Transport Fuel Quality Specification

Stakeholders workshop on air Quality and Transportation Challenges in Ethiopia

Organized by Ministry of Environment and Forest

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Topics to be covered

Transport fuel quality specification

- Transport fuel quality specification and significance
- Gasoline vehicle and fuel
- Diesel vehicles and fuel
- The need for Clean fuel
- Fuel Importation Trends
- Ethiopian vehicular fuel standards
- Progress towards cleaner fuel standards
- Overview of Global fuel sulphur level
- Recommendations

Transport Fuel quality specification

- Product specification is a mechanism by which producers and users of a product identify and control the properties necessary for satisfactory and reliable performance.
- A stated physical and chemical properties of product, which a manufacture should supply, satisfying the need of end users and fulfilling requirement of OEM and regulatory bodies.

SIGNIFICANCE OF FUEL QUALITY

- The vehicle & fuel (and oil) form an integrated system
- Direct impact on exhaust emissions leading to pollution
- Impact on engine performance and fuel consumption
- High sulfur – corrosion and wear of the engine
- High heavier end leads to soot / smoke / PM in tailpipe
- All catalyst /EC technologies are adversely affected

Gasoline Vehicles and Fuels

- Gasoline is a complex mixture of volatile hydrocarbons used as a fuel in internal combustion engines.
- The pollutants of greatest concern from gasoline-fuelled vehicles are CO, HC, NOX, PM4 and certain toxic hydrocarbons such as benzene, formaldehyde, acetaldehyde, and 1,3- butadiene

Impact of Gasoline Composition/fuel qualities on Emissions from Light Duty Vehicles

Gasoline	No Catalyst	Euro 1	Euro 2	Euro 3	Euro 4	Euro 5/6	Comments
Lead ↑	Pb, HC↑	CO, HC, NOX all increase dramatically as catalyst destroyed					Lead is now virtually banned worldwide
Sulfur ↑ (50 to 450 ppm)	SO2 ↑	CO, HC, NOX all increase ~15-20% SO2 and SO3 increase					OBD light may come on incorrectly
Olefins ↑	Increased 1,3 butadiene, increased HC reactivity, NOX, small increases in HC for Euro 3 and cleaner						Potential deposit buildup
Aromatics ↑	Increased benzene in exhaust						Deposits on intake valves and combustion chamber tend to increase. PM emissions could also increase
	Potential increases in HC,NOX	HC↑, NOX↓, CO↑		HC, NOX, CO ↑			
Benzene ↑	Increased benzene exhaust and evaporative emissions						
Ethanol ↑ up to 3.5% O2	Lower CO, HC, slight NOX increase(when above 2% O_2),	Minimal effect with new vehicles equipped with oxygen sensors, adaptive learning systems					Increased evap. emissions unless RVP adjusted, small fuel economy penalty
Distillation CharacteristicsT50, T90↑	Probably HC↑	HC↑					
RVP ↑	Increased evaporative HC Emissions						Most critical parameter for Asian countries because of high ambient Temperatures

Diesel Vehicles and Fuels

- Diesel fuel is a complex mixture of hydrocarbons with the main groups being paraffins, napthenes and aromatics.
- Organic sulfur is also naturally present
- Diesels emit high levels of oxides of nitrogen and particulates. Achieving very low levels of NOX and PM therefore require exhaust treatment.
- Lean NOX catalysts, selective catalytic reduction (SCR), NOX storage traps with periodic reduction, filter traps with periodic burn-off, and oxidation catalysts with continuous burn-off are evolving technologies
- To reduce PM and NOX emissions from a diesel engine, the most important fuel characteristic is sulfur

Impact of Fuels on Light Duty Diesel Vehicles

Diesel Fuel Characteristic	Pre-Euro	Euro 1	Euro 2	Euro 3	Euro 4	Euro 5/6	Comments
Sulfur↑	SO2, PM↑		If oxidation catalyst is used, SO3, SO2, PM↑		If catalyzed Filter, 50 ppm maximum, 10-15 ppm better		If NOX adsorber used requires near zero sulfur (<10 ppm) With low S, use lubricity additives
Cetane↑	Lower CO, HC, benzene, 1,3 butadiene, formaldehyde & acetaldehyde						Higher white smoke with low cetane fuels
Density↓	PM, HC, CO, formaldehyde, acetaldehyde & benzene↓, NOX↑						
Volatility (T95 from370 to 325 C)	NOX, HC increase, PM, CO decrease						
Polyaromatics↓	NOX, PM, formaldehyde & acetaldehyde↓ but HC, benzene & CO ↑						some studies show that total aromatics are important for emissions in a manner similar to polyaromatics

