Guidance to Fuel Importing Countries for Reducing On-Road Fuel Sulfur Levels

Dr. Supat Wangwongwatana
Regional Resource Centre of Asia and the Pacific (RRC.AP)
Asian Institute of Technology

for Heavy Duty Vehicle Initiative (HDVI)
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Outline

• Background

• Issues Specific to Importing Markets
  - Costs to consumers
  - Regulatory process and governance
  - Matching advanced vehicle emissions standards to cleaner fuels (including vehicle imports and second-hand vehicles)
  - Inspection and maintenance of Vehicle Imports and On-Road Vehicles
  - Lubricity

• Other Emission Reduction Benefits Associated with Low and Ultralow-Sulfur Fuels

• Conclusion
Background
• Nine out of every ten people breathes unhealthy air.

• In 2016, an estimated premature deaths of 4.2 million resulted from chronic exposure to ambient fine particulate matter and ambient ozone, reducing global average life expectancy at birth by about 1 year.
Global Burden of Disease 2015: Ranking of risk factors globally for total deaths from all causes for all ages and sexes in 2015
Global Map of Population-Weighted Annual Average Ambient Concentrations of PM$_{2.5}$ in 2015 comparing to WHO Guidelines
What is Climate and Clean Air Coalition (CCAC) ?

- Launched in February 2012 by 6 States and UNEP.
- Voluntary, Partner-led effort bringing together many diverse, experienced and influent government, IGOs, NGOs and private sector entities.
- As of October 2018, 61 State Partners and 68 Non-State Partners
- All Partners have endorsed meaningful action to address SLCPs.
- Complementary to global efforts to reduce CO₂
What is Climate and Clean Air Coalition (CCAC)?

**Objectives**

- Raise awareness of SLCP impacts and mitigation strategies;
- Enhance and develop new national and regional actions, identify and overcome barriers, enhance capacity and mobilize support;
- Promote best practices and showcase successful efforts; and
- Improve scientific understanding of SLCPs.
Heavy Duty Vehicles Initiative (HDVI)

• HDVI is an initiative of CCAC with the aim to promote reductions of SLCPs, in particular black carbon (BC) from heavy duty vehicles.

• Co-Leads of HDVI are US, Canada, Switzerland, UN Environment and International Council on Clean Transportation (ICCT).
Heavy Duty Vehicles Initiative (HDVI)

- The objective of the HDVI is to virtually eliminate fine particle and black carbon emissions from new and existing heavy-duty diesel vehicles and engines through the introduction of low sulfur fuels, and vehicle emission standards, and measures which address existing vehicles such as green freight programs.

- The Initiative works directly with countries to make cleaner fuels and vehicles a reality.
Heavy Duty Vehicles Initiative (HDVI)

• HDVI developed **GLOBAL STRATEGY TO INTRODUCE LOW-SULFUR FUELS AND CLEANER DIESEL VEHICLES** which was endorsed by 36 countries in December 2016 in the Marrakech Communique.

• The targets of the Global Strategy
  - Low-sulfur fuels (<50 ppm S) by 2025
  - Ultralow-sulfur fuels (<10 ppm S) by 2030
  - Soot-free transport through Euro 6/VI vehicles, NGV, EV and others.
Global Progression to Lower Sulfur Fuels

Sulphur Level in Diesel Globally
2012

Sulphur Level in Diesel Globally
July 2018
Effects of Fuel Sulfur on Emissions

• Sulfur in fuel leads to increased air pollution by

  - Direct emissions of harmful sulfur compounds, i.e. SOx and SO$_4^{2-}$.
  
  - Inhibiting the effectiveness of modern emission control devices, i.e. catalytic converter and diesel particulate filters, indirectly resulting in increasing emissions of air pollutants (CO, HC, NOx and PM) and climate pollutants in particular black carbon (BC) from diesel vehicles.
  
  - Diesel particulate filters which can reduce PM$_{2.5}$ emissions up to 99% and BC over 99% are only effective with low (<50 ppm) or ideally ultralow (<10 ppm), sulfur fuels.
Benefits of Lower Fuel Sulfur

• Pairing low-sulfur diesel fuel with the right emission control technologies leads to reductions in black carbon as well as other climate pollutants (Bond et al., 2013).

