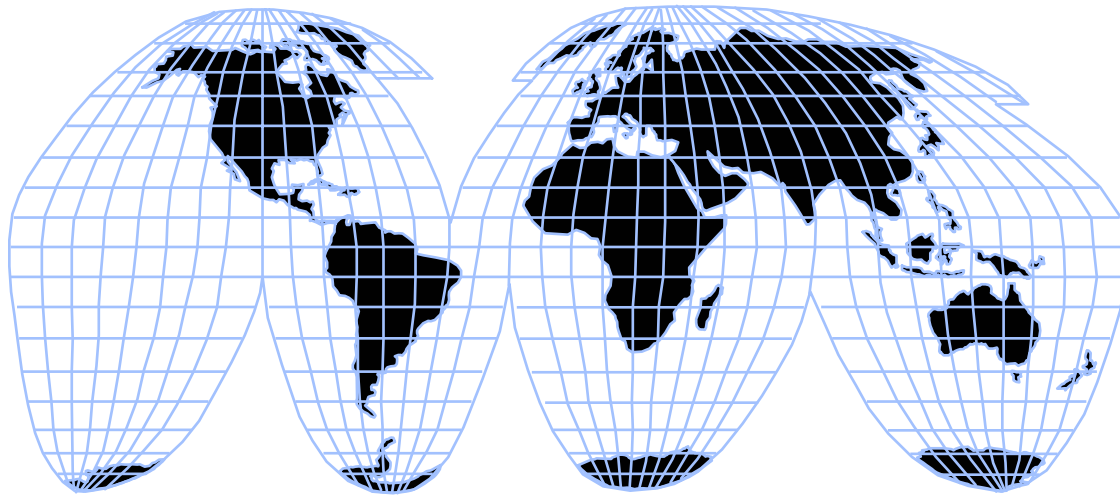


The World Bank

Refining Strategies and Options for Lead Phase Out and Sulfur Reduction



SSA Refiners Meeting
Cape Town – October 2003
Eleodoro Mayorga-Alba

Health and Environmental Impact


- Deteriorating air quality causes significant economic losses in developing countries (estimated between 0.5 to 2.5% of GDP)
- Vehicular emissions can be major contributors to urban air pollution
- In the large cities of developing countries two pollutants merit special attention:
 - **Lead:** well documented case of negative health impact, even in small amounts. Further, leaded gasoline precludes the use catalytic converters in exhaustion pipes.
 - **Particulates:** smaller than several microns (PM10 - PM2.5) that are a major cause of respiratory diseases.

Myths and realities

 *Leaded poisoning is not a problem*



The direct relationship between leaded gasoline use and lead in human blood is well documented

 *Some vehicles, especially older vehicles, require leaded gasoline*



All cars can run on unleaded gasoline

 *Phasing-out leaded gasoline costs too much*



Phasing-out leaded gasoline makes economic sense for vehicle owners, refineries and the society

 *Phasing-out leaded gasoline is not practical for developing countries*



Developing countries should take advantage of available technologies to phase-out leaded gasoline now

Lead Phase-Out Worldwide situation

- At present nearly 85% of the world gasoline consumption is lead free.
- By 2005, practically all countries from LAC, Middle East and Asia will be lead free.