Impact of Fuels on Heavy Duty Diesel Vehicles

Diesel	Pre-Euro	Euro 1	Euro 2	Euro 3	Euro 4	Euro 5/6	Comments
Sulfur↑	SO2, PM↑		If oxidation catalyst is used, SO3, SO2, PM↑		If catalyzed Filter, 50 ppm maximum, 10-15 ppm better		If NOX adsorber used requires near zero sulfur (<10 ppm) With low S, use lubricity additives
Cetane↑	Lower CO, HC, benzene, 1,3-butadiene, formaldehyde & acetaldehyde						Higher white smoke with low cetane fuels
Density↓	HC, CO ↑, NOX↓						
Volatility (T95 from 370 to 325 C)	Slightly lower NOX but increased HC						Too large a fraction of fuel that does not volatilize at 370 C increases smoke and PM
Polyaromatics↓	NOX, PM, HC ↓						Some studies show that total aromatics are important

Why Clean Vehicular Fuels

❖introduction of low sulfur fuels helps

- To import lower emitting and more efficient vehicle technologies,
- To establish vehicle emissions control roadmaps and ultimately improve air quality and human health
- emissions from the existing fleet through improved fuel quality and enabling the introduction of cleaner vehicles and technology, which additionally reduce transport- related pollution.

Why Clean Vehicular Fuels

- 2000 ppm diesel Markets with no or first level requirements
- for emission controls; based primarily on fundamental vehicle/engine performance and protection of emission control systems.
- Sulphur 500 ppm and below open the door to an assortment of emission control technologies DOC, older diesel vehicles to be retrofitted with emission control technologies
- Even greater reductions to below 50 ppm after which diesel particulate filters can be introduced

Why Clean Vehicular Fuels

- For Gasoline vehicles1000 ppm Markets with no or first level requirements for emission controls; based primarily on fundamental vehicle/engine performance and protection of emission control system
- reducing sulphur levels to 500 ppm and below improves the performance of catalytic converter systems.
- 10 ppm Markets with advanced requirements for emission control. Enables sophisticated NOx and PM after-treatment technologies
- fuels and vehicles work together as a system combining lower sulphur fuels with appropriate vehicle and emission control technologies

About EPSE

A public enterprise(**Regulation No. 265/2012**)with the following objectives:-

- on the basis of assessment of the country's demand, to supply petroleum to distribution companies by importing clean products and by importing and processing crude oil;
- to forecast, maintain and administer the required national petroleum reserve and, based on instructions of the government, supply petroleum products from the reserve;
- to build its own petroleum depots within the country and, as may be necessary, in neighboring countries; and to invest in companies operating petroleum depot facilities;
- to engage in any other related activities necessary for the attainment of its objectives.