• Matching vehicle emission standards to lower sulfur fuels would equal a reduction in annual PM$_{2.5}$ and BC emissions from on-road vehicles by over 85 percent, resulting in 100,000/year fewer premature deaths in 2020, and 470,000/year fewer in 2050.
Lower Sulfur Fuels Reduce Emissions from In-use Vehicles

Emission Reduction after Switching from 50 ppm S to 10 ppm S Fuels
Benefits of Lower Fuel Sulfur

• Low-sulfur fuels reduce emissions from existing in-use vehicles and make them perform better and cleaner, even they are without emission control devices.

• For those equipped with such emission control devices as catalysts, emissions are generally improved if sulfur levels are lowered.

• Implementing the Global Strategy would reduce cumulative BC emissions by 7.1 million tons by 2050.
Questions ????
Issues Specific to Importing Markets
Fuel Importing Countries

- Dependent only on fuel imports with no local refinery, fuel importing countries which make up the largest group of countries can act quickly to adopt lower sulfur fuel standards. As a consequence, air quality can be improved quickly.

- No concern for fuel importing countries on considerable capital investment needed for upgrading any refinery to produce lower sulfur fuels. Lower sulfur fuels could be obtained through imports from the international markets.

- The shift in regional demand to lower-sulfur fuels will have extensive influence on markets and spur investment in fuel refining countries.
Challenges Specific to Fuel Importing Countries

• Costs to consumers >>>

• Regulatory process and governance >>>

• Matching advanced vehicle emission standards to cleaner fuels (including vehicle imports and second-hand vehicles) >>>

• Inspection and maintenance for Vehicle Imports and On-Road Vehicles >>>

• Lubricity of Fuels >>>
Costs to Consumers
Challenges on Costs to Consumer

• Petroleum industry including refining sector and importing sector always raises an issue on fuel price increase every time tighter fuel quality standards including lowering sulfur level in fuels is proposed.

• There will be premium charges imposed on imported lower sulfur fuels which will be passed on directly to fuel consumers resulting in higher fuel prices at fuel stations.

• Transport and logistics industry will face operating difficulties due to the rising fuel cost which takes up a substantial part of their operating cost.
Challenges on Costs to Consumer

• As a consequence, prices of consumer products might increase.

• Making it difficult for policymakers in the implementation of lower sulfur fuels due to the unpopularity of any rise in fuel costs.

• Governments are often reluctant to impose lower sulfur fuel standards without which fuel importers will not import lower sulfur fuels.
Is incremental cost of lower sulfur fuels really high?

• Taking account only of technical factors unique to each country with the absent of financial and policy factors, additional costs when going down to 50 ppm and 10 ppm respectively could be 0.6 to 2.1 US cents and 1.1 to 3.2 US cents for a liter of diesel and 0.4 to 1.7 US cents and 0.8 to 2.4 US cents per liter of gasoline depending on the baseline fuel quality and sulfur levels (ICCT, 2012).

• These additional costs could be lower with financial and policy intervention, for example tax, fiscal and energy policies.
Prices of Low-Sulfur Fuels in Various International Oil Markets have been only Slightly Higher than High-Sulfur Fuels

- FOB prices of 50 ppm sulfur diesel in Singapore and Arab-Gulf markets were only 0.69 US cent per liter and 0.79 US cent per liter higher than 500 ppm sulfur diesel respectively. These increases were 1.85 to 2.21%.

- Price increases of 10 ppm sulfur diesel from those of 50 ppm sulfur diesel were even much lower, i.e. 0.11 to 0.31 US cent per liter or 0.29 to 0.85%.
Prices of Low-Sulfur Fuels in Various International Oil Markets have been only Slightly Higher than High-Sulfur Fuels

• In reality, the actual price increases in international oil markets for both 50 ppm and 10 ppm sulfur fuels have been much less than what were projected.