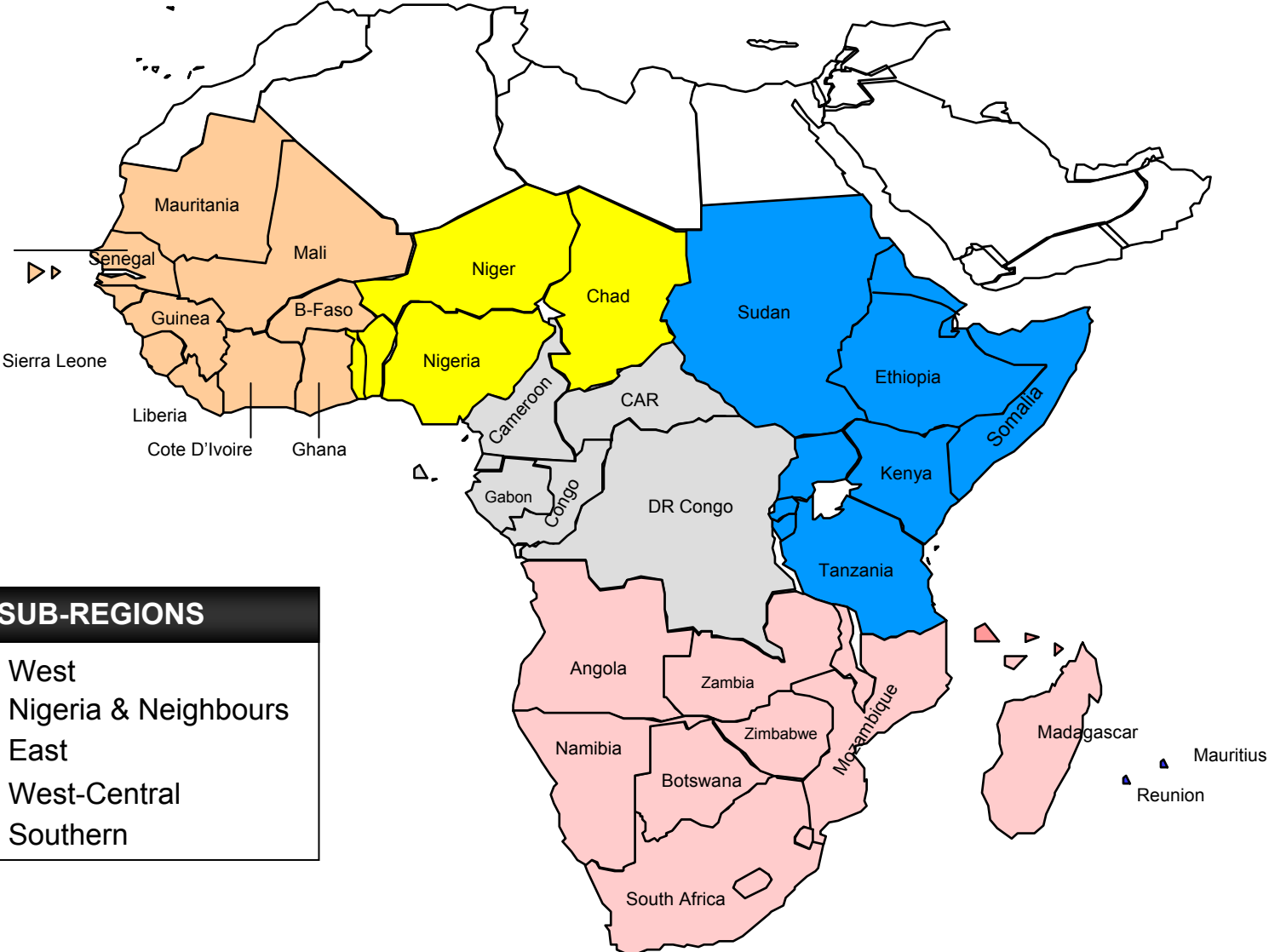







**Using the international experience,
Sub-Saharan Africa
should follow-up**

The Dakar Declaration (June 2001)

- **Participants from 25 SSA countries agreed to:**
 - join efforts to formulate and implement programs to **completely phase out leaded gasoline by 2005.**
 - recommend governments to reduce the lead content in gasoline to 0.4 gm/lt by 2002 and to 0.2 by 2003.
 - set up of 5 sub-regional working groups.
 - encourage importing countries with port facilities to accelerate their lead phase out programs.
 - establish AFRICACLEAN a network of African experts.
 - request to the oil industry: IPIECA to propose harmonize gasoline norms.
 - develop public information campaigns.