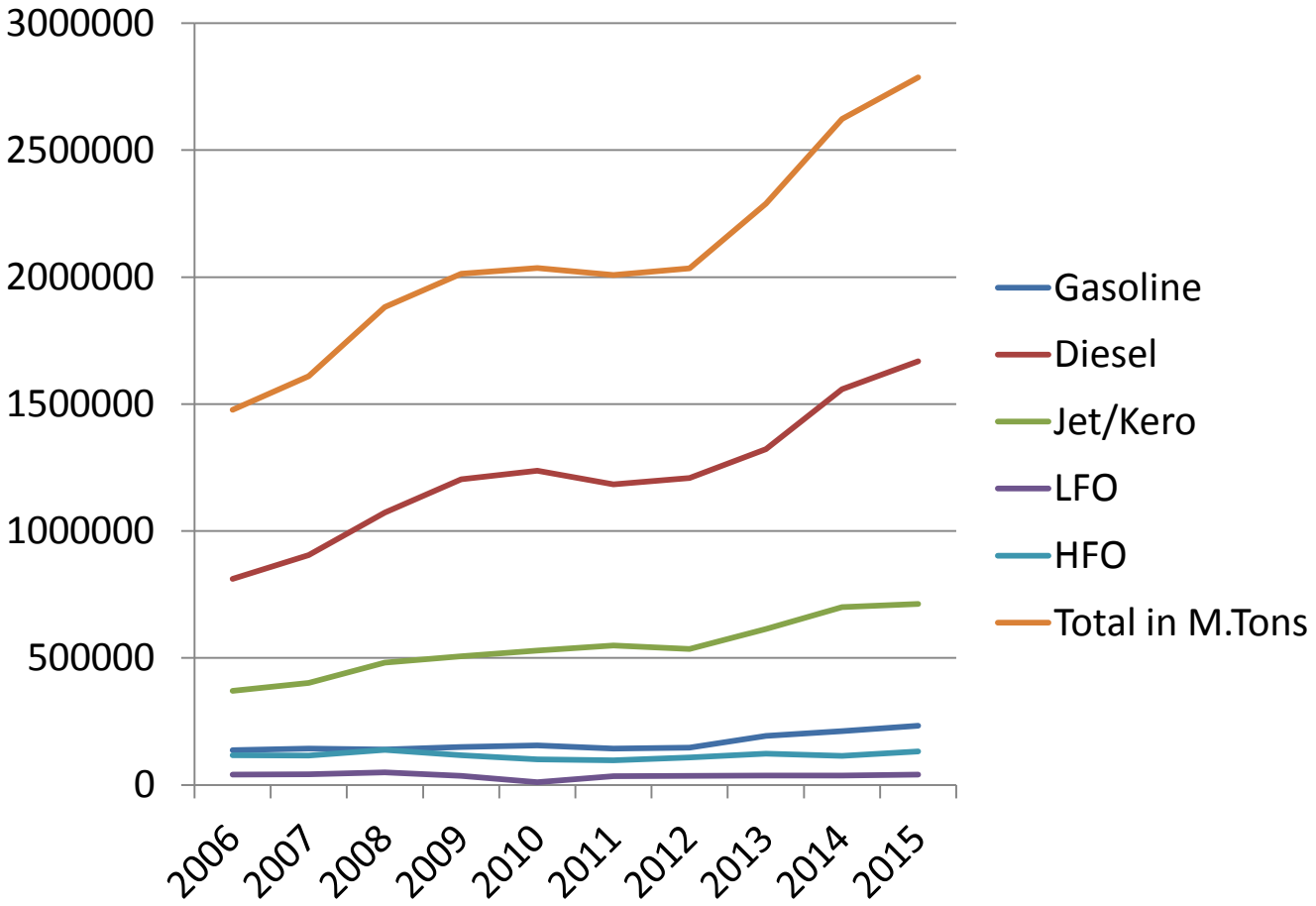
ETHIOPIND STANDARD SPECIFICATION OF GASOIL(DIESEL) ES 993:2012

Parameter	SPECIFICATION	TEST METHOD
Density @ 15 ^{0} c	Report *	ASTM D 4052/1298/ ES ISO 3675
Distillation 90% Volume, Deg. C Distillation, Final boiling Point (FBP), Deg.C.	Min 282 Max 362 Max 390	ASTM D 86/ ES ISO 3405
Colour	Max 2	ASTM D 1500/ES 1012
Total Sulphur % Weight	Max 0.05/0.5	ASTM D 4294/ ES 1000
Flash Point Pensky-Martens Closed Cup, Deg. C	Min 60	ASTM D 93/ ES ISO 2719
Kinematic Viscosity Centistokes @ 37.8 Deg. C.	Min 1.9 Max 5.5	ASTM D 445/ ES ISO 3104
Cloud Poinst Deg. C	Max 5.0	ASTM D 2500/ES ISO 3015
Cetane number /Index *	Min 48	ASTM D/613 D 976 ES ISO 5165
Copper Strip Corrosion rating, 3 hours @ 100 Deg. C	Max No.3	ASTM D 130/ ES ISO 2160
Carbon Residue Rams bottom 10% Distillation Residue % Weight	Max 0.35	ASTM D 524/ES ISO 4262
Ash % Weight	Max 0.01	ASTM D 482/ES ISO 6245
Water and Sediment Content % Volume	Max 0.05	ASTM D 95/ES 905