• Moreover, the price difference between high-sulfur and low-sulfur fuels has decreased in recent years.
FOB Prices of Diesel with Difference Sulfur Levels in Asia-Pacific (Singapore) and Arab-Gulf (Middle East) Markets on 1 October 2015
(Source: www.platts.com marketscan)

<table>
<thead>
<tr>
<th>Diesel with difference sulfur levels</th>
<th>Asia-Pacific Market FOB Singapore (US$ per barrel)</th>
<th>Arab-Gulf Market FOB Arab Gulf (US$ per barrel)</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Range</td>
<td>Mid</td>
</tr>
<tr>
<td>Diesel 10 ppm S</td>
<td>60.39-60.43</td>
<td>60.41</td>
</tr>
<tr>
<td>Diesel 50 ppm S</td>
<td>60.22-60.26</td>
<td>60.24</td>
</tr>
<tr>
<td>Diesel 500 ppm S</td>
<td>59.13-59.17</td>
<td>59.15</td>
</tr>
<tr>
<td>Diesel 2,500 ppm S</td>
<td>58.62-58.66</td>
<td>58.64</td>
</tr>
</tbody>
</table>
Daily Prices of Gasoil with 50 ppm sulfur and 500 ppm Sulfur from 2012 to 11 June 2018

(Source: Petroleum Authority of Thailand, 2018)
Thailand Experience on Costs of Low Sulfur Fuels

• When fuel sulfur was reduced in Thailand from 150 ppm in gasoline and 350 ppm in diesel to 50 ppm in both gasoline and diesel in 2012, the estimated incremental cost was around 1.6 US cents per liter.

• However, the pump price actually increased only around 0.7 cent per liter.

• This actual increase was equal to the price increase of fuels if imported from Singapore market since fuel prices in Singapore are used as reference fuel prices in Thailand.
Hong Kong Experience on Costs of Lower Sulfur Fuels

• When 50 ppm sulfur diesel was first introduced in Hong Kong in 2000, the retail price before duty was 5.24 HK$ per liter which was 0.8 HK$ per liter higher than regular 350 ppm sulfur diesel (4.44 HK$ per liter). (1 HK$ = 0.12821 US$)

• Hong Kong government lowered the tax for 50 ppm sulfur diesel from 2.00 HK$ per liter to 1.11 HK$ per liter resulting in the pump price with duty of 50 ppm sulfur diesel of 6.35 HK$ per liter which was slightly lower than that of regular diesel of 6.44 HK$ per liter.
Hong Kong Experience on Costs of Lower Sulfur Fuels

• As a result of a tax concession provided for low-sulfur diesel, there was not an additional cost to fuel consumers.

• When 10 ppm sulfur diesel was introduced in Hong Kong in 2007, its import price was higher than 50 ppm sulfur diesel by up to about 0.1 HK$ per liter. To encourage the use of the cleaner fuel, its duty was halved (0.56 HK$ per liter) of that of low-sulfur diesel to make it more price-competitive.
Recommendations on Cost Issue

• Since the incremental price of fuel when going down from 50 ppm to 10 ppm sulfur is less than a US cent (i.e. 0.11 to 0.31 US cent per liter), it is encouraged for import-dependent markets to jump to 10 ppm sulfur fuels (ultralow-sulfur) rather than 50 ppm sulfur fuels.

• There will be practically no constraints on considerable capital investment and time needed for upgrading any refinery to have the capability to produce low or ultralow sulfur fuels.
Recommendations on Cost Issue

• If it is necessary to equalize the incremental price of low-sulfur fuel, a mix of economic instruments, such as financing, subsidy, and taxation policies can be used to reduce economic and social impacts as in the case of Hong Kong.

• These instruments can also encourage early and rapid introduction of low-sulfur fuels.
Questions ????
Regulatory Process and Governance
Governance

• The policy process, tools and examples for transitioning to low sulfur fuels are covered in detail in the Partnership for Clean Fuels and Vehicles Regulatory Toolkit available online:

Regulatory Process

• Step 1: Develop science-based policy for how to address sulfur in fuels in relation to air pollution problem.

• Step 2: Necessary regulations with legal basis should be subsequently designed, developed, implemented, enforced and evaluated.
Science-based Policy: Background and Information Needed

• Status of air pollution problem and associated impacts
• Emission inventory and emission contribution from road transportation
• Fuel consumption
• Characteristics of existing fuels and distribution system
• Characteristics of existing vehicle fleets
• Characteristics of fuel and automotive industries
Components of Low Sulfur Fuels Action Plan

• What steps/actions/activities to be undertaken?
• What regulations to be developed?
• How to enforce, monitor/verify compliance and audit?
• By when (timeframe)?
• By whom?
• Needed resources including human and financial resources? >>>
Policy Instruments

- Regulatory Instruments
  - Norms & Standards
  - Environmental Liability
  - Environmental Compliance and Enforcement

