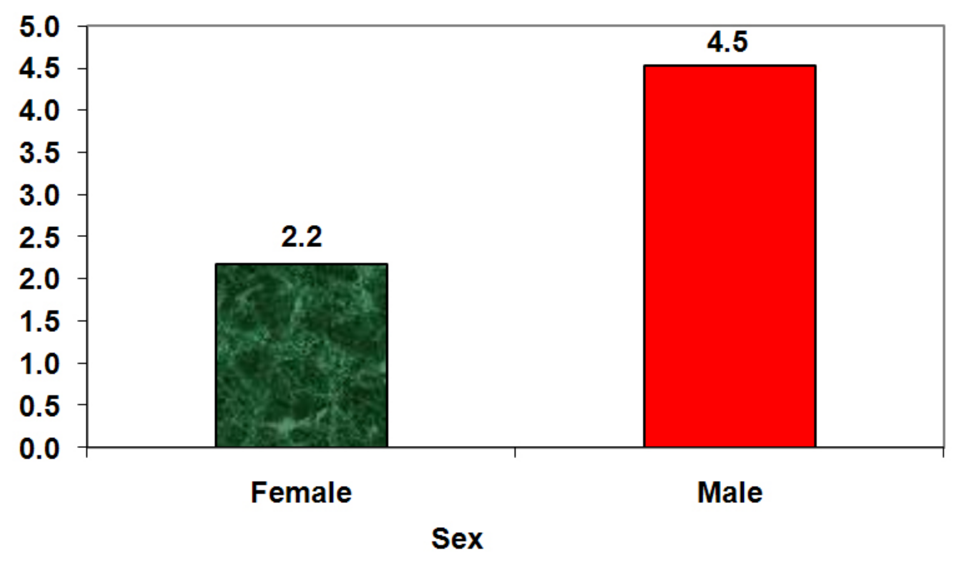
Occupation

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	178.073	66	2.698	1.611	0.005
Within Groups	443.815	265	1.675		
Total	621.889	331			

Table ( ) Shows the Mean , Max and Min value of the resluts by Sex

Sex	Mean	Max	Min
Male	4.5	1.4	8.5
Female	2.2	0.7	4.6
Total	4.1	0.7	8.5

Fig. ( ) Shows the Mean of the resluts by Sex



The result shows that males are more effected than females . Because that the males spend most of their time in streets either for work or playing with children , while females spend most their times either in the houses , schools or in places of works . In the other hand the women cover their faces with veils and this reduces breathing polluted air.

T-Test

Group Statistics

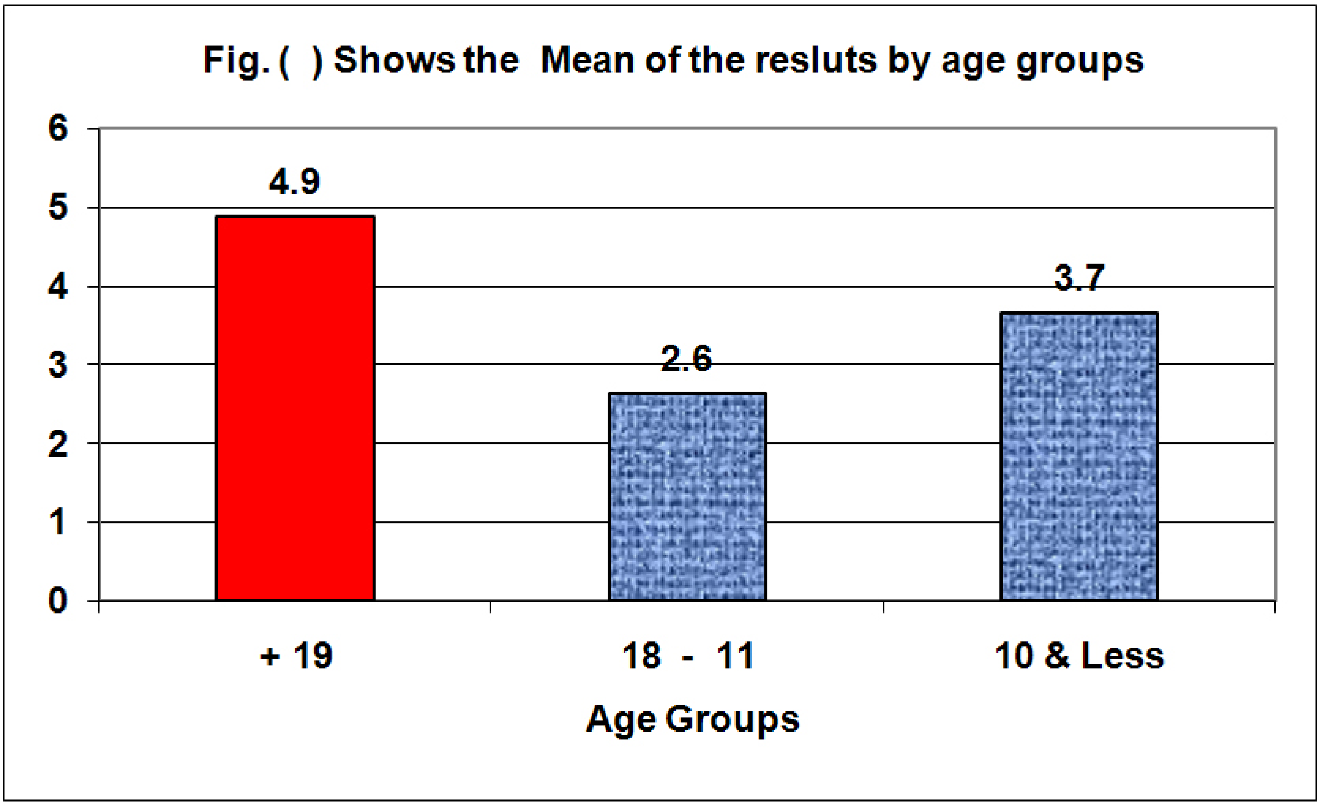
	Sex	N	Mean	Std. Deviation	Std. Error Mean
REsults	Male	265	4.524	1.3903	0.0854
	Female	67	2.182	1.0177	0.1243

Independent Samples Test

		Levene>s Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	99% Confidence Interval of the Difference	
									Lower	Upper
REsults	Equal variances assumed	6.540	0.011	12.932	330	0.000	2.3417	0.1811	1.8725	2.8108
	Equal variances not assumed			15.524	135.440	0.000	2.3417	0.1508	1.9476	2.7358

Table ( ) Shows the Mean , Max and Min value of the resluts by age groups

Age-Groups	Mean	Max	Min
10 & Less	3.7	1.6	7.7
18 - 11	2.6	0.7	5.1
+ 19	4.9	0.8	8.5
Total	4.1	0.7	8.5



From the chart above one can notice that the effects on the age group 19 years and more are more than the other groups because its include the drivers and traffic men. But if we noticed that the children at the age 10years and less are more effects than the age group 11- 18 years the children spend most of their time in the street either playing or buying things to their parents and more sticks to the ground , this make them more effects through sucking their fingers or eating without washing their hands well . if the previous situation still as it's the children will suffer from the nervous status and their intelligence decrease will increase . not only this but also the new infants will more effect through taken decease before birth and after.

Oneway

ANOVA

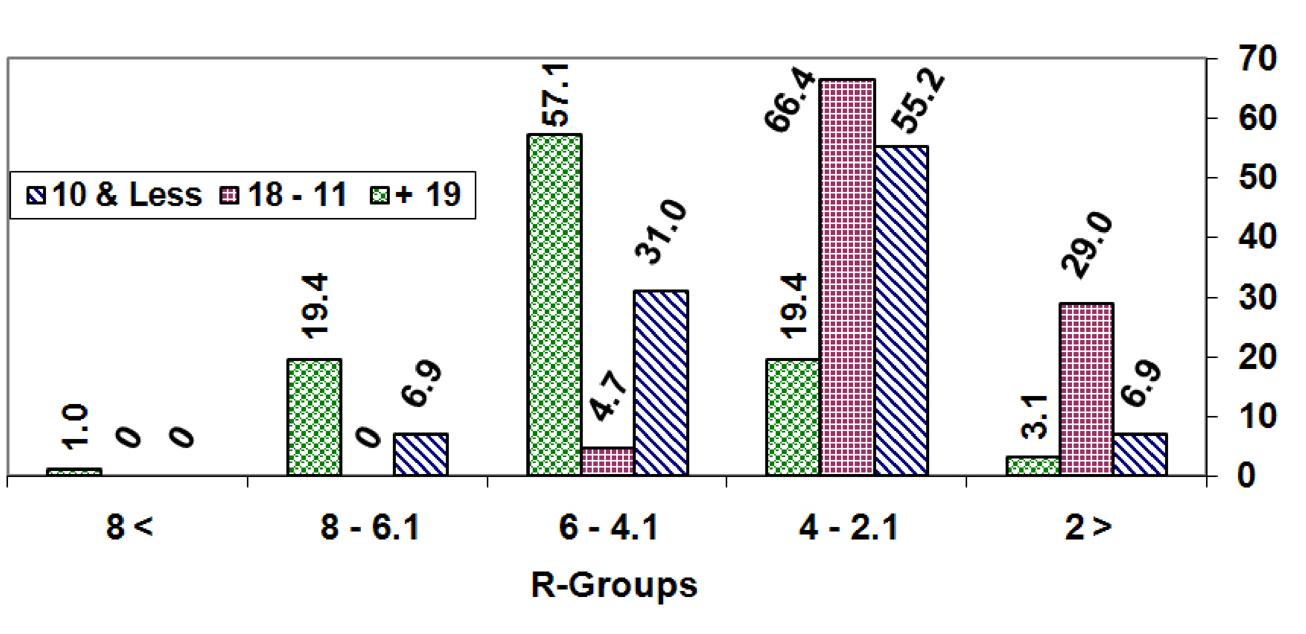
REsults

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	355.146	2	177.573	113.053	0.000
Within Groups	516.764	329	1.571		

Table ( ) Shows the distrbuation of the results by Age groups

R-Groups	10 years & less		18 - 11		+ 19		Total	
	No.	%	No.	%	No.	%	No.	%
2 >	2	6.9	31	29.0	6	3.1	39	11.7
4 - 2.1	16	55.2	71	66.4	38	19.4	125	37.7
6 - 4.1	9	31.0	5	4.7	112	57.1	126	38.0
8 - 6.1	2	6.9			38	19.4	40	12.0
8 <					2	1.0	2	0.6
Total	29	100	107	100	196	100	332	100

Fig. ( ) Shows the distrbuation of the results by Age groups

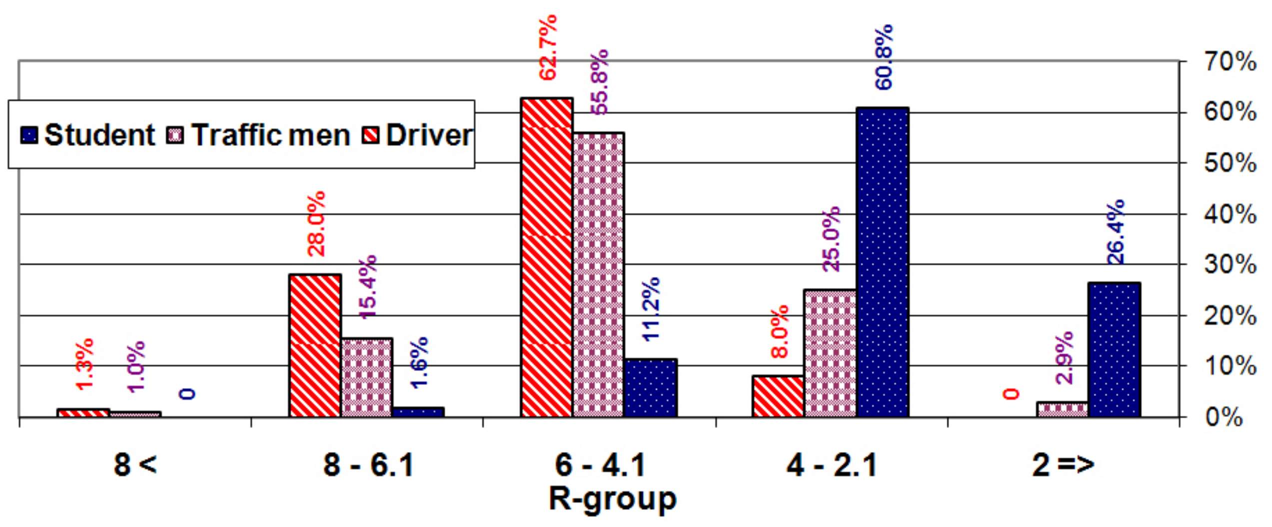


The chart shows that 86.2 % of children at the age 10 and less lead concentrate rate in their blood between 2.1-6 μg/dl . And 66.4 % of children at age group 11-18 years the lead concentrate rate in their blood between 2.1-4 μg/dl this is a very dangerous indicator on children health

Table ( ) Shows the distrbuation of the results by Occupation Status

R-groups	المهنة / الحالة														الاجمالي	
	student		trafiic men		drivers		teachers		high officials		cancer patients		kidny failure patients		No.	%
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%		
<= 2	33	26.4%	3	2.9%					1	20.0%			2	20.0%	39	11.7%
2.1 - 4	76	60.8%	26	25.0%	6	8.0%	3	50.0%	3	60.0%	7	100.0%	4	40.0%	125	37.7%
4.1 - 6	14	11.2%	58	55.8%	47	62.7%	3	50.0%	1	20.0%			3	30.0%	126	38.0%
6.1 - 8	2	1.6%	16	15.4%	21	28.0%							1	10.0%	40	12.0%
> 8			1	1.0%	1	1.3%									2	0.6%
Total	125	100.0%	104	100.0%	75	100.0%	6	100.0%	5	100.0%	7	100.0%	10	100.0%	332	100.0%

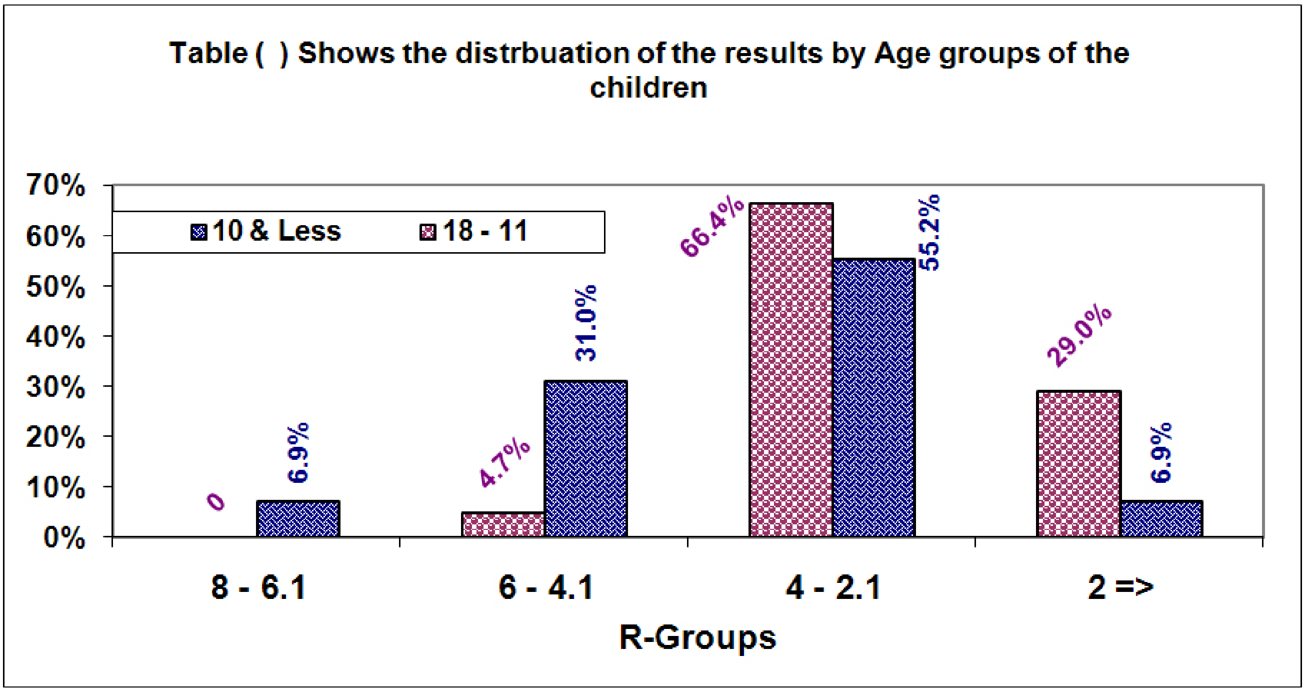
Fig. ( ) Shows the distrbuation of the results by Occupation Status



If we have a look to the size of the problem according to the occupation and status we can notice that most of students which reached 72 % the lead concentrate rate in their blood are between 2.1-6 µg/dl . while the lead concentrate rate in traffic men blood are between 2.1 – 8 µg/dl at the rate of 96.2 % and the drivers rate reached 90.7 % have between 4.1 -8 µg/dl of kidney failure patients