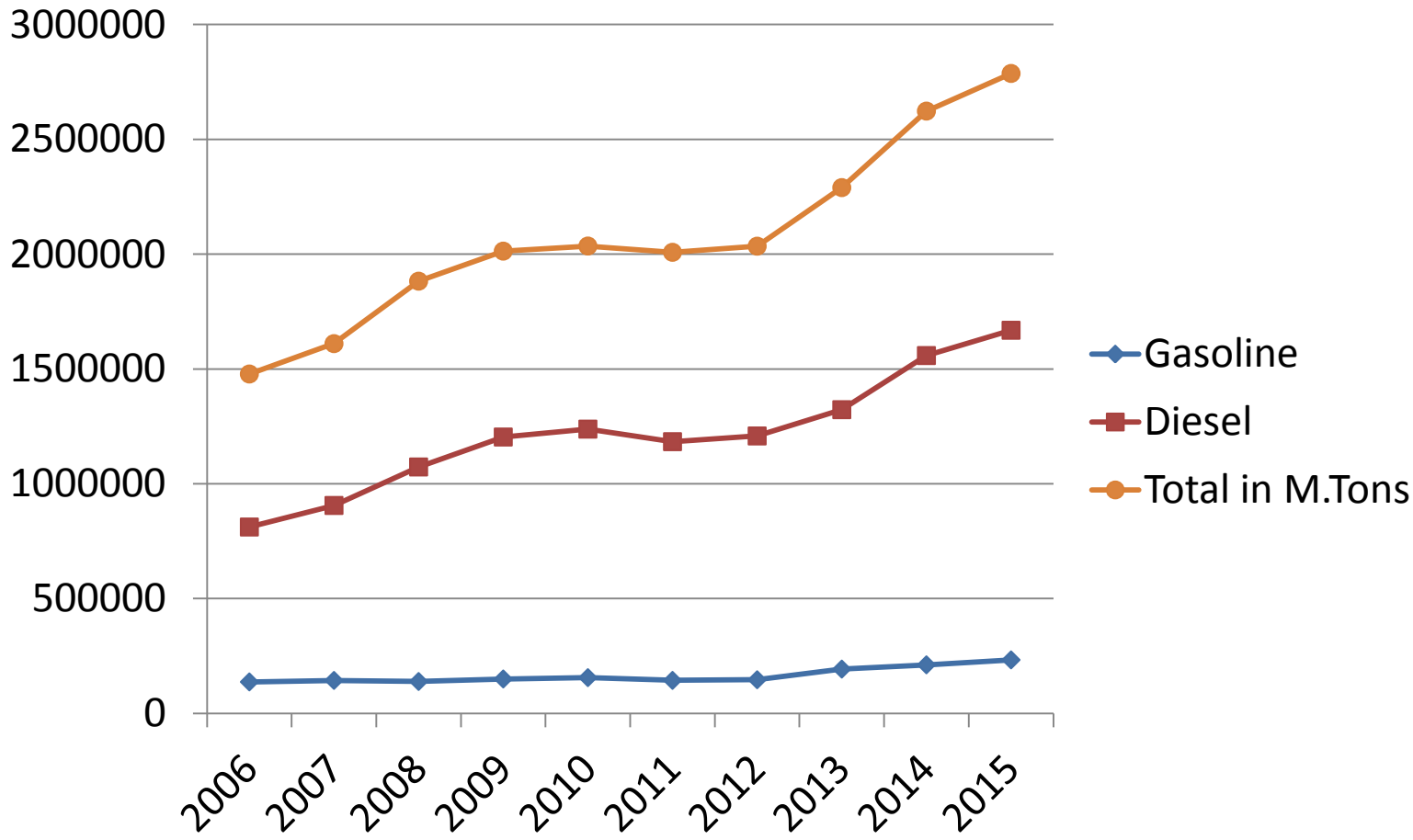
ETHIOPIND STANDARD SPECIFICATION OF UNLEADED GASOLINE ES 924:2013

TEST	SPECIFICATION	TEST METHOD
RESEARCH OCTANE NUMBER (RON)	Min. 91/95	ASTM D 2699/ ES 636
DENSITY @ 15 DEG. C.	0.705-0.75	ASTM D 1298/4052/ ES ISO 3675
DISTILLATION: 10% Volume Deg. C 50% Volume Deg. C 90% Volume Deg. C, Max. Final Boiling Point Deg.C Residue,% Vol,	 Max. 70 77-121 190 Max. 225 Max. 2	 ASTM D 86 ES ISO 3405
COLOUR	Yellow/Orange	Visual
TOTAL SULPHUR % WEIGHT	Max. 0.10	ASTM D 4294/ ES 1000