- Economic Instruments
  - Environmental Taxes
  - Fees and User Charges
  - Certificate trading
  - Environmental Financing
  - Green Public Procurement
  - Subsidies

- Cooperation Instruments
  - Technology Transfer
  - Voluntary Agreements in adopting measures
  - Corporative Social Responsibilities (CSR)

- Informational Instruments
  - Eco-labelling
  - Sustainability Reporting
  - Information Centers
  - Consumer Advice Services
  - Environmental Quality Targets and Monitoring
Questions ?????
Matching Advanced Vehicle Emissions Standards to Cleaner Fuels (including Vehicle Imports and Second-Hand Vehicles)
Situations on Vehicle Emission Standards of Fuel Importing Countries

• Majority do not have emission standards or have lenient emission standards for both new and in-use vehicles in place.

• Usually dependent on vehicle imports, both new and used vehicles.

• Imported used vehicles can be very highly polluting.

• Advanced emission control devices are usually removed from used vehicles coming in to countries since they contain valuable precious metals.
Situations on Vehicle Emission Standards of Fuel Importing Countries

- Switching to import lower sulfur fuels will enable the country to adopt tighter emission standards for new and used vehicles imported into the country or produced locally.

- Consequently, newly registered vehicles added to the vehicle fleets on roads will be cleaner with low emissions and will not exacerbate air pollution situation.
Concomitant Vehicle Emission Standards with Lower Sulfur Fuels

• Vehicles and fuels must be treated as a system to achieve the optimum benefits from emissions control policy.

• It is essential to match right vehicle emission standards to fuel quality standards, in particular fuel sulfur contents, otherwise emission control devices used in vehicles will not perform efficiently to their full potential and hence higher emissions.

• It is important to ensure that advanced emission control devices used in vehicles to meet the adopted vehicle emission standards are not impeded by sulfur in fuels.
Concomitant Vehicle Emission Standards with Lower Sulfur Fuels

• For fuel importing countries, matching the right vehicle emission standards to the imported lower sulfur fuels will lead to reductions in emissions of air pollutants as well as climate pollutants.

• The same emission standards applied to locally produced and imported new vehicles have to also be applied to imported used vehicles to prevent highly polluting used vehicles coming into the country.
<table>
<thead>
<tr>
<th>Fuel Sulfur Contents</th>
<th>Concomitant Vehicle Emission Standards</th>
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<tbody>
<tr>
<td>Low-sulfur fuels ($S \leq 50$ ppm)</td>
<td>Euro 4-equivalent for light duty vehicles and earlier standards</td>
</tr>
<tr>
<td></td>
<td>Euro IV-equivalent for heavy duty vehicles and earlier standards</td>
</tr>
<tr>
<td>Ultralow-sulfur fuels ($S \leq 10$ ppm)</td>
<td>Euro 5 and 6-equivalent, U.S. Tier 2 and 3 for light duty vehicles and earlier standards</td>
</tr>
<tr>
<td></td>
<td>Euro V and VI-equivalent, U.S. 2010 emission standards for heavy duty vehicles and earlier standards</td>
</tr>
</tbody>
</table>
Impact of fuel sulfur levels and vehicle emission standards on PM$_{2.5}$ emissions from heavy-duty diesel vehicles

(Source: CCAC, 2016)
Enforcement of Vehicle Emission Standards

• When a country adopts vehicle emission standards, it is essential to ensure that locally produced vehicles and new/used imported vehicles are in compliance with the enforced emission standards before it is permitted to registered and used on roads.

• Vehicles or engines have to be subject to emission tests on a chassis or an engine dynamometer laboratory for compliance verification of their emissions.
Laboratory for vehicle emission test on dynamometers

Photo credit: Pollution Control Department of
Alternatives to vehicle emission test on dynamometers

• It is the responsibility of local vehicle manufactures and importers to submit a certificate of passing the standards, either “Type Approval Certificate” or “Certificate of Conformity”, to the country’s authorities otherwise vehicles will not be permitted to be registered or imported in to the country.

• Such emission testing certificates issued by international certified vehicle emission testing laboratories can be accepted.
Alternatives to vehicle emission test on dynamometers

- Imported used vehicles and vehicles made by any individual person have to be equally treated the same way as new vehicles as they will be registered the first time in the country.