Table ( ) Shows the distrbuation of the results by Age groups of the children

R-Groups	Less & 10		18 - 11		Total	
	No.	%	No.	%	No.	%
<= 2	2	6.9%	31	29.0%	33	24.3%
2.1 - 4	16	55.2%	71	66.4%	87	64.0%
4.1 - 6	9	31.0%	5	4.7%	14	10.3%
6.1 - 8	2	6.9%			2	1.5%
Total	29	100.0%	107	100.0%	136	100.0%



The chart shows that 86.2 % of children at the age 10 and less lead concentrate rate in their blood between 2.1-6 µg/dl . And 66.4 % of children at age group 11-18 years the lead concentrate rate in their blood between 2.1-4 µg/dl this is a very dangerous indicator on children health

Table ( ) Shows the distrbuation of the results by sex of the children

R-Groups	Sex				Total	
	Male		Female		No.	%
	No.	%	No.	%		
<= 2	2	2.7%	31	49.2%	33	24.3%
2.1 - 4	56	76.7%	31	49.2%	87	64.0%
4.1 - 6	13	17.8%	1	1.6%	14	10.3%
6.1 - 8	2	2.7%			2	1.5%
Total	73	100.0%	63	100.0%	136	100.0%

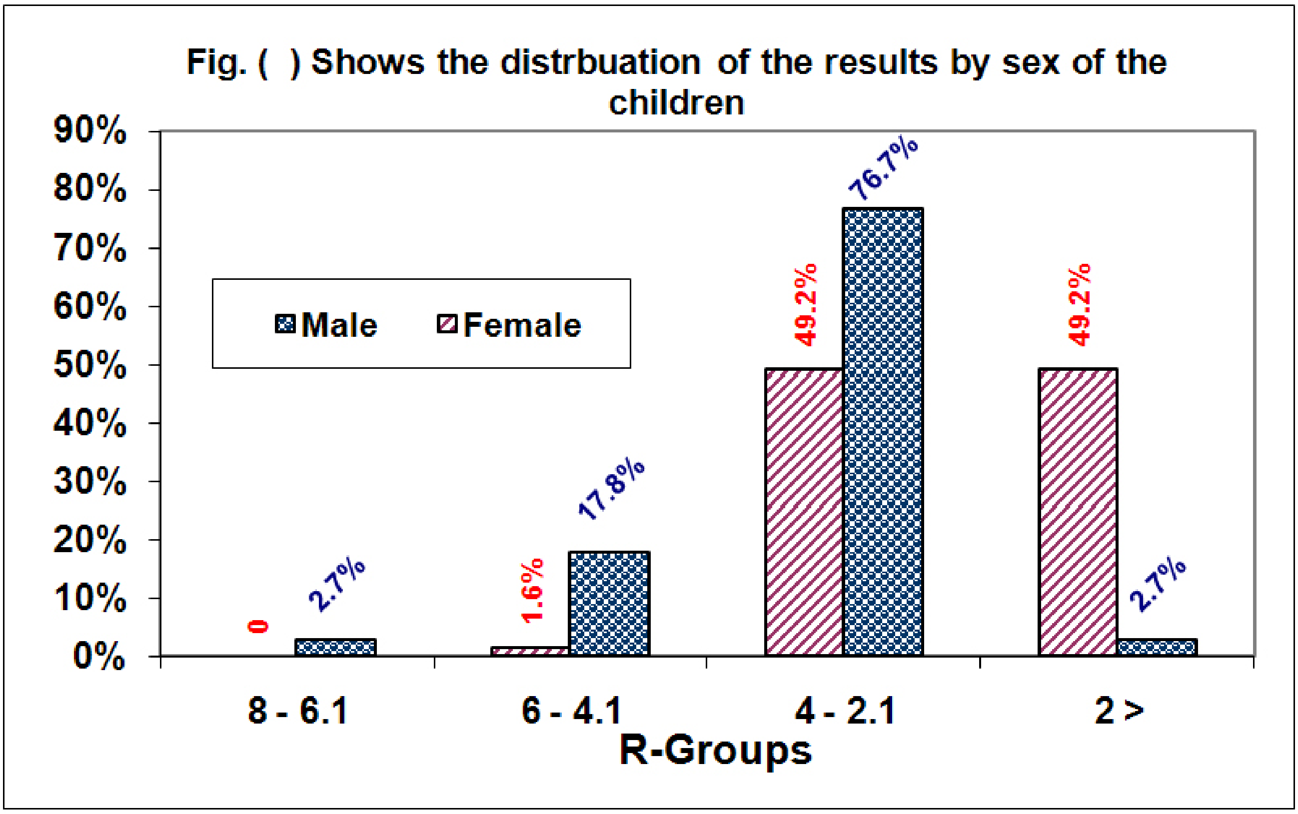
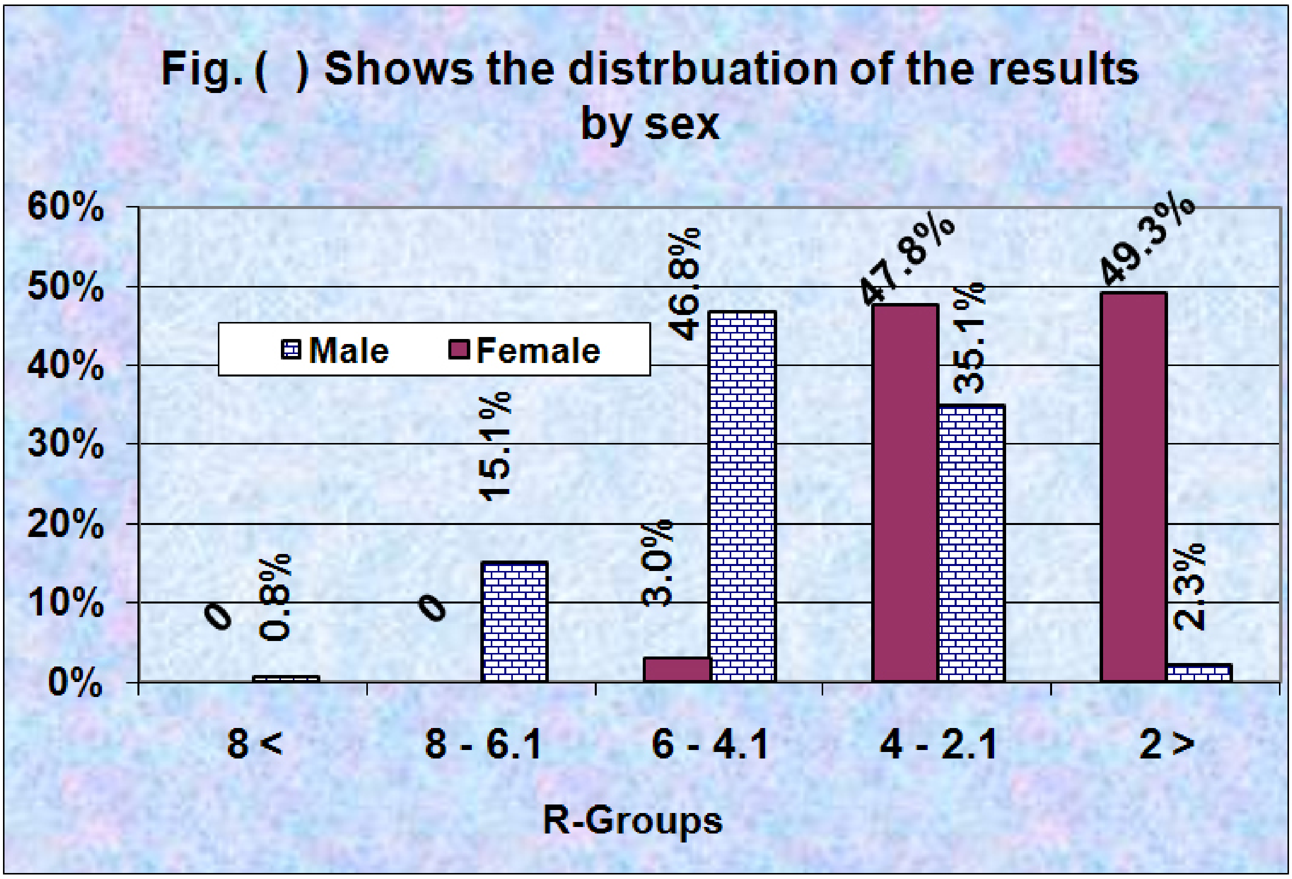


Fig. ( ) Shows the distrbuation of the results by sex of the children

According to the sex of children we can notice that the concentrate of lead in male blood is more than in females . We have 94.5 % of males have the average concentration in their blood is between 2.1-6 µg/dl as well as 98 % of females is between 0-4 µg/dl.

Table ( ) Shows the distrbuation of the results by sex

R-Groups	Sex				Total	
	Male		Female		No.	%
	No.	%	No.	%		
<= 2	6	2.3%	33	49.3%	39	11.7%
2.1 - 4	93	35.1%	32	47.8%	125	37.7%
4.1 - 6	124	46.8%	2	3.0%	126	38.0%
6.1 - 8	40	15.1%			40	12.0%
> 8	2	0.8%			2	0.6%
Total	265	100.0%	67	100.0%	332	100.0%



According to the sex in general we can notice that the concentration of lead in male blood is more than in females . We have 97. % of males have the average concentration in their blood is between 2.1-8 µg/dl as well as 97.1 % of females is between 0-4 µg/dl.

The Health Effects of Lead in Gasoline

Sana'a, Yemen
March 14, 2007

Michael P. Walsh
International Consultant
Board Chairman, International Council on Clean Transportation

http://walshcarlines.com

Outline

- Lead in Gasoline
  - Why Lead Was Added
  - Why A Consensus To Eliminate It
    - Direct Health Benefits
    - Allows Advanced Technology to Clean Up Other Pollutants

Why Was Lead Added To Gasoline

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

We Have Learned However

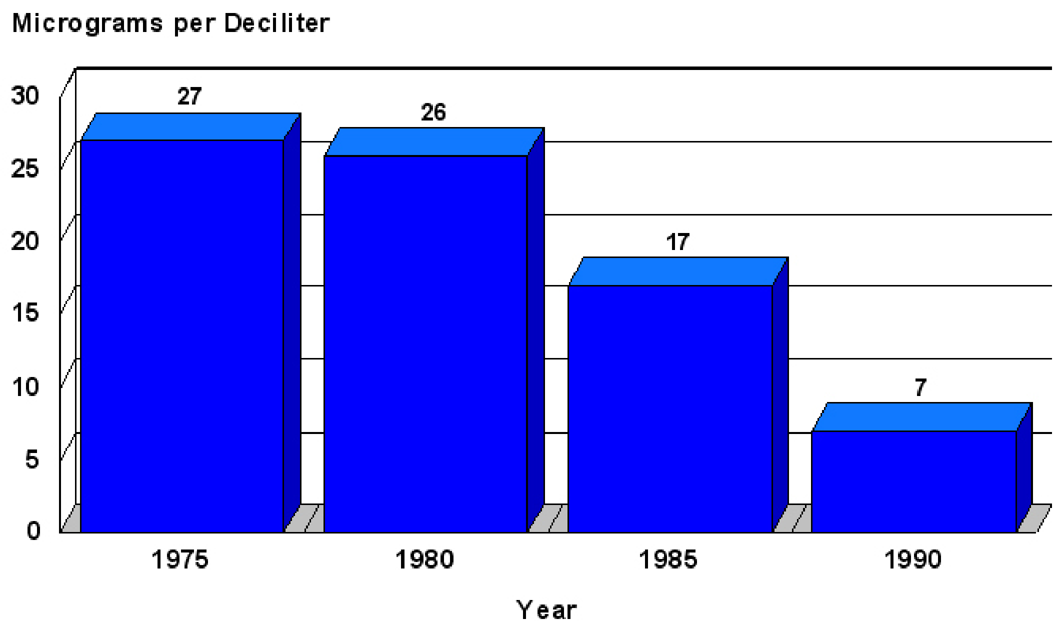
Lead In Gasoline Has Negative Side Effects

- 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

Why Do We Care About Leaded Gasoline?

- Concerns About Lead
  - Impairs development of brain function in children & lowers IQ
  - Causes cardiovascular diseases in adults
  - No safe level of exposure
- Concerns About Leaded Gasoline
  - Largest source of exposure in most urban areas
  - Effective dispersion to all environmental media
  - Long-term exposure by accumulation
  - Increasing problem due to high traffic growth

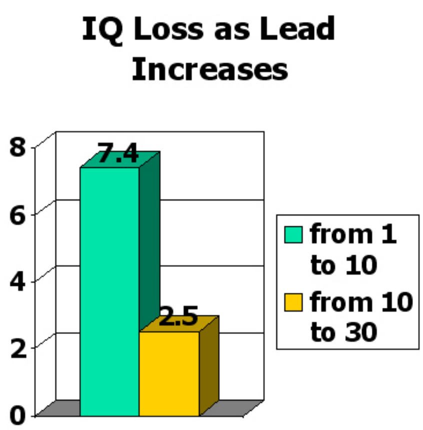
Blood Lead Levels Considered Elevated



Is Any Lead Acceptable From A Health Standpoint?

Largest Impact Occurs at Very Low Lead Levels

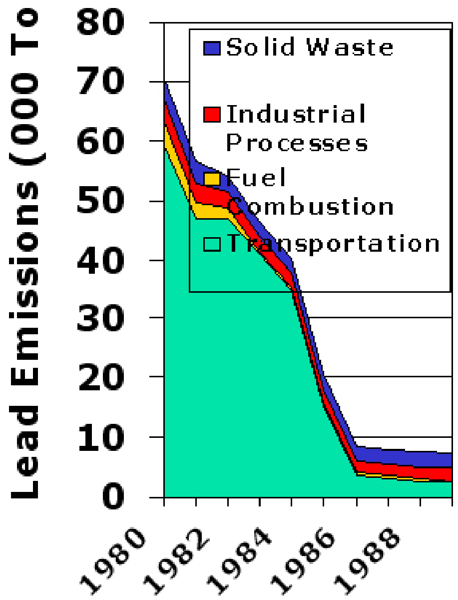
- New England Journal of Medicine (4/17/2003)
- 172 children tested at 6, 12, 18, 24, 36, 48, 60 months
- Corrected for confounding variables
- 101 children never above 10µg/dl
- Blood lead significantly associated with I/Q



Children Are Especially Susceptible To Adverse Health Effects

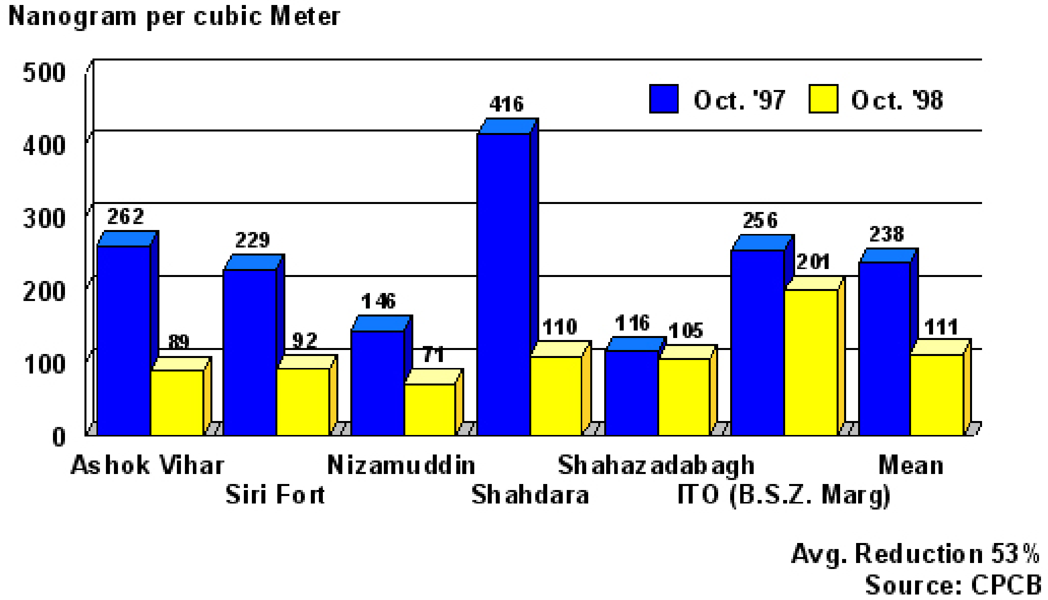
- increased likelihood of exposure,
- increased absorption, and
- increased susceptibility of the brain.