REID VAPOUR PRESSURE (RVP), Kpa, max.	69	ASTM D 323/ ES ISO 3007
EXISTENT GUM MG/100 ml	Max. 4	ASTM D 381 ES 627
OXIDATION STABILITY INDUCTION PERIOD MINUTES	Min. 240	ASTM D 525/ ES 634
LEAD CONTENT G/LITRE	Max. 0.013	IP 352/ ES 640:
COPPER CORROSION 3 HOURS @ 50 Deg. C	Max No. 1	ASTM D 130 ES ISO 2160
DOCTOR TEST	Negative	IP 30

Imported Petroleum Products



Imported Vehicular Fuel



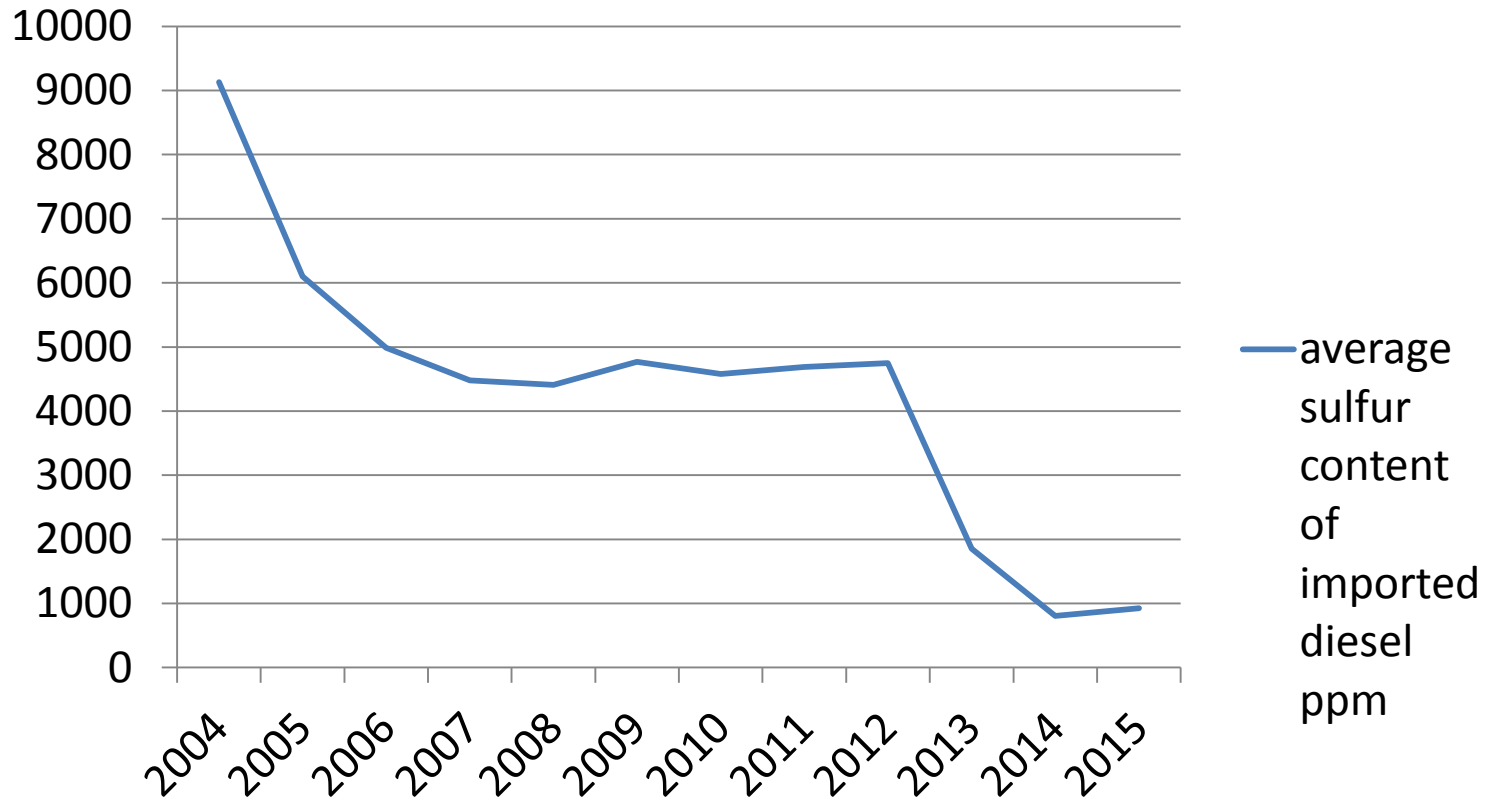
Progress Towards Implementing Cleaner vehicular fuels