- Vehicle emission tests can be performed locally once a certified vehicle emission testing laboratory is established within the country.

- Such a laboratory will have to also support the new Worldwide Harmonized Light Vehicle Test Procedure (WLTP).
Alternatives to vehicle emission test on dynamometers

• Another alternative is to employ a Portable Emissions Measurement System (PEMS) which can provide lower-cost on-road testing.
Questions ????
Inspection and Maintenance for Vehicle Imports and On-Road Vehicles
Needs for I/M Program

• Air quality benefits will be obtained only if emissions from vehicles when they are in normal use on roads are in compliance with the enforced standards.

• Vehicles need to be properly maintained on a regular basis to keep engines functioning properly and emission control devices performing efficiently in order to be in conformity with their corresponding new vehicle emission standards.

• Vehicles that are properly tuned and adjusted will be cleaner than vehicles out of tune.
Needs for I/M Program

• Vehicle’s owners tend not to have vehicles regularly maintained after warranty period is expired. Vehicles are brought to mechanics only when they have problem. As a result, performance of vehicle engines and emission control devices will deteriorate and vehicles become highly polluting.

• An effective in-use vehicle inspection and maintenance program has to be put in place to ensure engines and emission control devices of in-use vehicles are durable and emissions are effectively controlled throughout the vehicle useful life.
Inspection and Maintenance (I/M) Program

• The combination of inspection (I) and remedial maintenance (M) has become known as I/M. Targeted I/M programs can contribute substantially to reduce the pollution caused by such vehicles.

• Emphasis in I/M program is on identification of gross polluters within each technology category and have the failed vehicles repaired and retested to have emissions at the levels that they are supposed to.
Inspection and Maintenance (I/M) Program

• An I/M program based on periodically subjecting vehicles to a short test can identify polluting vehicles and, by requiring a retest after necessary maintenance assures their repair.

• Considerations in establishing of an I/M system
  – whether appropriate in-use vehicle emission standards and test procedures on which to base I/M are adopted,
  – whether there is the institutional capacity and willingness to enforce an I/M program, and
  – whether the repair sector has been trained sufficiently to be able to carry out the repairs.
Key Principles and Determinants for I/M Program

- In-use vehicle emission standards and test procedures
- I/M Program Structure and Institutional-Administrative Set up
- Technical Issues and Capacity Building
- Roadside Inspection Programs
- Public Participation in I/M
- Quality Assurance – Audit
- The “M” in I/M
In-use vehicle emission standards and test procedures

- Pollutants of concern will differ between diesel-fuelled vehicles (PM, smoke and NOx) and gasoline-fuelled vehicles (CO, HC and NOx).

- In-use vehicle emission standards and test procedures have to appropriately reflect the differences between each classification of vehicles taking into account differences in emission control technologies employed in vehicles.
In-use vehicle emission standards and test procedures

• Tightening of new vehicle emission standards should be followed by a concomitant tightening of in-use vehicle emission standards for those newer model vehicles.

• As vehicle technology advances, more sophisticated test procedures rather than “idle test” or “free acceleration test” are necessary including loaded mode tests that use a chassis dynamometer to simulate the works which an engine must perform and hence emissions in actual driving.
Loaded Mode Test Cycles Used for Emission Inspection of In-use Vehicles

For countries which have adopted EU or US vehicle emission standards for new vehicles, a European short loaded mode test cycle and the US derived IM240 test cycle (the first 240 seconds of the hot-start FTP cycle) can be used.
Alternatives to vehicle emission test on dynamometers

Another alternative is to employ a Portable Emissions Measurement System (PEMS) which can provide lower-cost on-road testing.
I/M Program Structure and Institutional–Administrative Set up

• In-use vehicles should be subject to I/M program when manufacturer warranty is expired or even earlier.

• Frequency of inspections should vary for vehicles with differing mileage accumulation rates and with more or less durable emission control systems.

• Public and commercial vehicles, for example, taxicabs and buses typically accumulate far more mileage in a given period than do private cars and therefore they should be subject to more frequent inspections.
I/M Program Structure and Institutional–Administrative Set up

• The actual implementation of I/M programs can be carried out by the private sector while governments should be a regulator.

• A well-functioning audit and quality assurance system is crucial and should be in place otherwise its credibility will be seriously compromised.