Trend in Lead Emissions and Air Quality in the US



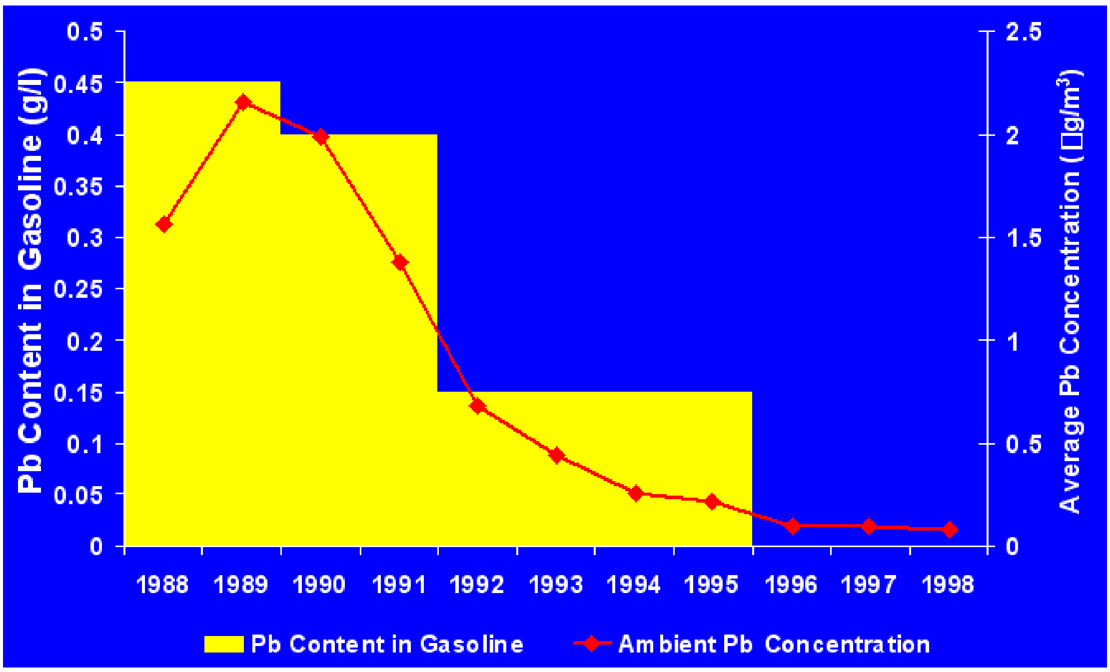
- 87% Decrease in Average Ambient Lead Levels in 189 Urban Sites Over This Same Period
- Median Blood Lead Level Declined From 9.2 to 2.8 micrograms/dL

Ambient Particulate Lead in Delhi Pre and Post Unleaded Petrol

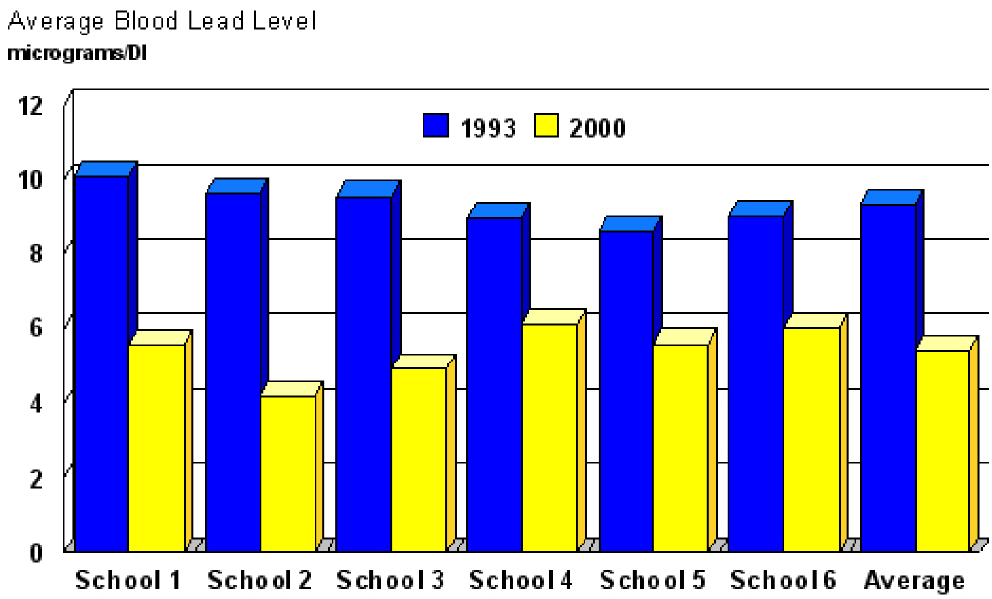


Lead Phase Out Started in September 1998

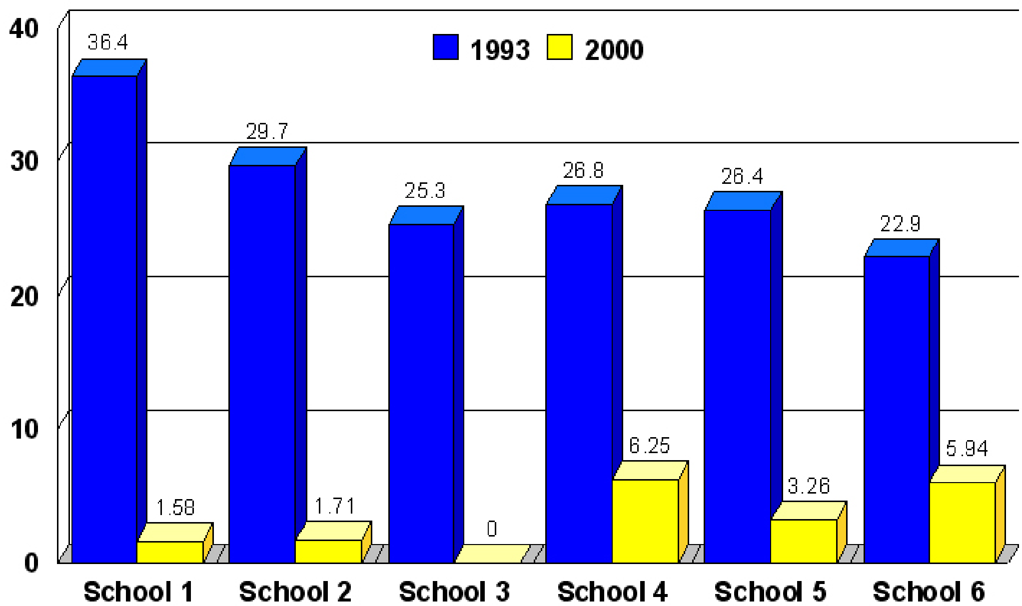
Ambient Pb Concentrations in Bangkok and Pb in Gasoline from 1988 - 1998



Comparison of Average Blood Pb Levels in Children at 6 Schools in Bangkok between 1993 and 2000



Percentage of School Children with Blood Pb Levels Above 10 micrograms/dl



The Magnitude of Health Impacts

- Losses of 4 or more IQ points in 30,000-70,000 Children in Bangkok
- More than 800 Infants and 10,000 Adult Deaths Annually in Cairo
- More than 150 Premature Deaths Annually in Jakarta

The Cost of Health Impacts

- Reduced Productivity and Lifetime earnings
- Increased Medical Costs
- Compensatory Education Costs
- Premature Deaths of Infants and Adults

An Estimated $17 Billion for each 1 ug/m3 Increase in Ambient Airborne Lead in the US

Cost Effectiveness and Policy Implications

- Phasing out Lead from Gasoline is Highly Cost-effective (In the US, the Benefits Outweighed Costs more than 10 Times)
- Benefits Justify Rapid Phase-out - Faster than Car Fleet Replacement

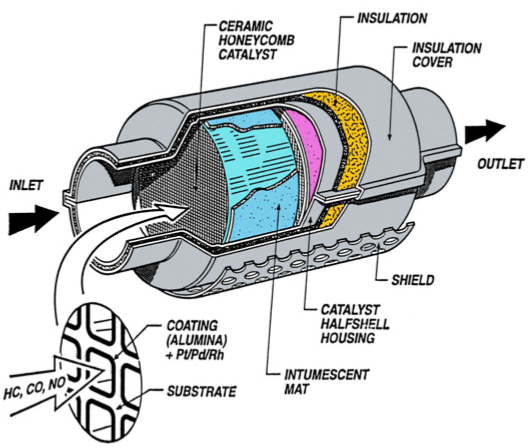
Unleaded Gasoline: Gateway To The Future

- 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

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

The Three-way Catalytic Converter: A Familiar Technology Re-Engineered for High Performance in Close-coupled and Underfloor Applications



- Layered washcoat architectures and support materials with high thermal stability
- Integrated HC adsorption functions
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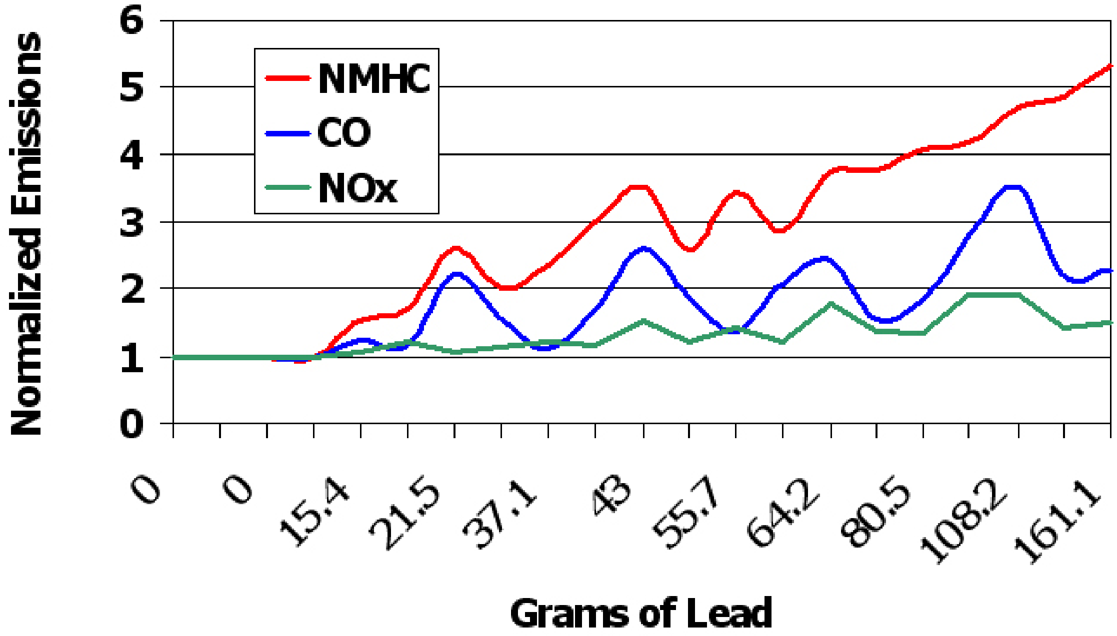
- High cell density ceramic or metallic substrates
- Insulation schemes for heat management

Impact of Lead on Catalyst Performance



Health Effects

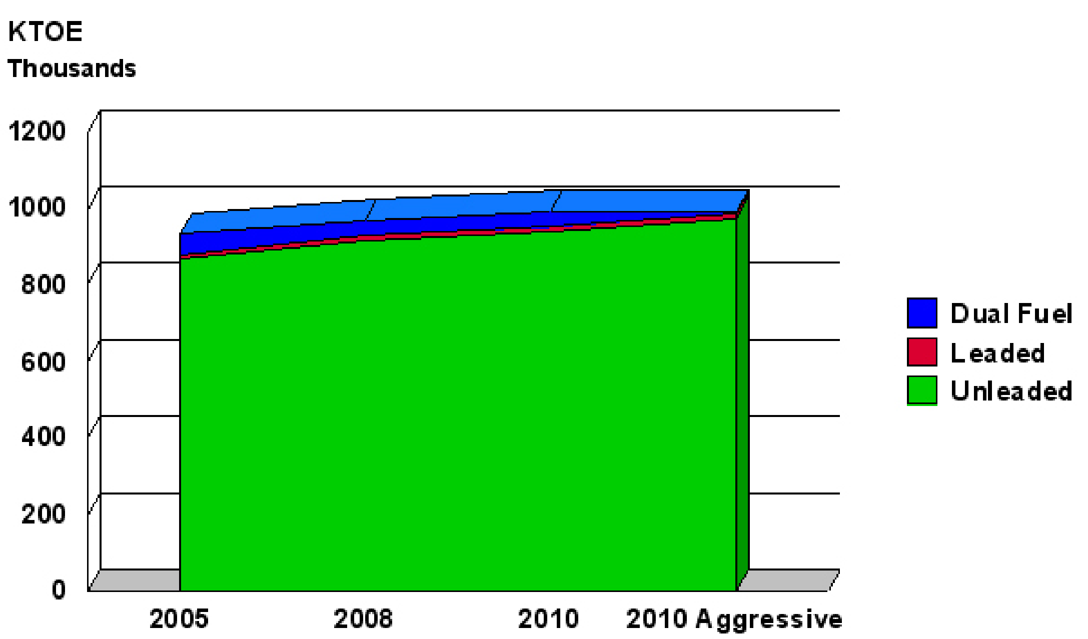
- Different Pollutants have Different Effects
    - Carbon Monoxide - circulatory system, heart
    - Ozone - respiratory system, lung
    - PM - lung, potential effects on heart
    - Diesel, Air Toxics - cancer, respiratory effects
- There are potential effects of the Mixture
- Some Populations more sensitive than others
    - elderly
    - people with heart and lung disease

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

Global Distribution of On Road Unleaded Gasoline



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

Regional Perspectives on Cleaner Fuel - Phasing Out Leaded Gasoline

Basel Al-Yousfi, Ph.D., PE, DEE
United Nations Environment Programme
Regional Office for West Asia

National Commitment Building to Phase out Leaded Gasoline in Yemen

Sana'a, Yemen, 14-15 March 2007

Transportation Systems and Air Quality

(Global)

• Vehicular Population is > 700 million ⇨ 1 billion (soon). ~ 11.5% Increase 1995-2000.

• Kilometers traveled (per capita per year) Tripled (since 1970).

• Transportation consumes 25% of world Energy & 50% of Oil.

• Fuel Consumption for Transportation Doubled (since 1970), is 18 MB ⇨ 27 MB (2010), 50% increase in 10 years (1.5%/year Developed & 3.6% Developing Countries).

• Fuel Consumption for Transportation (1550 MTOE/year): ~ 40% Diesel & 60% Gasoline (<2% Alternative Fuels) .

• WHO: Only 15% of Cities in Developing Countries have acceptable air quality.

- ~460,000/year Die Prematurely because of Air Particulates.

- US EPA: 60% of annual cancers are due to Air Pollution from Automotive Emissions.

Good News…

- 1970 Emission : 100 gr./km of CO+HC+NOx to Standards of 2-3 gr./km in Year 2000 (almost ZERO in 2005)
- 95% of World Fuels Consumption is Unleaded

Transportation Systems and Air Quality

(Regional)

• Vehicular Population in the Arab Region is > 20 million (74 vehicle/1000 people).

• 12 vehicle/1000 in Mauritania to 408 vehicle/1000 people in Kuwait.

• 1980-1997 Increase 5% (Kuwait), 20% (Jordan), 68% (Tunisia).

• Arab Transportation Sectors Exceeds 25% of Total Energy Use.

• 20 Years Consumption Increase 240% Versus 32% Increase in the World.

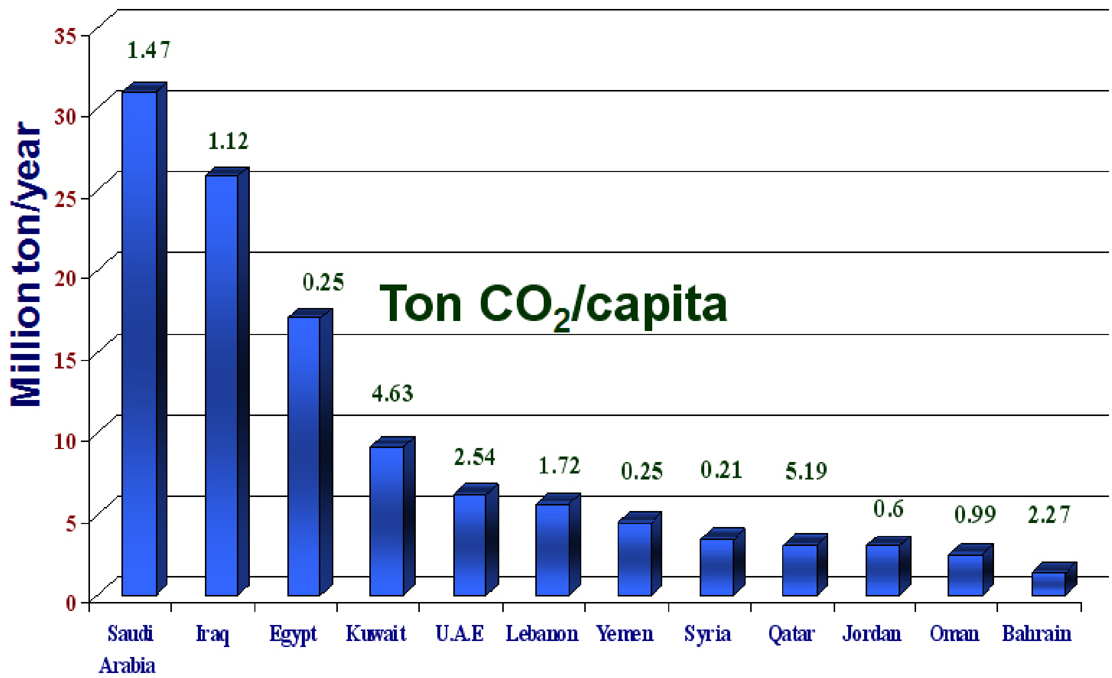
• >90% CO Emission (~ >16 million ton/year) from Vehicular Transportation.