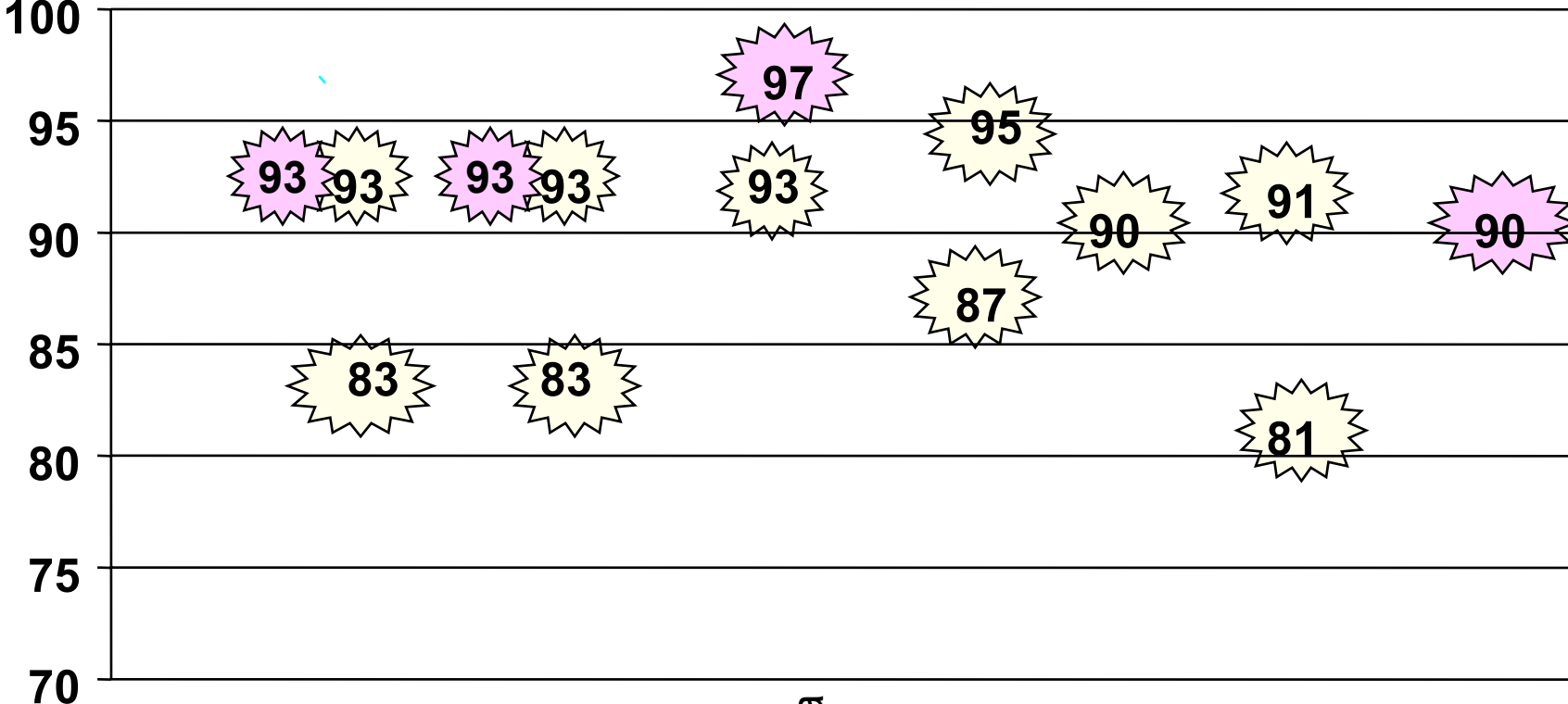
SSA - Sub-regions



SUB-REGIONS	
	West
	Nigeria & Neighbours
	East
	West-Central
	Southern

Gasoline Grades

RON (Research Octane Number)



Kenya

Tanzania

RSA-
Botswana

Senegal

Nigeria

Ghana

Ethiopia

Pricing Policies

- A great differences between the price of gasoline or diesel and the price of kerosene will induce *adulteration*.
- A great differences between the price of leaded and ULG gasoline will induce *adulteration and misfueling practices*.
- A great differences between the price of gasoline of neighbor countries will induce *smuggling, and possibly adulteration and misfueling practices*.

How costly is to phase out leaded gasoline?

- Depends on the country's gasoline supply:
 - Importers with access to international markets could benefit from lower ULG prices. Case of Mauritania, Ethiopia, Tanzania, Mali
 - Producers need to adapt refineries
- Octane sources to replace TEL have a different cost and a different impact on the technical specifications of resulting gasoline.