• Regular audits can be implemented by a special unit in the government agency responsible for the I/M program or can be outsourced to a private sector firm provided it is not operating a part of the I/M program.
I/M Program Structure and Institutional-Administrative Set up

• Test only systems where the inspection function is separated from the maintenance function have produced the best result.

• Combined inspections and repairs systems are very difficult to supervise and audit and have been found to be subject to poor quality control and corruption.

• A centralized inspection system with a limited number of large inspection centers will produce much better result than a decentralized system with a large number of small independent inspection workshops.
I/M Program Structure and Institutional–Administrative Set up

• Problems associated with decentralized system
  – Have lower numbers of customers which might not be economically feasible to operate and hence provides poor quality inspection and subjects to poor quality control.
  – If the test procedure is shifted to a “loaded test” with the use of a chassis dynamometer, the costs of new additional test equipment will make it difficult for small-scale inspection workshops.

• An appropriate fee structure should be developed in which vehicle owners pay the full costs of the I/M program including the costs of auditing and overseeing the program.
I/M Program Structure and Institutional–Administrative Set up

• Poor coordination between agencies involved in the implementation of an I/M program will hamper its effectiveness.

• Dialogue at the early stages of I/M program design should be taken and agreement is worked out regarding their specific roles and responsibilities.

• I/M program should be linked to registration of vehicles, i.e. failure to present proof of passing an inspection leads to denial of registration, to assure that all vehicles subject to the I/M program are actually inspected and repaired.
I/M Program Structure and Institutional–Administrative Set up

• A data management system is needed to ensure that all emission test data are transmitted to a central database at vehicle registrar office.

• It will be more effective if I/M inspection centers are linked by computers through which vehicle information together with emission test data are automatically transmitted on a real time basis to vehicle registrar office to prevent data tampering.

• Increased reliance on data management centers will make it necessary to strengthen the quality of the overall database on vehicles in actual use.
Technical Issues and Capacity Building

- Capacity building program has to be put in place
  - Staff of all inspection centers have to be trained and certified by government authority to have adequate capability to do proper emission tests, including calibration of equipment and maintenance of all hardware without which they will not be allowed to perform inspections.
  - Vehicle manufacturers can play an important role in providing training to mechanics to have sufficient capability to carry out the repairs on vehicles which fail the tests. They should be involved in the development of an overall strategy to upgrade the repair sector.
Roadside Inspection Programs

• “Clean for a Day” syndrome – Vehicles are tuned or catalytic converters are put back to pass periodical inspection and then immediately readjusted or catalytic converters removed afterward to gain more power but becoming high polluting.

• A roadside inspection can be carried out to remediate “Clean for a Day” syndrome complementing periodical inspection programs for in-use vehicle but not for replacement.
Roadside Inspection Programs

• On-road vehicles will be spotted and checked for emissions by policemen or official inspectors from transport or environment ministries or local authorities.

• Vehicles failing the tests will be subject to fine and prohibited to be used on the roads until they are repaired and pass the retest.
Roadside Inspection Programs

• Remote sensing technologies which emissions test equipment does not physically interact with the vehicle undergoing testing can also be used to complement roadside inspections as a screening step. 

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**Diagram Description:***

[Diagram illustrating the components of a remote sensing system: Data processing & video display, Source & detector module, Speed & acceleration detector, Video camera & license plate reader, Lateral transfer mirror, EDAR unit (vehicle emissions remote sensing system), Weather sensor, Camera (speed and license plate), Reflective strip.]
Roadside Inspection Programs

- Since the start of the Smoky Vehicle Control Program in Hong Kong in 1988, smoky vehicle reports received started to decline from 2000.
Public Participation in I/M

• Vehicle owners tend to be more interested in roadworthiness and safety of vehicles than in emission levels.

• It is important that public understand public health need for the program and believe that it is fair and effective to assure their positive perception and acceptance and their willingness to participate in I/M of vehicles.

• I/M program should have a strong routine public awareness and participation component that informs the public regarding the need for the program, the benefits which it is having and the overall performance.
Public Participation in I/M

• Performance standards, such as waiting times and pass/fail rates, should be developed for I/M centers which will guarantee fast and reliable testing for the public.

• Poorly performing centers should be penalized.