• Arab Motor Vehicle Emit > 1.1 million ton/year of NOx (40% of total).

- Emit > 3 million ton/year of HC (70-80% of total).

- Emit ~50% of total atmospheric lead emission (decreasing).

CO2 Emissions in the Transport sector of some Arab Countries (2000)



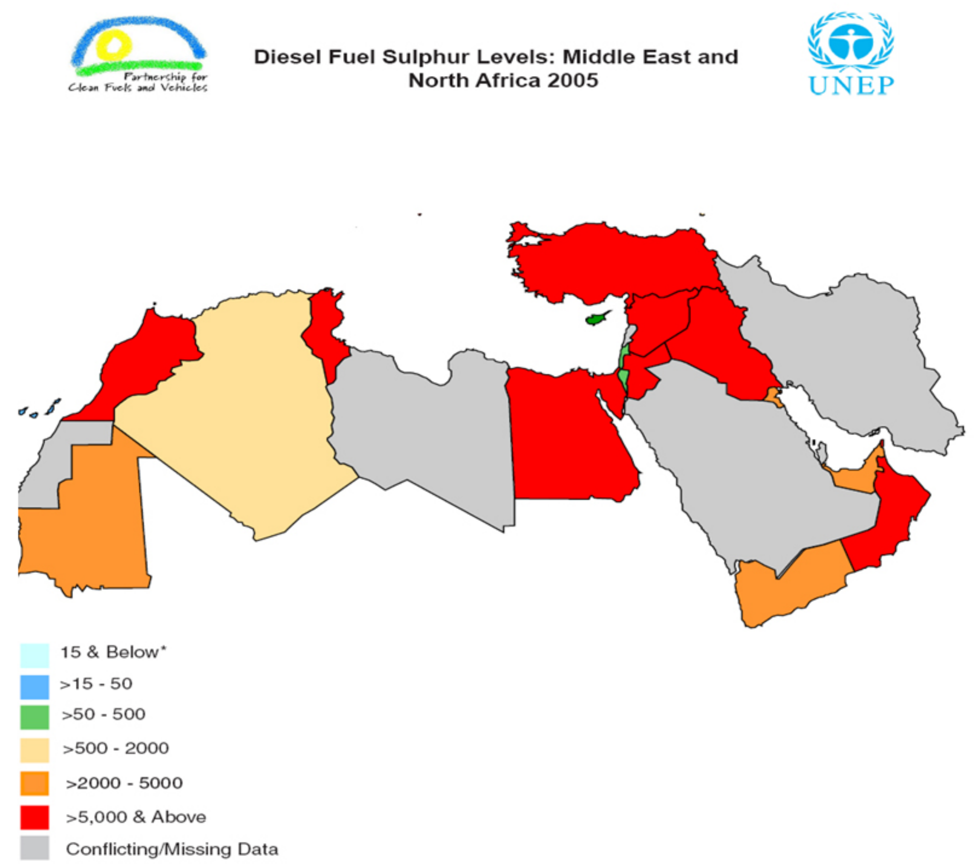
Good News…

• Arab States to phase out Leaded Gasoline in 2008 & decrease S in Desiel. (CAMRE, 2006)

• GCC Set 2003 Deadline for Lead Gasoline Phase-out (Kuwait done in 1998), but Still Exists (Morocco, Iraq, Jordan, Yemen,etc.).

• Lebanon Band Diesel Vehicle in Urban Centers (Beirut, 2002) .

• Egypt Shifting towards NG in Mass Transport: Egypt has about 30,000 NGV (2.2% of world fleet).



Mitigation Measures-Technological Options

- Fuel Options:
  - Cleaner Fuels
  - Alternative Fuels
- Automotive Improvement Options:
  - Options for New Vehicles
  - Options for In-Use Vehicles

Mitigation Measures-Cleaner Fuels…Cleaner Air

- Lead Phase-Out
- Sulfur Content Reduction
- Aromatic, HC, Olefins Reduction
- Increase No. of Octane and Cetane. Oxygenates additives. MTBE??
- Reformulation, Refining Improvements.
- Fuel Alternatives (LPG, CNG, Ethanol, Fatty Acid Methyl Ester, Ethyl-tertiabutyl ether).

Historical Changes in Gasoline Specifications (EU)

Specifications	98	99	2005	Recommendations WWFC 97	After 2005
Sulfur (ppm)	500	150	50	10-5	<10
Benzene (%)	5	1	1	1	1-0.5
Aromatics (%)	-	42	35	35	35-25
Olefins (%)	-	18	18	10	15-10
Oxygen(% wt.)	-	2.7	2.7	-	-

Historical Changes in Diesel Specifications (EU)

Specification	93	98	99	2005	Recommendations WWFC 97	After 2005
Sulfur (ppm)	2000	500	350	50	10-5	10>
Density (Kg/m^3)	860	860	845	845	820-840	840-820
Min. No. of Cetane	49	49	51	51	52	55-51
(.PAH (% wt	-	-	11	11	2.0	3>

Mitigation Measures- Management Options

- Transportation Supply Management (TSM):
    - TSM measures to enhance capacity and throughput, and traffic flow and operations
    - TSM measures to restrain traffic flow and throughput

- Transportation Demand Management (TDM): include a variety of measures to reduce individual transport and change transport demand types.

What is Next…

- Build Capacity & Partnerships Globally & Regionally, including Initiatives (PCFV).
- Steer Technology Transfer and use of advanced and environmentally friendly fuels & technologies.
- Increase the reliability and availability of Information and experience.
- Obtain Political Commitment (Yemen,CAMRE-18th) & foster National & Regional Strategies.
- Catalyze Policy Changes & Sound Management.

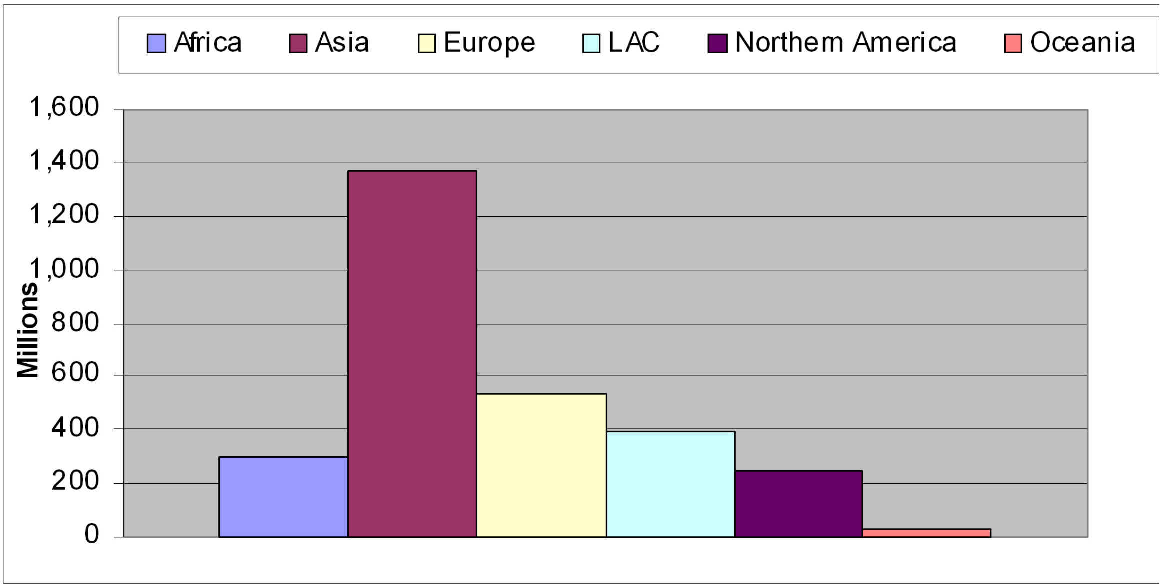
Partnership for Clean Fuels and Vehicles:An Overview

Shoa Ehsani

UNEP

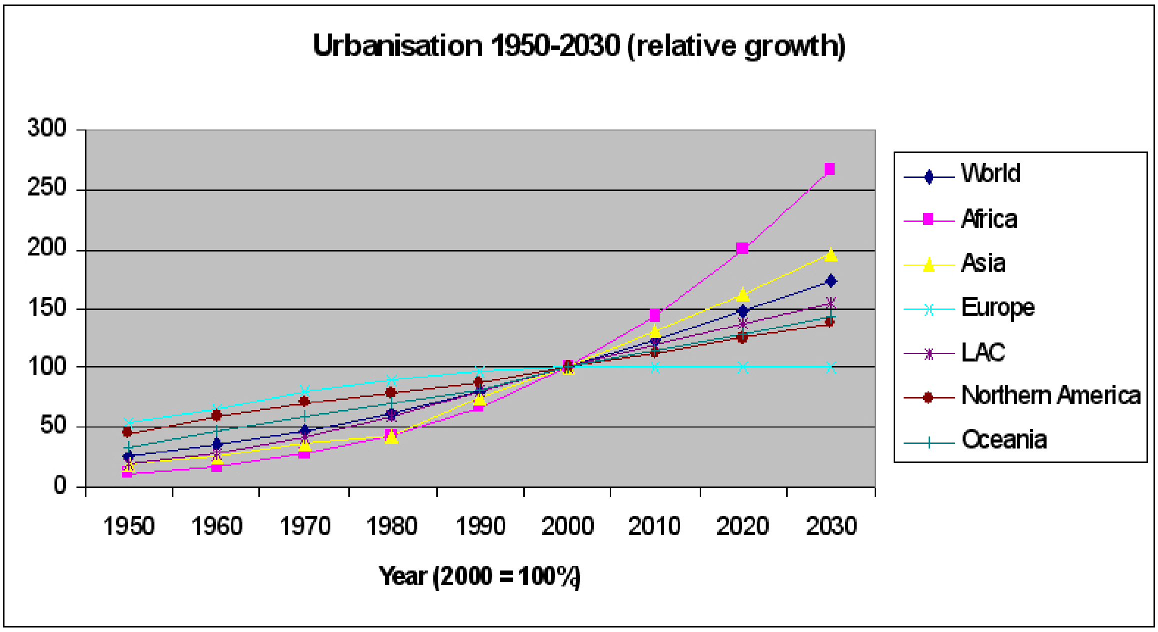
March 14, 2006

Urban Populations – by Region



Urban populations in 2000, by region

Urbanisation by Region



Urban Air Pollution issues in Yemen

- Fast paced vehicle and population growth, high population and vehicle densities in cities.
- Leaded gasoline use and hence lack of catalytic converters in petrol vehicles
- Large portion of vehicles run on diesel with high fuel sulphur content resulting in substantial PM & other pollutant emissions and inability to use aftertreatment.
- Aging vehicle fleet. Slow driving speeds.
- Proximity to desert makes PM pollution and visibility issues more pronounced
- Some aging refineries can't produce low sulphur and/ or unleaded fuels

Strategies to Reduce Transportation Emissions in Urban Areas

Environment and transport strategies:

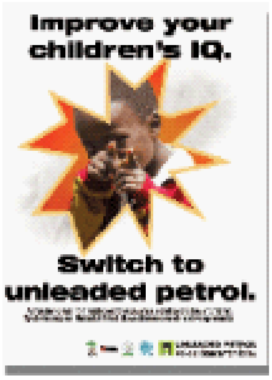
- Modal splits (subsidies & new modes)
- City planning
- Promoting non-motorised transport
- Promoting public transport
- Cleaner fuels and vehicles

PCFV Established

• Set up at the World Summit on Sustainable Development, August 2002

• To promote clean fuels and vehicles to address urban air quality

• Public–private partnership



• Clearing-House at UNEP Headquarters in Nairobi, Kenya

PCFV Objectives

“The elimination of lead in gasoline and the phase down of sulfur in diesel and gasoline fuels, concurrent with; the adoption of cleaner vehicle technologies”

website:
www.unep.org/pcfv

PCFV Partners

- 90 Partners to date
- From 5 continents
- Organisations:
  - International Organisations
  - Governments
  - Industry
  - NGOs
  - Institutions of Higher Learning

OTHERS

INDUSTRY

GOVERNMENTS

NON-GOVERNMENTAL ORGANISATIONS

INTERNATIONAL ORGANISATIONS

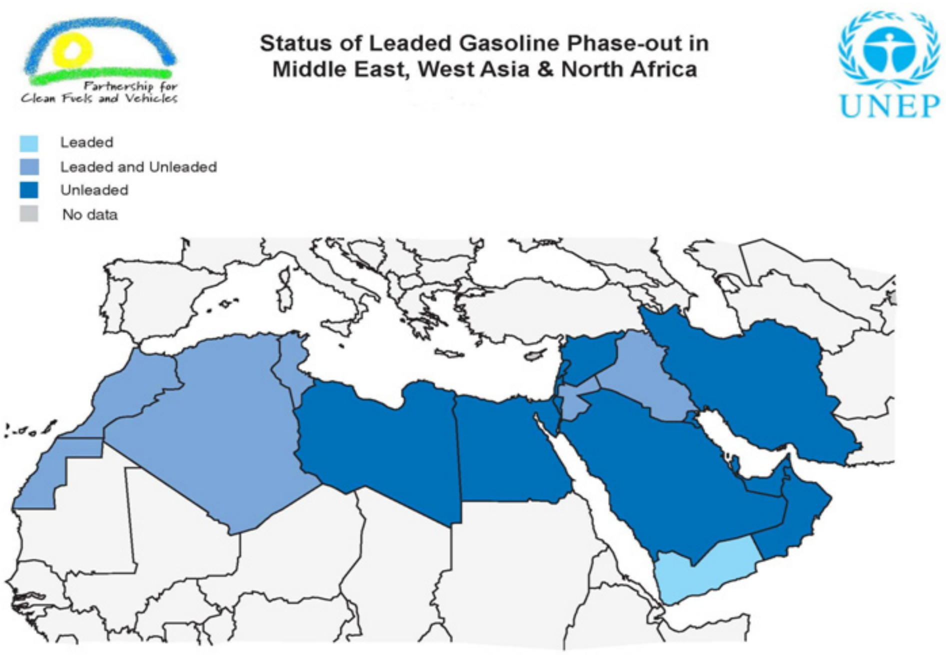
Key Pollutants: Lead in Gasoline

- Lead is added to gasoline to enhance octane
- Lead has severe health effects
- Blocks clean vehicles technologies, esp. introduction catalytic converters
- Alternatives available
- Lead phased-out from gasoline is almost global
- Sub-Saharan Africa fully unleaded. Middle East, North Africa and Asia still using lead.