Year	Average sulfur in Diesel content ppm	minimum ppm	maximum ppm
2004	9130	7000	9900
2005	6100	3100	9700
2006	4990	1400	9500
2007	4480	2800	4800
2008	4410	4000	9300
2009	4770	3800	4900
2010	4580	3400	5000
2011	4690	4000	5000
2012	4750	4700	4800
2013	1855	243	4800
2014	805	269	1800
2015	925	245	1850

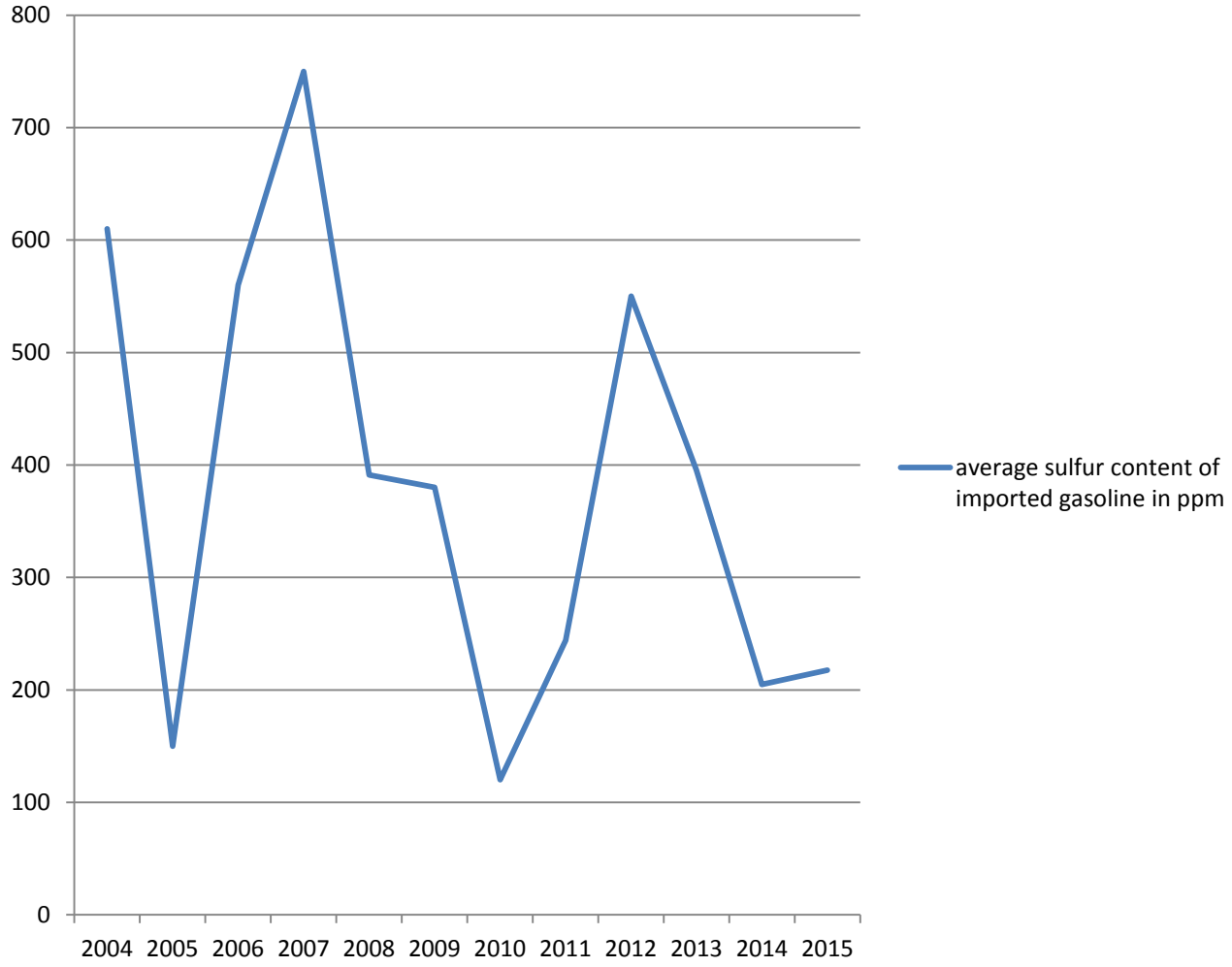
Progress Towards Implementing Cleaner vehicular fuels