• To get a better cooperation from the public in I/M programs, tax incentives, lower registration fees, less frequent inspection for cleaner vehicles, or linkage to vehicle insurance rates may be considered.
Quality Assurance – Audit

• Quality assurance and auditing functions have to be fully built into the overall I/M program design.

• The less the test and audit systems need to rely on human judgment or manual actions, the more reliable the result.

• A fully automated test and data transmission to minimize the chance of data manipulation can greatly improve reliability of the test results, deter fraud and enable easier and more effective audits of performance of test centers and individual testers.
Quality Assurance – Audit

• Test fees should be set at a reasonable level that will allow private I/M centers to make a sufficient profit to maintain, replace and upgrade equipment as required for good quality testing.

• Calibration audits of test equipment, audits of test centers using the data reported, and covert audits of test centers should be made on a regular basis.

• The audit functions could be outsourced to independent third parties provided they are not operating a part of the I/M program.
The Maintenance “M” in I/M

• I/M programs need to include a particular focus on the repair sector, in particular where the repair sector is very informal and usually lacks good training or equipment.

• Vehicle manufacturers can play an important role in providing training to mechanics to have sufficient capability to be able to repair failed vehicles, in particular those equipped with modern advanced emission control technologies.
The Maintenance “M” in I/M

- The repair centers must have sufficient equipment to properly repair vehicles.

- Adequate training must be made available so that the mechanics and technicians are sufficiently skilled to repair the failed vehicles.

- In tightening the I/M requirements, careful attention should be made to assuring that the repair sector has sufficient lead-time, possibly one year, to equip itself to repair failed vehicles.
Questions ????
Lubricity of Fuels
Impact of Fuel Desulfurization on Lubricity of Fuels

• Removing sulfur from fuels, esp. diesel, in refining reduces components that provide natural lubricity

• Poor lubricity results in deterioration in fuel injection system

• Excessive wear of rotary fuel injection pump and fuel injectors in fuel injection system could also affect the combustion process and consequent higher emissions, or even lead to engine failure.

• Lubricating additives are readily available.
Other Emission Reduction Benefits Associated with Lower Sulfur Fuels

• Biodiesel with higher viscosity has excellent lubricating characteristics

• Blending 2% biodiesel can increase lubricity of petroleum based diesel fuel to the acceptable levels (EPA 2000).

• Other fuel parameters: benzene and aromatics
  - Lower sulfur gasoline (≤10 and ≤50 ppm S) have limits on benzene and aromatics contents of ≤1% and ≤35% respectively.
  - Low-sulfur (≤50 ppm S) and ultralow-sulfur (≤10 ppm S) diesel have limits on polycyclic aromatic hydrocarbons (PAH) of 11% and 8% respectively.
Declining Trends of Benzene and 1,3-Butadiene in Bangkok, Thailand
Questions ?????
Conclusions

• Sulfur reduction provides immediate near-term emissions reduction – including PM$_{2.5}$ and black carbon - from existing in-use vehicles, with/without emission control devices.

• Fuel-import dependent countries can shift relatively quickly to low sulfur or ultralow sulfur fuels

• No considerable capital investments, time needed for upgrading refineries.

• Cleaner fuels must be matched with vehicle emission standards, e. 10ppm, Euro 6/VI
Conclusions

• Challenges faced by fuel importing countries for lower sulfur fuels, vehicle emission standards:
  o costs to consumers
  o regulatory issues
  o matching advanced vehicle emissions standards to cleaner fuels
  o inspection and maintenance of vehicles, and
  o fuel lubricity.

• Actual price increase associated with low-sulfur fuel is always smaller than the normal fluctuation of market fuel prices; annual benefit-to-cost ratio could range from 4:1 to 16:1.
Conclusion

- Used vehicle import restrictions, emission standards should be combined with verification systems: international certified vehicle emission testing laboratories and/or Portable Emissions Measurement System (PEMS).

- Vehicle manufactures and importers should be required to provide a valid “Type Approval Certificate” or “Certificate of Conformity.”

- Centralized test-only I/M program has produced the best results; roadside inspection program can complement periodical inspection programs.
Resources

• The Climate and Clean Air Coalition, Heavy Duty Vehicles Initiative: http://www.ccacoalition.org/en/initiatives/diesel


• TRUE Real Urban Emissions Initiative: https://www.trueinitiative.org/


THANK YOU

www.ccacoalition.org
Questions ????