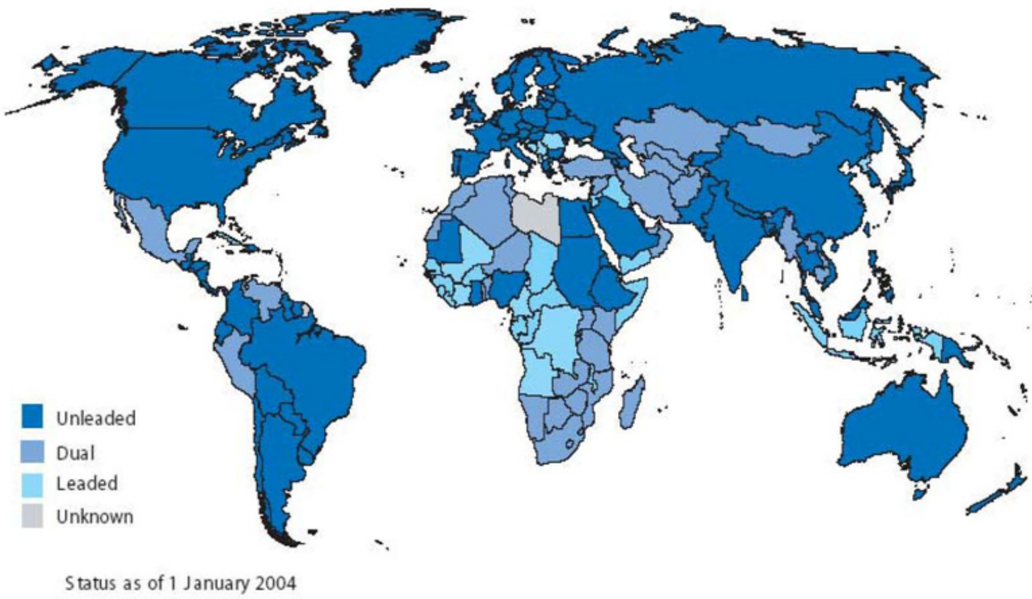
Leaded Gasoline: Health & Environmental Effects (example Egypt)

- 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
- Damage to cars (spark plugs, filters…)
- Egypt went unleaded

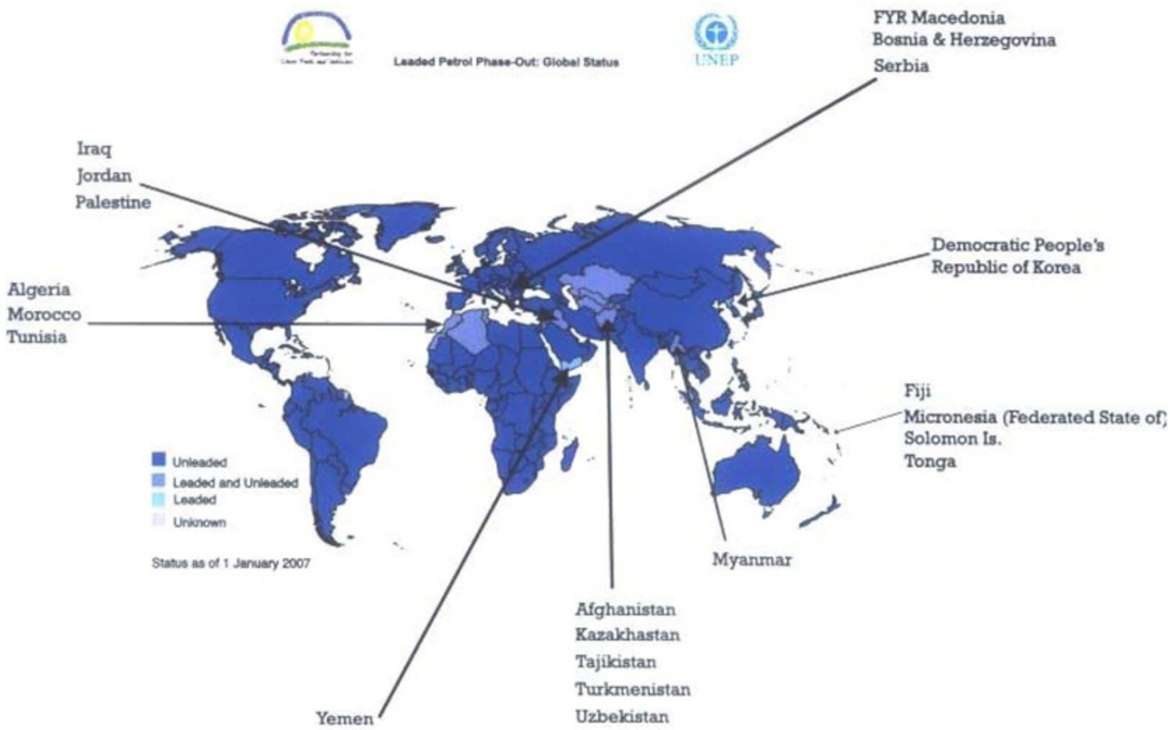
Leaded Gasoline Use in the Middle East 2007



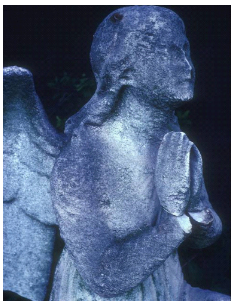
Leaded Gasoline 2004



Leaded Gasoline 2007



Sulfur: Health & Environmental Effects



- Sulfur: bronchitis, asthma
- PM: Cardio-respiratory problems and some carcinogenic constituents
- Sulfur and particulate problems (visibility)
- Damage to plants and buildings
- Acid rain
- Vehicle engine & component damage

Objective 3: Clean Vehicles

- Need to see fuels and vehicles as a system: certain vehicles need certain fuels and vise-versa
- Need to look at fuel-vehicle combination per region; every situation is unique
- Vehicles - Options:
  - No or ultra low emission vehicles
  - Conventional vehicles
  - Retrofit vehicles

PCFV Substantive Activities

- Global level
  - Working groups
- Regional level
  - Regional action plans
- Sub-regional
  - Sub-regional workshops
- National level
  - Direct support
- Global Working groups:
  - Valve Seat Recession
  - Octane
  - Sulfur
  - Public Awareness
  - In-use Vehicles (New)

Economic Impacts by Leaded Gas in Yemen

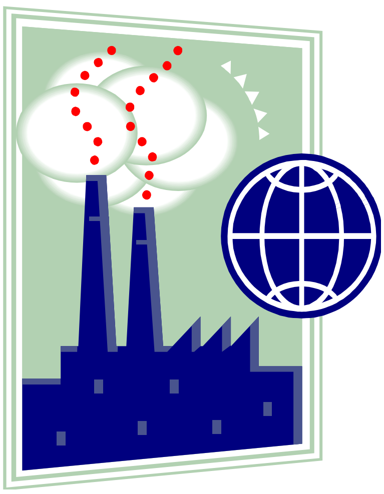
By: Aidrous Bazara

Economic Side

- This issue is about health and Environment at the first place

- Economic side is less important

1. Vehicles Issue



- Major auto makers committed to produce only Environment Friendly Vehicles
    - Better emission
    - Better fuel consumption

- New Hydride Vehicles
    - Only 10% fuel consumption

Whom to blame!

- Major pollution come from the transportations
- But major Auto makers already converted to unleaded fuel long time ago
- Some countries are so late to convert to unleaded

What's needed

Simple equation:

1) New generation engines

2) + Unleaded fuel

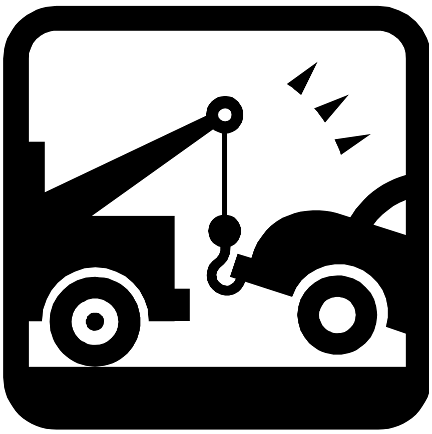
3) = better emission

What else

- High octane level
  - Now 96 RON required for new cars
  - Near future above 100 RON expected

If we use leaded gas in new Engines

- Engine design + Octane
  - Knocking valve
  - Minor damage
  - Major damage
  - Carbons built-up
  - Engine computer compatibility



If we use leaded gas in new Engines

- Catalyst Converter
    - Damage & required frequent replacement
    - High fuel consumption
    - Bad emission

Prioritize the issue

- Nothing more important than health
- Fun can be secure by:
    - Current high crude price:
        - Government support
    - Loan or financing
    - Private sector
- Only 18 county remain leaded
    - Most low income countries already converted

Source of leaded fuel !!!

- Some converted countries still producing leaded fuel
  - They don't want to upgrade their refineries
  - To export it to leaded countries!!!

Economic Implications In Yemen

- Major Auto makers already stop exporting some models to Yemen
- More models to be blocked in the future

Consequences

- In direct import
- Trade balance deficit
- Lost of financial grants $$$
- Yemen official car distributor cannot import otherwise because:
    - Engine compatibility with fuel
    - No warranty

Consequences

- Consumer trouble:
    - Frustration from frequent breakdown
    - Lose money for parts & repair
- Unfair Bad reputation for the auto makers

Consequences

- Tourism
  - GCC countries tourist will not come by their cars.
  - Their cars will face engine problems
- Yemeni immigrants:
- Will face problems when they visit their country by cars

Consequences

- Increase demand for used cars
  - Outdated cars
  - Leaded engine
  - Frequent maintenance
  - High consumption of Parts
  - Consume more hard currency $$$

Consequences

- Low government income:
  - Small car traders
  - Less income tax revenue
  - Less sales tax revenue

What should be done

- Political intention to go over this chronic problem
- come up with set of laws and legislations in this respect
- Import fuel immediately and partially subsidies the price.
- impose new technical standard for all new vehicles
- Short & long term plan to go total phase out
- E10 & beyond

Work Together

- Help each other financially and technically
    - North America
    - EU
    - GCC
    - Africa
- Set targets & deadlines

Cleaning Up Gasoline Fueled Vehicles

Sana'a, Yemen
March 14, 2007

Michael P. Walsh
International Consultant
Board Chairman, International Council on Clean Transportation

http://walshcarlines.com

Outline

• The Problem of Motor Vehicle Pollution

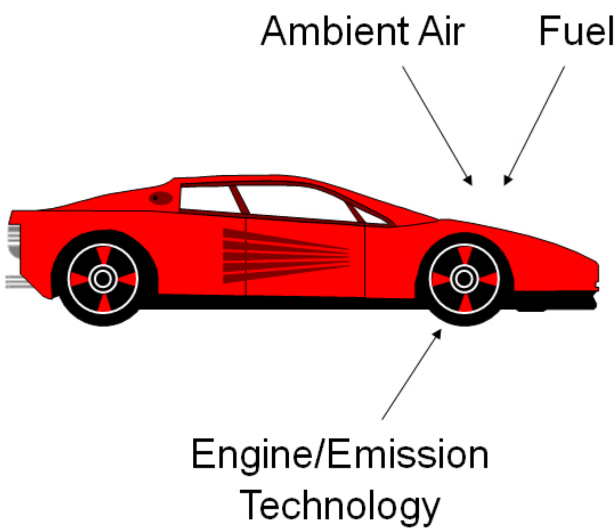
• A Comprehensive Control Strategy

• Adding Lead Must Be Stopped; Alternatives Are Available

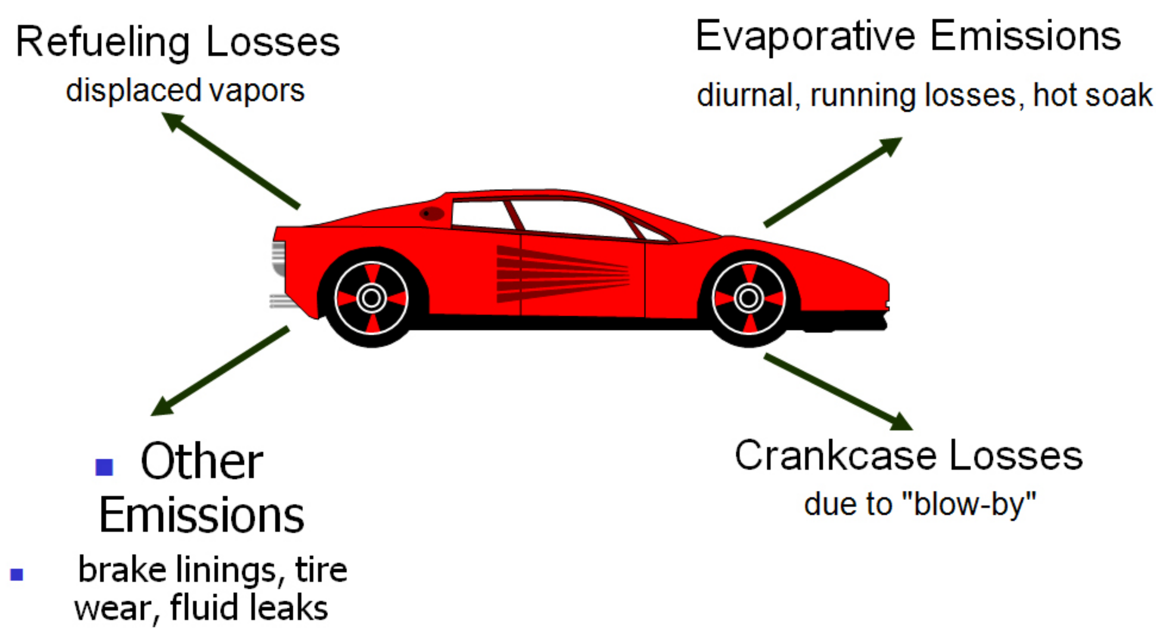
• Inspection & Maintenance Also Important

Combustion Emissions

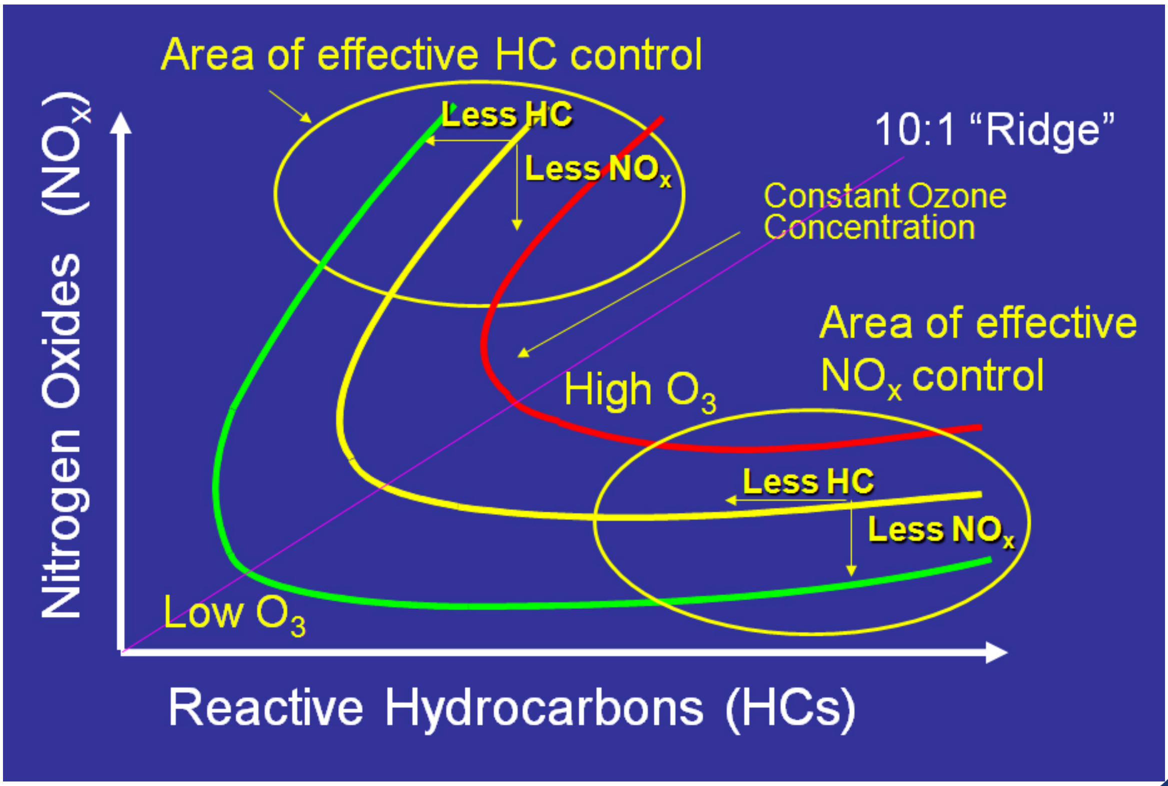
• Lead
• Hydrocarbons
• Carbon Monoxide
• Oxides of Nitrogen
• Carbon Dioxide
• Particulates
• Other toxic pollutants
• Water Vapor



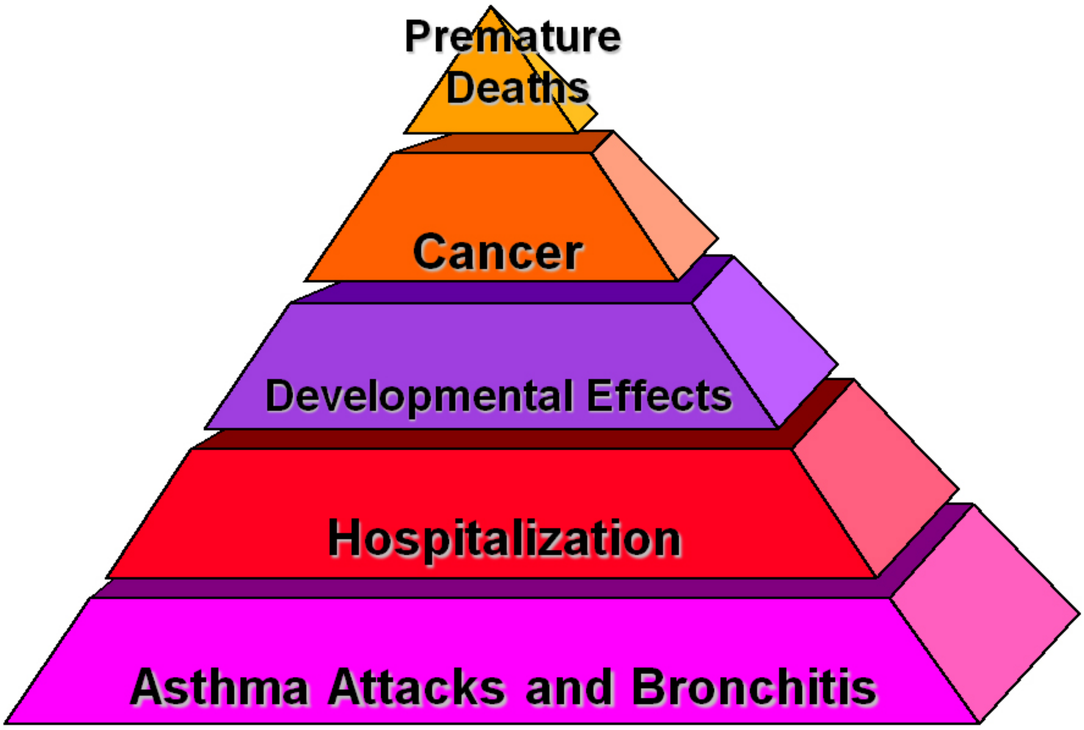
Other Emissions



Ozone Isopleth Plot (EKMA Diagram)