Straight run gasoline = 60-73 RON

C4 = 93 RON

Isomerate = 82-92 RON

FCC naphta = 90-93 RON

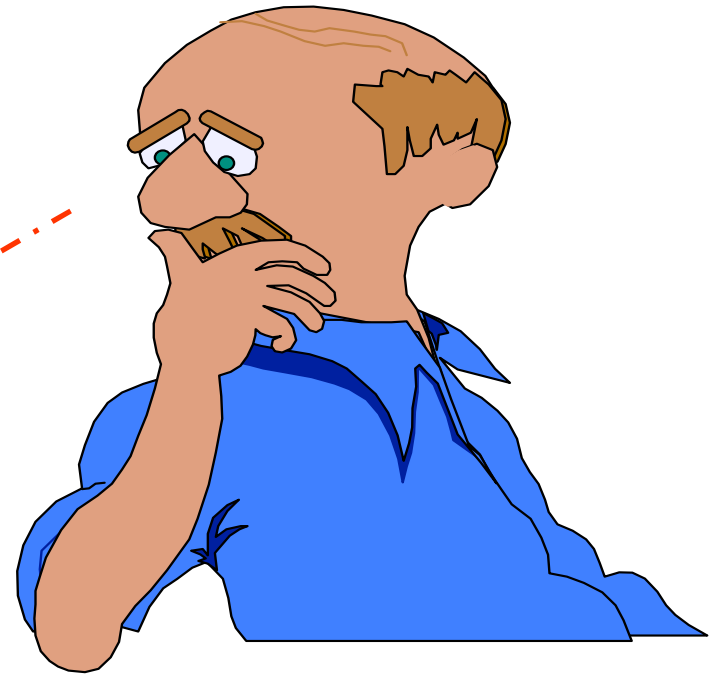
Reformate = 90-103 RON

Alkylate = 90-97 RON

MTBE = 118 RON

Options to remove TEL...?

New processes...?
New additives...?



Refiners process

To produce a higher octane gasoline by investing in new processing units:

- Reforming
- Isomerisation
- FCC
- Alkylation
- Others

Additives

To be added to the available gasoline pool so as to increase the RON:

- Imported high octane gasoline for blending
- Alcohols
- MTBE
- MMT
- Butane
- Others

Reduction of sulfur content

- Why?
 - Sulfur in gasoline reduces the efficiency of the catalytic converters
 - Sulfur in diesel is associated with higher PM and other pollutants (SO₂).
- The content of sulfur depends on
 - The feedstock
 - The refinery configuration (hydro desulfurisation)
- The reduction of sulfur in diesel in SSA can be made by steps:
 - Immediately to 1000 ppm in the SSA west coast and 2000 ppm in the SSA west coast
 - By 2010 to 500 - 400 ppm

Improving fuels quality

- Refiners' decisions will depend on several factors:
 - available raw material (low octane naphtha, mid-distillate, residual oil, ...).
 - technical specifications of the gasoline and of the diesel (aromatic content, RVP, sulfur content, cetane index...)
 - size and configuration of the refinery
 - expected margins/prices in a given market
 - **Last but not least → the economic viability of the investment projects**

How costly is the improvement of fuels quality?

- For the same octane grade, a liter of ULG costs maximum US\$ 0.01 more than a liter of leaded gasoline.
- The reduction of sulfur in diesel to 500 ppm, feasible in large refineries, would have an additional cost of US\$ 0.005 to 0.01 per liter.

Financing

- Refineries should be operated under competitive market conditions.
- Regulated product pricing policies usually complicate the participation of private investors.
- Governments should carefully identify areas to invest the scarce public financial resources.

Regional Cooperation for realistic norms

Why not harmonize region-wide the fuels' technical specifications, and also the vehicle emission standards and air monitoring equipment?



Evolution of fuel specifications

<u>By 2005</u>	European Union	LAC Proposed
Gasoline		
Lead, g/l, max	0.005	0.013
Benzene, vol %, max	1	2.5
Aromatics, vol %, max	32	45
Sulphur, wt ppm, max	50	400
Diesel		
Cetane, min	51+	47
Sulphur, wt ppm, max	50	2000
Polyaromatics, vol %, max	11-	30

Expected Benefits

- **Economic**
 - facilitation of regional trade and cooperation
 - larger markets and economies of scale
 - security of supplies
 - facilitate capacity building
- **Environmental**
 - joint implementation of environmental standards
 - reduce adulteration

Conclusions

- Develop a National Plan with a broad consensus among all key stakeholders, involving:
 - a sound technical option,
 - a reasonable time table,
 - and the least cost solution.
- Develop a public information campaign.
- Secure Technical Assistance. There is a vast international experience to prepare better decisions and speed-up implementation. The industry should play a major role
- Regional Cooperation is important to facilitate lead phase-out programs and achieve a sound harmonization of fuels specifications, of vehicle emission standards and of air monitoring equipment.