	Average sulfur content of imported gasoline in ppm	minimum ppm	maximum ppm
2004	610	40	900
2005	150	40	900
2006	560	200	900
2007	750	700	900
2008	391	40	800
2009	380	40	900
2010	120	40	900
2011	244	40	600
2012	550	400	1000
2013	395.6	37	1000
2014	204.75	32	1000
2015	217.5	40	900

Progress Towards Implementing Cleaner vehicular fuels

- 

Progress Towards Implementing Cleaner vehicular fuels

- 

Global sulphur level

- **gasoline range from below 10 ppm to as high as 1,000 ppm or more**
- **In diesel fuel, levels range from below 10 ppm to more than 10,000 ppm.**
- **Europe, the US, and Japan have all put in place measures to reduce sulphur to lower levels (below 10-15 ppm), often along with emission standards that require advanced emission control technologies that cannot be used with higher sulphur fuels.**
- **Some developing country regions have developed, or are now developing, harmonised standards that will allow them to use a regional approach to lowering sulphur levels and improving fuel qualities in general.**
- **In both the US and EU programs, the close linkage between vehicle emissions standards and fuel quality, the systems approach, has been established as an overarching principle**

RECOMMENDATIONS

- **The use of low-sulfur fuels, including importing low sulfur fuel;**
  - **Harmonization of mixed grade import to 500 ppm (no refinery)for all imported vehicular fuel Vs status of control over producer**
  - **Then moving to 50ppm and lower fuel a necessary step for enabling the use of improved catalysts, filters, and other technologies that can remove most of the pollution from today's petrol and diesel-fueled vehicles.**
  - **That calls for vehicular emission standard for maximum benefit**

RECOMMENDATIONS

- Revise fuel standards to clean fuel in line with producers (middle east) harmonization and making it mandatory.
- Develop mandatory emission standard- vs tax incentive
- Enforcement and Compliance.
- Alternative energy sources (less sulfur content<10mg/Kg)
  - Hydroelectric power
  - GTL/HVO/CTL/BTL
  - Bioethanol & Co-generation (sugar factories) from byproducts
  - Biodiesel
- Commitment by all stake holders

Sources

- WORLDWIDE FUEL CHARTER September 2013
- **Report of the Sulphur Working Group of the Partnership for Clean Fuels and Vehicles (PCFV)**
  Clean Fuels and Vehicles Toolkit (pcfv) UNEP -2014
- EPSE IMPORT and SUPPLY DEPARTMENT
- EPSE QUALITY CONTROL

Thank You All for Your Attention