Health Impacts of Air Pollution



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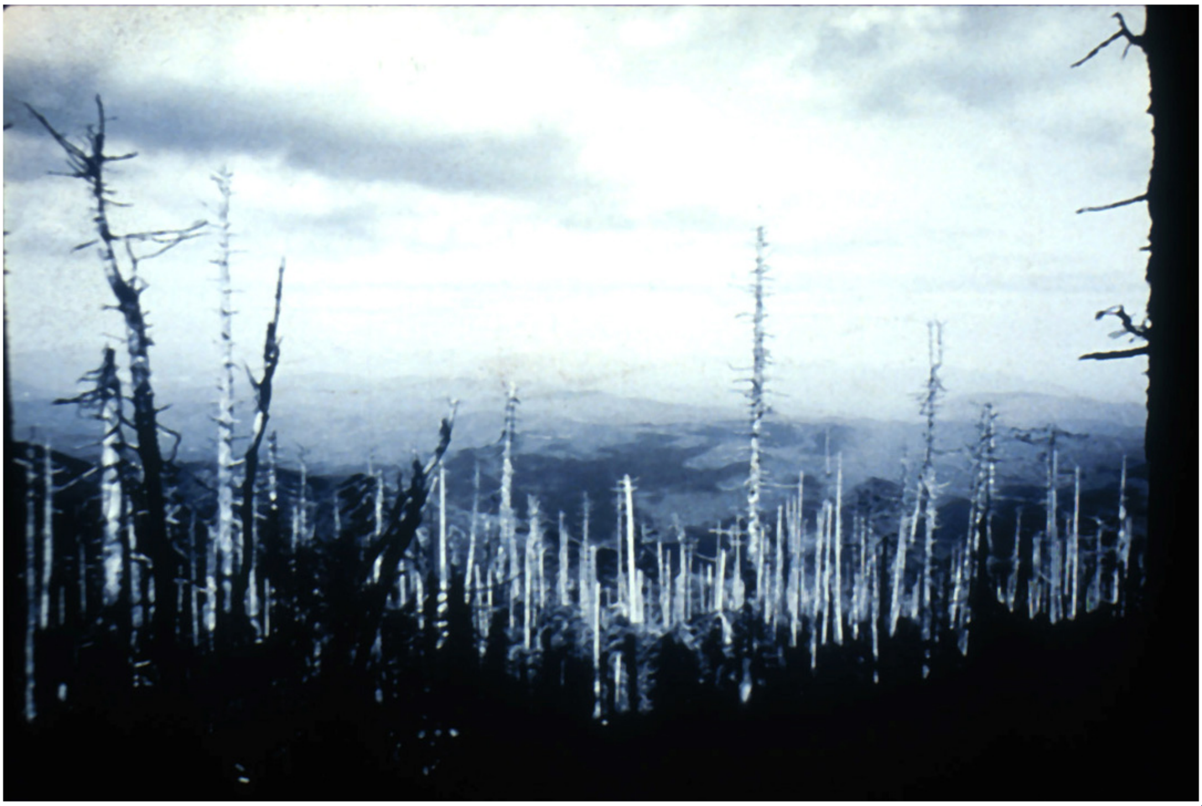
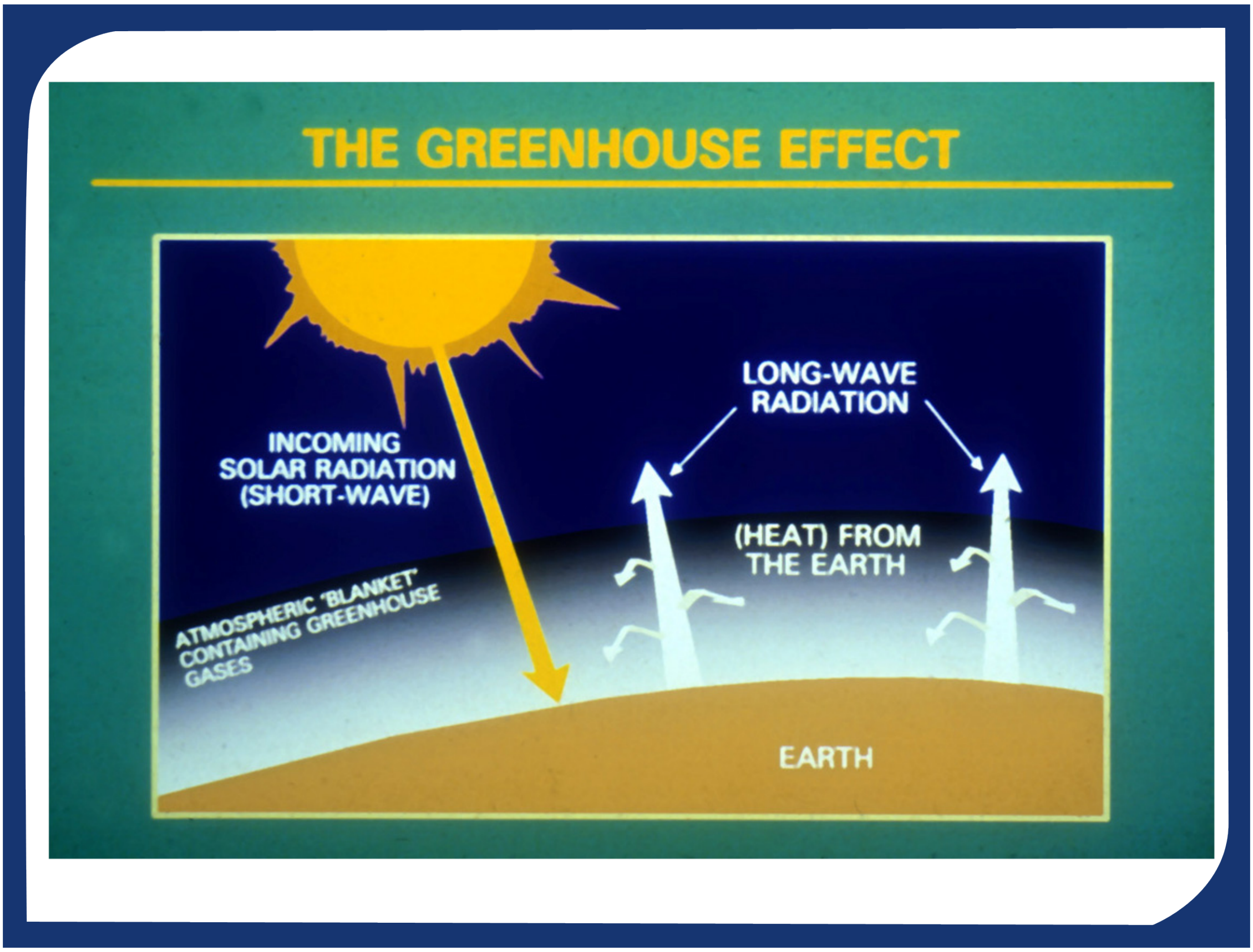
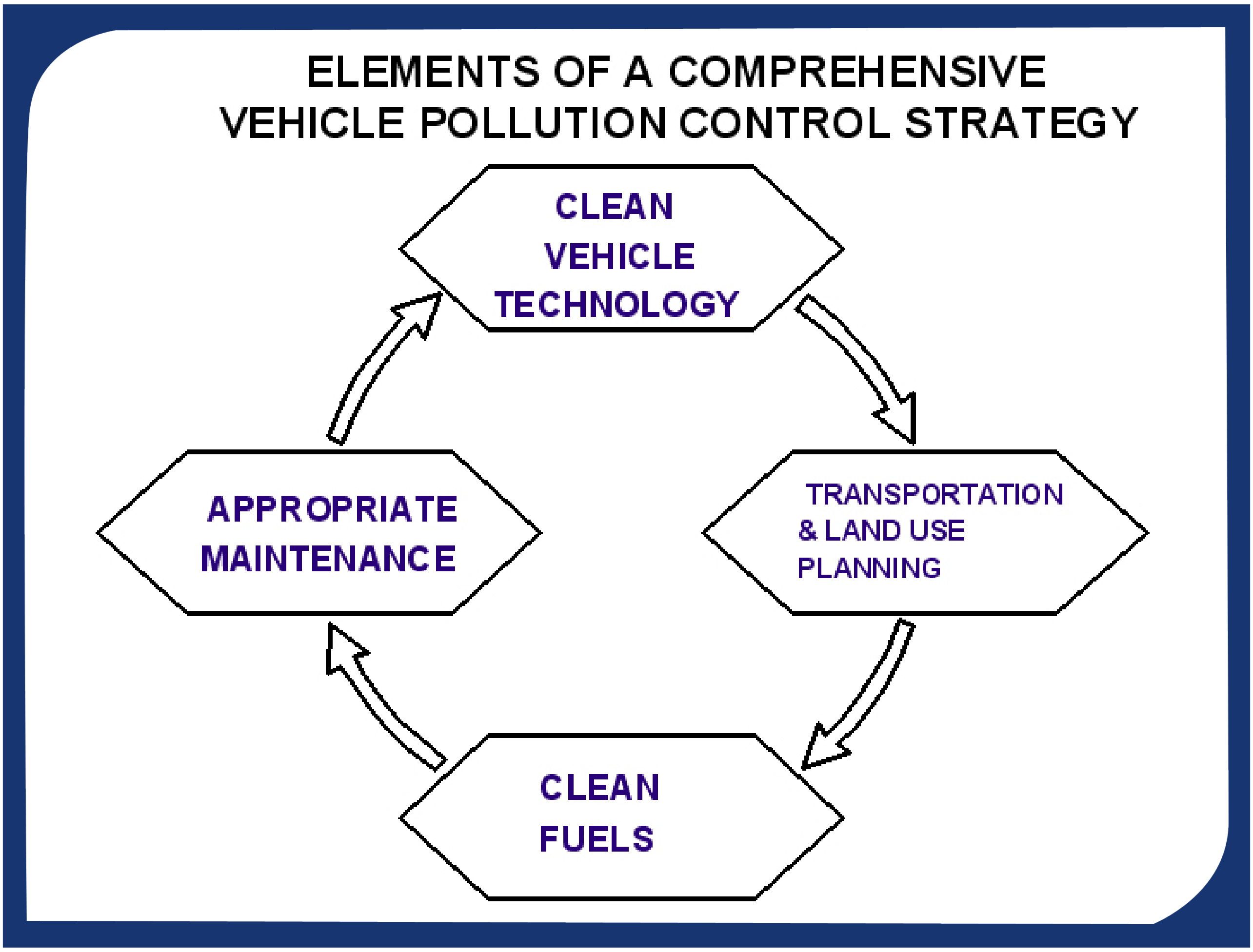
  - Ozone - respiratory system, lung
  - PM - lung, cardiovascular damage
  - Diesel, Air Toxics - cancer, respiratory effects
- There are potential effects of the Mixture
- Some Populations more sensitive than others
  - elderly
  - people with heart and lung disease

Special Population Exposures

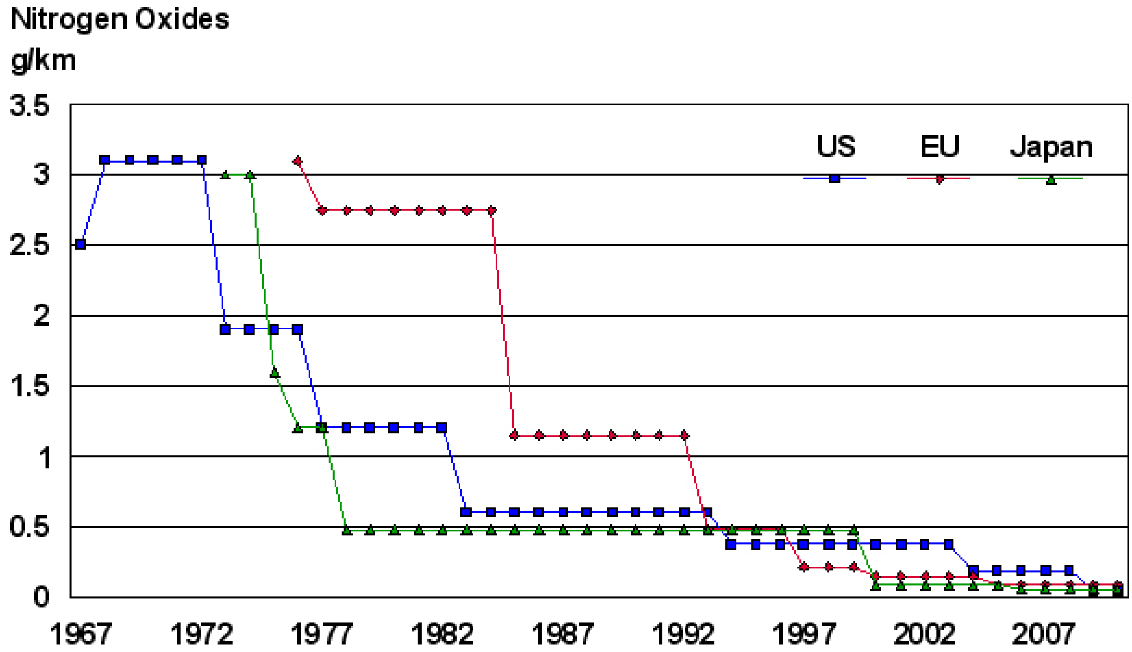
- Average Annual Levels Can Be Misleading
- In Urban Areas, there are Hot Spots:
  - Street canyons, roadsides, urban centers
  - Exposure levels for PM, diesel, CO, air toxics can be 2 to 10 times higher than average
  - Exposure levels for Ozone will be somewhat lower (NOx "scavenges" the ozone)
- In these settings, vehicle contribution will be higher



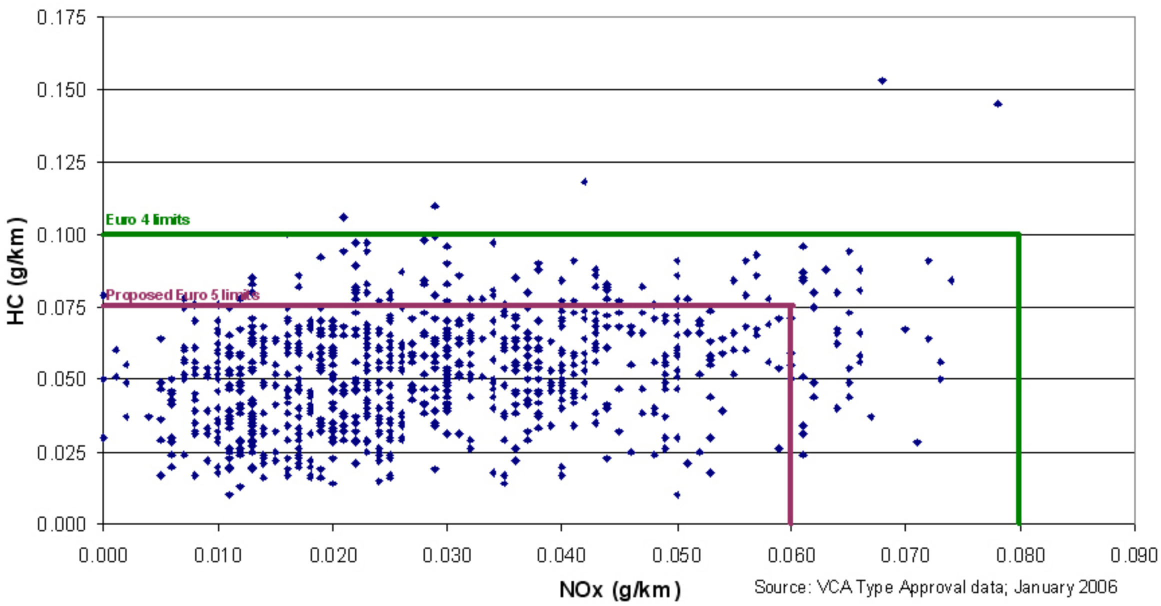

THE GREENHOUSE EFFECT
INCOMING SOLAR RADIATION (SHORT-WAVE)
LONG-WAVE RADIATION
(HEAT) FROM THE EARTH
ATMOSPHERIC 'BLANKET' CONTAINING GREENHOUSE GASES
EARTH


ELEMENTS OF A COMPREHENSIVE VEHICLE POLLUTION CONTROL STRATEGY
CLEAN VEHICLE TECHNOLOGY
TRANSPORTATION & LAND USE PLANNING
CLEAN FUELS
APPROPRIATE MAINTENANCE

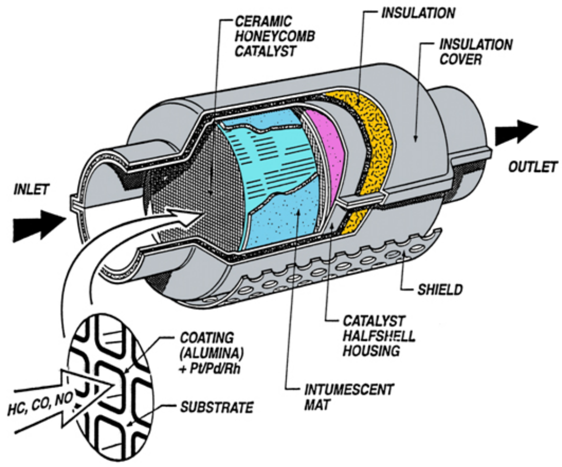
Emissions Standards Trends For Gasoline Cars



Type approval data for Euro 4 petrol



The Three-way Catalytic Converter: A Familiar Technology Re-Engineered for High Performance in Close-coupled and Underfloor Applications



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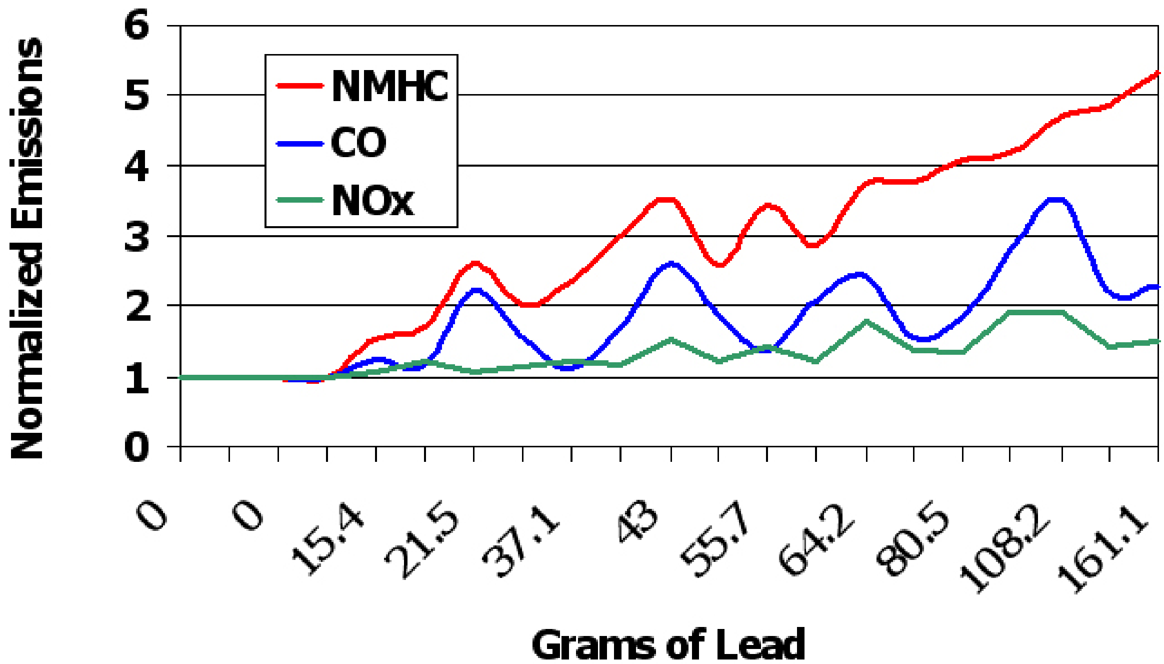
Impact of Lead on Catalyst Performance



Why Was Lead Added To Gasoline

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

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

Octane Can Be Enhanced By

- Blending in High Octane Components Such As Reformate, Alkylate
- Adding Oxygenates
- Adding Metallic Additives (Pb, MMT, Ferrocene)

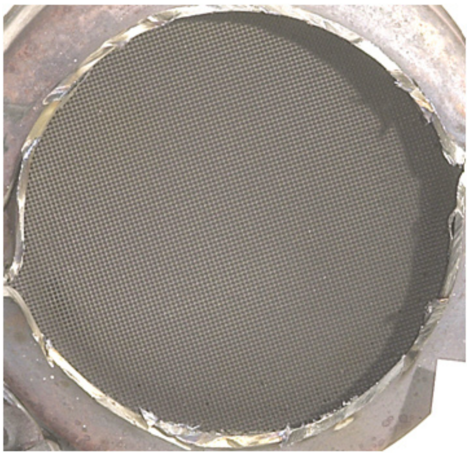
Criteria For Selecting Octane Enhancers

- Cost to Refiner
- Cost to Society
- Impact on Air Quality/Health
- Impact on Vehicle Pollution Controls

Another Metallic Additive (MMT)Has Entered The Marketplace – With Similar Concerns As With Lead

- Lowest cost lead alternative, octane response less than lead.
- 10-20% of the MMT derived manganese from the fuel is emitted from the tailpipe- the majority remains within the engine, catalyst and exhaust system
- Most major auto-makers recommend against using MMT, advising that any damage caused by MMT not covered by the warranty
- Because of Growing Concerns Regarding Adverse Health Effects of Manganese & Possible Damage to Advanced Pollution Controls, Very little MMT is Used in OECD Countries and it is Banned in India & Brazil

Don't Replace One Harmful Substance With Another



California Civic 600 cpsi catalyst - 49,000 miles

No MMT

Canadian Civic 600 cpsi catalyst - 49,000 miles

With MMT

Health Effects Institute Statement(December 2005)

- There is a large body of evidence that
  - under certain circumstances, manganese can accumulate in the brain,
  - chronic exposure can cause irreversible neurotoxic damage over a lifetime of exposure,
  - manganese may cause neurobehavioral effects at relatively low doses, and
  - these effects follow inhalation of manganese-containing particles.

HEI's Comments on the Afton Rebuttal; HEI is Much More Credible Than Afton.

Health Concerns With MMT Lead to the Brescia Declaration

- Scientific Committee on Neurotoxicology and Psychophysiology and the Scientific Committee on the Toxicology of Metals of the International Commission on Occupational Health (ICOH) convened an International Workshop; Scientists and physicians from 27 nations participated.
- Conclusions:
- Exposures of pregnant women and young children to manganese need to be reduced to prevent subclinical neurotoxicity.

• In children, evidence from two recent epidemiological studies suggests that exposure to manganese in early life causes subclinical developmental neurotoxicity.

• The addition of organic manganese compounds to gasoline should be halted immediately in all nations.

• New data raise grave concerns about the likelihood that addition of manganese to gasoline could cause widespread developmental toxicity similar to that caused by the worldwide addition of tetraalkyllead to gasoline.

Gasoline Blendstock Qualities

Example Properties of Gasoline Blending Components

Blending Component	RVP psi	Arom. %	Benz. %	Olef. %	Sulfur ppm	T50 degF	T90 degF	RON
Reformate	6	71	3	0	small	279	339	98
Alkylate	7	0	0	0	small	227	244	100
Butane	60	0	0	0	small	31	31	94
FCC Light	12	7	1	42	60	141	224	91
FCC Heavy	1	40	0	13	300	274	339	89
Light Straight Run	12	3	2	0	10	161	192	75
Hydrocracked Light	13	1	1	0	small	140	181	81
Isomerate	15	0	0	0	small	176	176	86
Coker Light	12	1	1	43	1800	109	164	78
Polymer Gasoline	9	0	0	100	small	170	334	97
MTBE	8	0	0	0	0	131	131	110
Ethanol	18	0	0	0	small	173	173	115

Gasoline is Made by Blending Many Components To Produce A Fuel With Acceptable Quality Considering Vehicle Performance and Emissions

Octane Replacement Options

- Refinery Processing
  - Reforming – Increase severity, moderate cost, increased benzene/aromatics, loss of volume, overall net producer of hydrogen
  - Isomerization - moderate cost, lower octane addition than reforming , volatility impact , reduced benzene, requires small amount of hydrogen
  - Alkylation - higher cost, favorable benzene/ aromatics dilution, high motor octane contribution to gasoline pool

- High Octane Blend Purchases
  - MTBE – High octane, low volatility, no sulfur, benzene or aromatics, widely traded on international market. Moderate to high cost
  - Ethanol – High octane, no sulfur, benzene or aromatics, high volatility, higher cost.
  - Other ethers (ETBE, TAME) - High octane, low volatility, no sulphur, benzene or aromatics, Moderate to high cost

Selected EU Fuel Quality Requirements

Requirement	1996 (Euro 2)	2000 (Euro 3)	2005 (Euro 4)	2009 (Euro 5)
Gasoline				
Vapour Pressure (Summer) max kPa		60	60	?
Benzene max Vol %		1	1	?
Aromatics max Vol %		42	35	?
Sulphur max ppm	500	150	50/10	10
Diesel				
Cetane Number min	48	51	51	?
Density max kg/m3		845	845	?
Polycyclic Aromatics max Mass %		11	11	?
Sulphur max ppm	500	350	50/10	10

Vehicle Inspection and Maintenance (I/M) Program

- Purposes:
  - To assure that vehicle is properly maintained and used
  - Identify Dirtiest Vehicles & get them repaired
  - Identify Unsafe Vehicles & get them repaired

- General attributes:
  - Relatively short
  - Relatively simple
- Test types
  - Idle
  - 2-Stage idle
  - Steady speed loaded
  - Transient loaded
- Variety of safety tests

  (not included in this presentation)

Emission Reductions

- Technical Status of Vehicle
  - New vehicle standards
  - Maintenance
- Fuel Quality (adulteration)
- Administrative Set Up For I/M
- Type of Test Method
  - Accuracy, Quality
- Cut Points (pass/fail criteria)

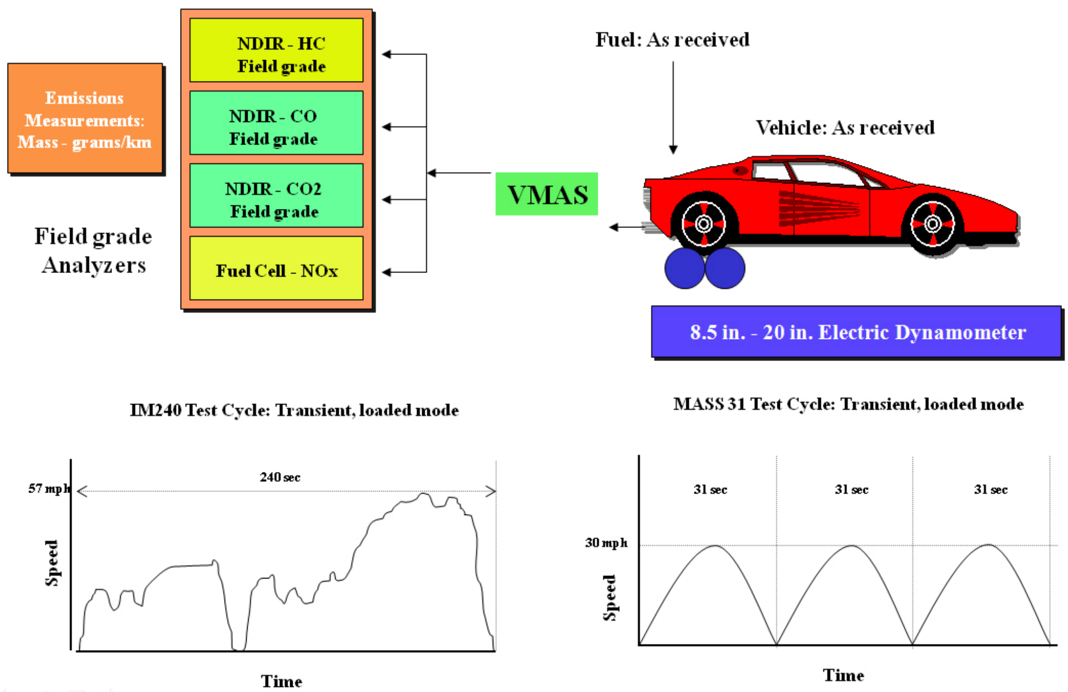
No – Load Tests (Idle)

- Fastest, cheapest and easiest to perform
- Effectively identify faulty vehicles w/o converter
- Not possible to measure NOx
- Not possible to measure transient emissions
- Detect only 15 % of high emitting vehicles with converter

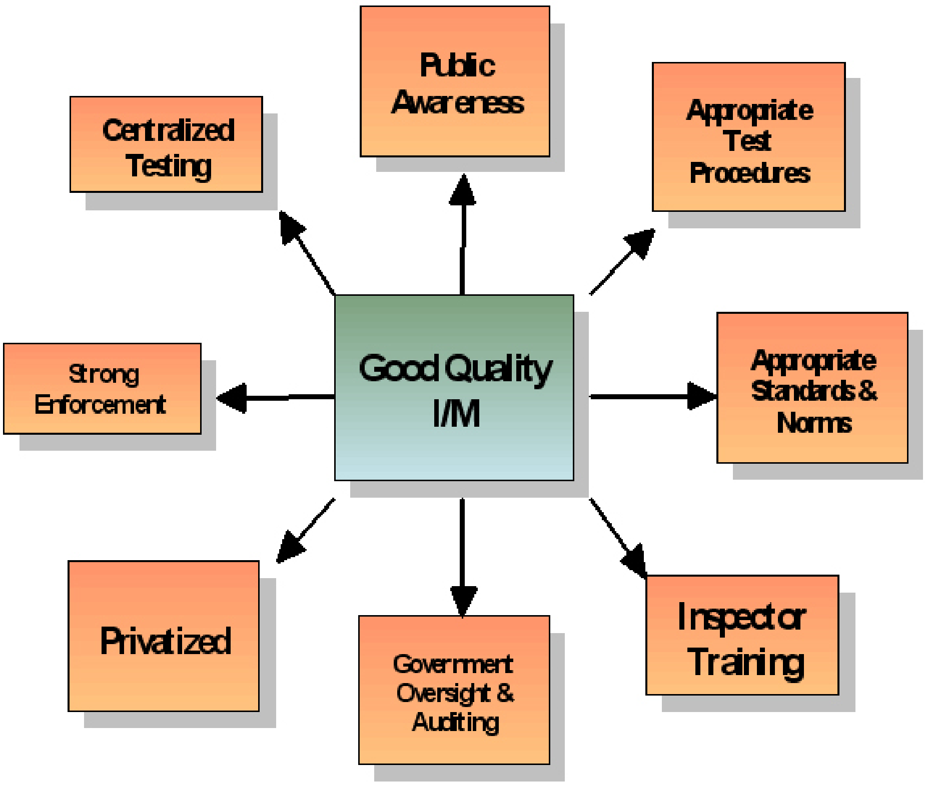
Steady-State Loaded Tests

- Possible to measure NOx
- ASM driving cycles simulates a car during acceleration
- Appropriate to inspect vehicles with converters
- “Type specific” cut points
- Test time app. 10 minutes

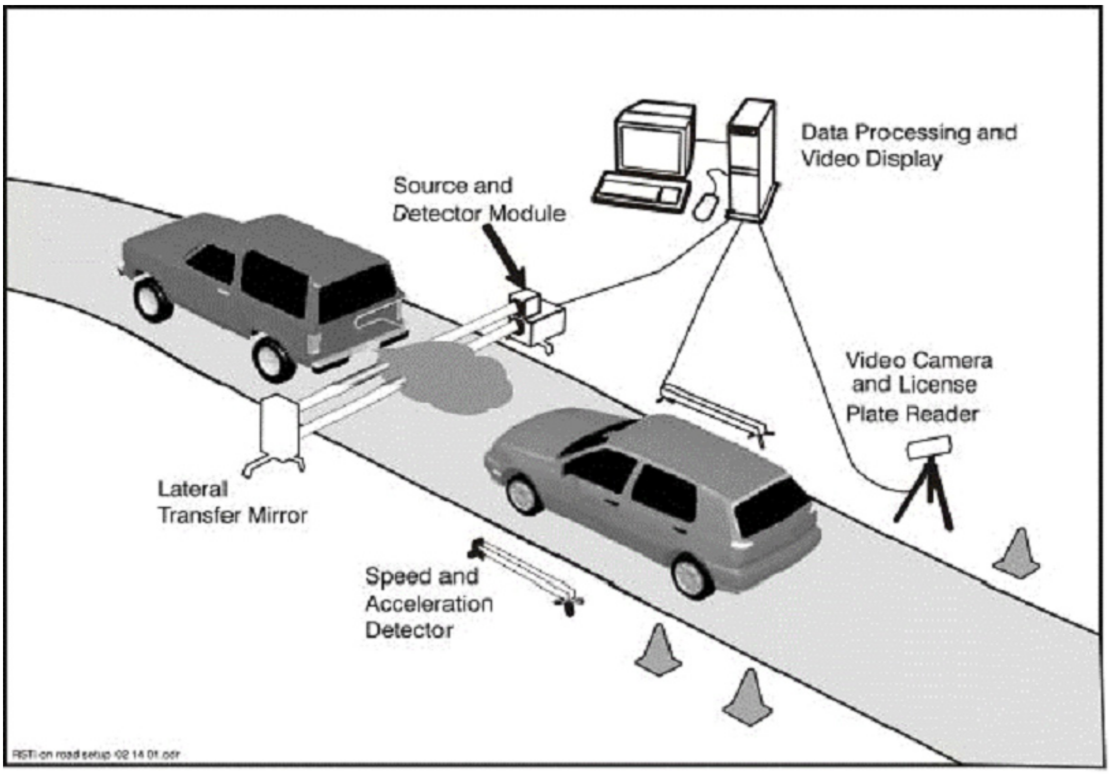
Test Type: Transient Loaded Test (VMAS)



Elements of A Successful I/M Program



Lay out of test site for Remote Sensing



CNG Car-Conversion in RAK / UAE - An experience

or

"Take the lead - without lead"

Agenda

- Who is “Salzburg AG Utilities“
- General Information CNG-Vehicles
- Conversion of Toyota Camry 2007
- Emission tests on engine test bench
- Further Conversion Options

General Information

Salzburg AG

Salzburg AG Utilities UAE

Multi Utility Supplier

- Salzburg AG Utilities UAE was established mid 2006 and offers the services and products of its Austrian parent company.
- Salzburg AG is a Multi Utility Energy supplier in Austria
- natural gas, power, district heating, telecommunication, water, internet, cable TV, public transport
- largest CNG-station owner in Austria (approx 50, plan for 2010 approx. 200 all over Austria)
- Approx. 2100 employees
- Annual turnover approx. 730 Mio.EUR
- 100% governmental owned

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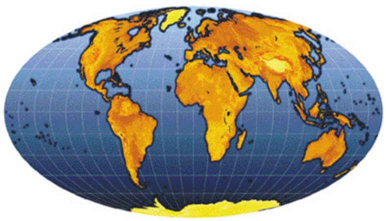
General Information CNG-Vehicles

CNG-Vehicles in operation: approx. 5,100,00 Source NGV, Dec. 2006

North-America 134,000(USA 130,000)

South-America 2.600.000(Argentina 1,5 Mio. Brazil 1,1 Mio.)

CIS 205,000



Europe 500,000(Italy 410,000)

Africa 41.000(Egypt 36.000)

Asia 1,400,000 (Pakistan 1,000,000 India 250,000, + diverse

Australia & New Zealand 14,000

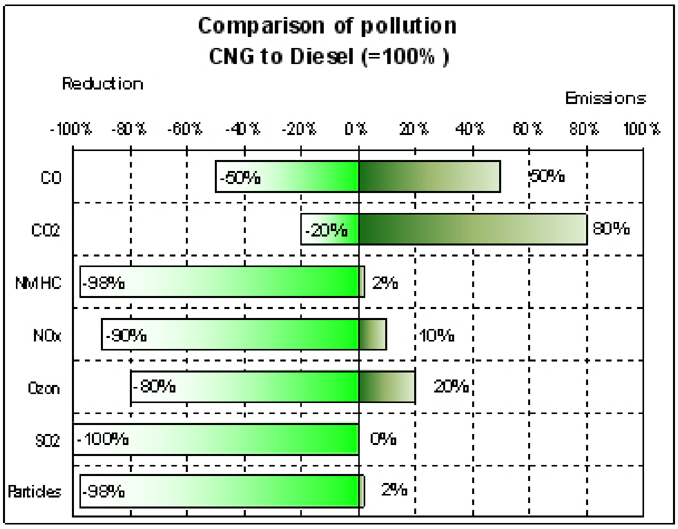
Economic – Safe – Clean:Cost-Advantages

- Economic
  - Approx. 50 % compared to Petrol-engines
  - Approx. 30 % compared to Diesel-engines
  - 1 kg CNG equals 1,5 l Petrol or 1,3 l Diesel

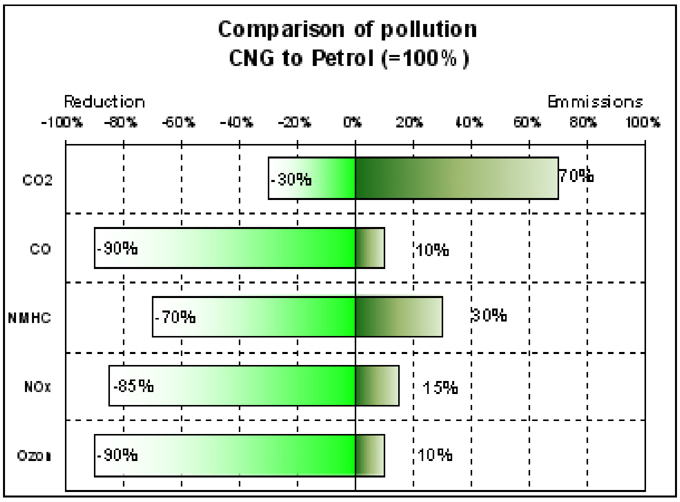
- Safe
  - The Cylinders, Valves, safety-systems and mechanical parts contain a 300% Safety-Reserve. Which means even in case of accidents or fire a highest level of safety is achieved.

Economic – Safe – Clean: Enviromental Protection

• Until now more than 50% of environmental pollution is caused by the traffic



• Natural Gas (CNG) as fuel can give a tremendous advantage and benefit to the reduction on toxic gases.

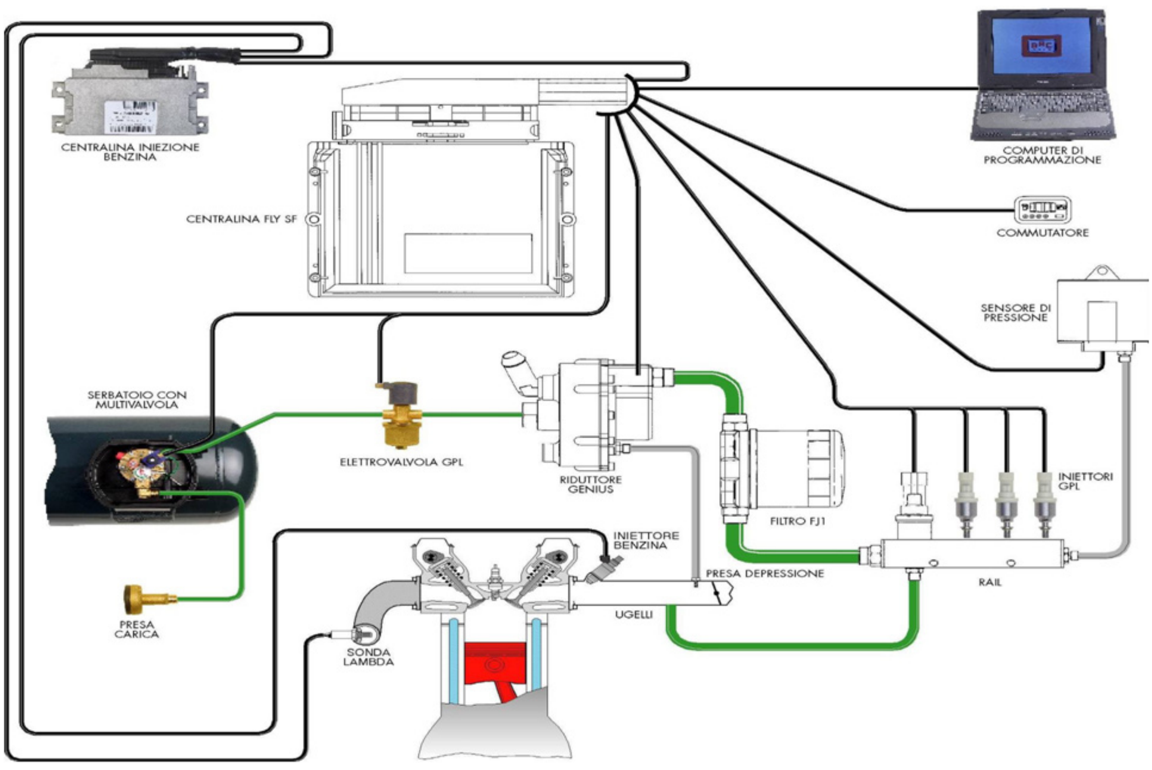


• Approx. 50% less environmental pollution compared to Petrol-Engines

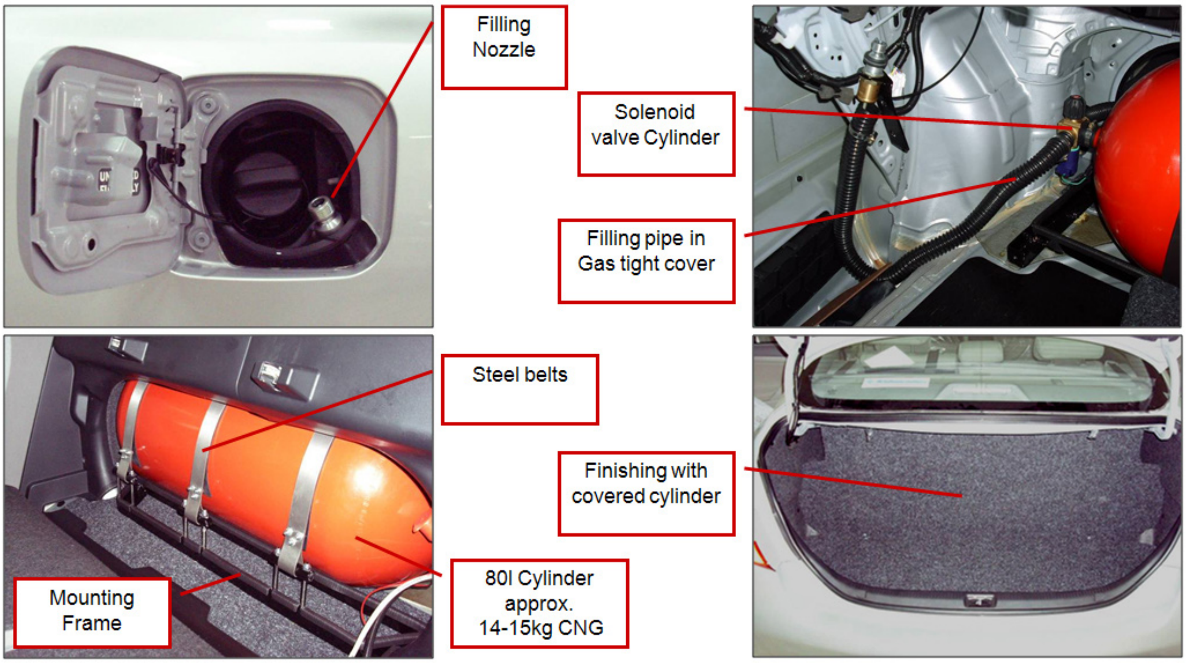
• Approx. 66% less environmental pollution compared to Diesel-Engines.

Conversion of Toyota Camry (Mod. 2007)

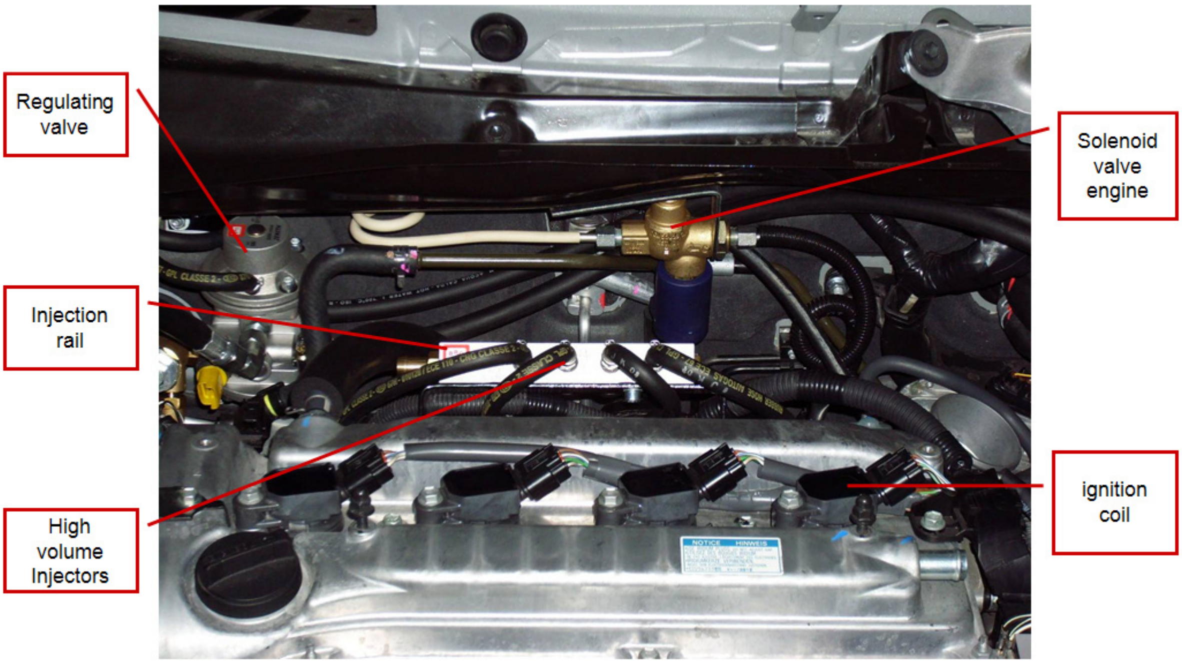
The System



Mounting of the CNG Cylinder



Mounting of the CNG Equipment



Mounting of the CNG Equipment

The Team

Emission Tests

Opel Zafira (GM Mini-Van)

(Mod. 2004)

Emissions of CNG EnginesCNG - Petrol

OPEL Zafira CNG / Petrol	CO [g/km]	NMHC [g/km]	Basis Ozonbd. [g/km]	CO2			Consumtion		
				inner-city [g/km]	motorway [g/km]	total [g/km]	inner-city [kg, m3, l / 100 km]	motorway [kg, m3, l / 100 km]	total [kg, m3, l / 100 km]
Type 1,6 CNG (quasi-monovalent - CNG / Benzin) in CNG-Betrieb Motor-Type Z16YNG, EURO 3 / D4, 1598 cm3, 71 kW, Sm 1590 kg, 5H;	0,171	approx. 0,010	approx. 0,044	174	114	136	7,08 kg	4,67 kg	5,55 kg
Type 1,6 Petrol Motor-Type Z16XE, EURO 3 / D4, 1598 cm3, 74 kW, Sm 1470 kg, 5H;	0,219	approx. 0,032	approx. 0,058	238	147	180	9,9 l	6,1 l	7,5 l

OPEL Zafira CNG / Benzin	-22%	-69%	-24%	-27%	-22%	-24%

Emissions of CNG EnginesCNG - Diesel

OPEL Zafira CNG / Diesel	NOx [g/km]	NMHC [g/km]	Basis Ozonbd. [g/km]	Partikel [g/km]	CO_2			Consumtion		
					inner-city [g/km]	motorway [g/km]	total [g/km]	inner-city [kg, m3, l / 100 km]	motorway [kg, m3, l / 100 km]	total [kg, m3, l / 100 km]
Type 1,6 CNG (quasi-monovalent - CNG / Benzin) in CNG-Betrieb Motor-Type Z16YNG, EURO 3 / D4, 1598 cm3, 71 kW, Sm 1590 kg, 5H;	0,034	approx 0,010	approx 0,044	approx 0,006	174	114	136	7,08 kg	4,67 kg	5,55 kg
Type 2,0 DTI (Diesel - DUD) Motor-Type Y20DTH, EURO 3, 1995 cm3, 74 kW, Sm 1470 kg, 5H;	0,414	approx 0,024	approx 0,438	0,024	216	143	169	8,0 l	5,3 l	6,3 l

OPEL Zafira CNG / Diesel	-92%	-58%	-90%	n.b. (ca. - 75)	-19%	-20%	-20%

CNG is not the „cleanest“ fuel but it helps to reduce the emissions caused by traffic

…and where is the end of the conversion business??

CNG Options / References

- First natural gas driven snow cat
  - a novelty in the world market: the first snow cat equipped with a CNG-engine
  - protecting sensitive alpine regions reduction in emissions in the province of Salzburg:
    - 1.600 tons of carbon dioxide
    - 45 tons of nitrogen oxide
    - 7 tons of dirt particles

- Middle East ReferenceToyota Camry (Model 2007)
  - in cooperation with RAK-Motors / Ras al Khaimah a Toyota Camry was converted to CNG
  - CNG-System full-automatic switch-over Bi-fuel-system
  - Live on outside stand

CNG Options / References

- First CNG driven SnowJet
    - a novelty in the world market: the first SnowJet equipped with a CNG-engine
    - protecting sensitive alpine regions reduction in emissions in the province of Salzburg:

- First CNG driven Quad
    - a novelty in the world market: the first Quad equipped with a CNG-engineprotecting sensitive alpine regions reduction in emissions in the province of Salzburg

    - protecting sensitive desert regions reduction in emissions in the middle east

CNG - the final solution?

- CNG is NOT the final solution - if there is one at all – BUT:

- Conversion business give advantages for:
  - Car/Fleet owners with heavy duty cars (40,000km+ per year)
  - Congested areas with high traffic density to reduce the emissions out of traffic
  - Regions where nature needs a special protection (tourist regions, wildlife parks etc.)

- In the long run car producer will supply ready made CNG-Cars OPTIMIZED for CNG.

- CNG is just the first ECONOMICAL step for shifting to alternative fuels like (SynFuel, Hydrogen or Biofuels etc.) to take pressure from oil products

…and CNG gives a tremendous chance for a sustainable protection of the environment.

Annex