OVERVIEW OF THE ASIAN FUEL MARKET

THE EUROPEAN FUELS CONFERENCE – 9 March 2011

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Mission and Vision

- Working closely with fuel policymakers, regulators and stakeholders in the fuel industry, ACFA promotes and advances the use of cleaner automotive fuels based on principles of sound science, cost efficiency and sustainability of the environment.

- EFOA considers that ethers have an important role to play in creating a cleaner environment based on sustainable transport fuels. This is reflected in our mission: EFOA is dedicated to the promotion of ethers as fuel components towards a cleaner and sustainable future.
Asian Fuel Quality Issues

- Major Asian cities are among the most polluted in the world; 13 of the 15 most polluted cities in the world are from Asia.
- Continued growth in vehicle population.
- Significant improvements in fuel quality in the last decade.
- Lead phase-out almost complete.
- Fuel quality monitoring legislation lacking in many countries.
- Subsidised fuels in several countries.
- Fuel adulteration a major issue (market price distortion, taxation).
- Fuel quality is not harmonized among the countries.
Sulphur Content in Fuels (Asia Pacific)

- Fuel quality standards not harmonized across region
- Generally aim to align fuel and emissions regulations with EU
- Vast differences in regional fuel sulphur
- Most countries in 50ppm to 500ppm fuel sulphur range

<table>
<thead>
<tr>
<th>Sulphur level</th>
<th>* Only automotive diesel</th>
<th>** Only gasoline</th>
</tr>
</thead>
<tbody>
<tr>
<td>Leaded</td>
<td>Burma (leaded gasoline still on the market)</td>
<td></td>
</tr>
<tr>
<td>1,000 ppm to 10,000 ppm</td>
<td>Bangladesh, Cambodia, Nepal, Pakistan</td>
<td></td>
</tr>
<tr>
<td>500 ppm to 5,000 ppm</td>
<td>Brunei, Indonesia*, Laos*, Malaysia, Sri Lanka</td>
<td></td>
</tr>
<tr>
<td>50 ppm to 500 ppm</td>
<td>China, India, Philippines, Thailand, Vietnam, Fiji, Papua New Guinea, Indonesia**, Laos**</td>
<td></td>
</tr>
<tr>
<td>50 ppm</td>
<td>Taiwan, Singapore*</td>
<td></td>
</tr>
<tr>
<td>10 ppm</td>
<td>Japan, Hong Kong, South Korea, Australia*, New Zealand*</td>
<td></td>
</tr>
</tbody>
</table>

Source: IFQC, June 2010
Global Gasoline Sulphur Limits

Source: HART's International Fuel Quality Center, May 2010

- 10 ppm
- 30 ppm
- 30 - 80 ppm
- 150 ppm
- 200 - 600 ppm
- 1,000 - 2,500 ppm
Global Gasoline Benzene Limits

Source: HART’s International Fuel Quality Center, January 2010

- 0.7 - 1 vol % max
- 1.4 - 3 vol %
- 3.5 - 4.9 vol %
- 5 - 7 vol %
- No Standard
- No Information
Global Diesel Sulphur Limits

Source: HART’s International Fuel Quality Center, January 2010

- 10 or 15 ppm
- 50 ppm
- 300 - 500 ppm
- 1,000 - 12,000 ppm
### Emission Standards (New Light Duty Vehicles)

| Country                  | 95 | 96 | 97 | 98 | 99 | 00 | 01 | 02 | 03 | 04 | 05 | 06 | 07 | 08 | 09 | 10 | 11 | 12 | 13 | 14 |
|--------------------------|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
| European Union           | E1 | Euro 2 | Euro 3 | Euro 4 | Euro 5 | E6 |
| Bangladesh               | Euro 2 | Euro 2 | Euro 3 | Euro 4 | Euro 5 | E6 |
| Bangladesh²              | Euro 1 | Euro 2 | Euro 3 | Euro 4 | Euro 5 | E6 |
| PRC³                     | Euro 1 | Euro 2 | Euro 3 | Euro 4 | Euro 5 | E6 |
| PRC²                     | Euro 1 | Euro 2 | Euro 3 | Euro 4 | Euro 5 | E6 |
| Hong Kong, China         | Euro 1 | Euro 2 | Euro 3 | Euro 4 | Euro 5 | E6 |
| India                    | Euro 1 | Euro 2 | Euro 3 | Euro 4 | Euro 5 | E6 |
| Indonesia                | Euro 2 | Euro 3 | Euro 4 | Euro 5 | E6 |
| Republic of Korea        | No conclusive information available | Euro 1 | Euro 2 | Euro 4 | E6 |
| Malaysia                 | Euro 1 | Euro 2 | Euro 3 | Euro 4 | E6 |
| Nepal                    | Euro 1 | Euro 2 | Euro 4 | E6 |
| Pakistan                 | No conclusive information available | Euro 1 | Euro 2 | Euro 4 | E6 |
| Philippines              | Euro 1 | Euro 2 | Euro 4 | E6 |
| Singapore                 | Euro 1 | Euro 2 | Euro 4 | E6 |
| Singapore²               | Euro 1 | Euro 2 | Euro 4 | E6 |
| Sri Lanka                | Euro 1 | Euro 2 | Euro 4 | E6 |
| Taipei, China            | US Tier 1 | US Tier 2 Bin 7 | Euro 4 | E6 |
| Thailand                 | Euro 1 | Euro 2 | Euro 3 | Euro 4 | E6 |
| Vietnam                  | Euro 2 | Euro 3 | Euro 4 | E6 |

Source: CAI-Asia, 2008
## Current Select Gasoline Standards (North Asia)

<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
<td>RON</td>
<td>-</td>
<td>89/96</td>
<td>92/95/98</td>
<td>95</td>
<td>91/94</td>
</tr>
<tr>
<td>Aromatics vol%, max</td>
<td>-</td>
<td>36</td>
<td>35</td>
<td>24**</td>
<td>40****</td>
</tr>
<tr>
<td>Olefins  vol%, max</td>
<td>-</td>
<td>18</td>
<td>18</td>
<td>18</td>
<td>18</td>
</tr>
<tr>
<td>Benzene  vol%, max</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
<td>0.7</td>
<td>1.0</td>
</tr>
<tr>
<td>Oxygen   wt%, max</td>
<td>1.3</td>
<td>2.7</td>
<td>2.7</td>
<td>2.3</td>
<td>2.7</td>
</tr>
<tr>
<td>Sulphur  ppm, max</td>
<td>10</td>
<td>50</td>
<td>50</td>
<td>10</td>
<td>150</td>
</tr>
<tr>
<td>RVP      kPa</td>
<td>65/93*</td>
<td>60</td>
<td>60</td>
<td>60/96***</td>
<td>72/88*</td>
</tr>
</tbody>
</table>

* Summer/winter  
** Either aromatics 24 vol% max and olefins 16 vol%, or aromatics 21 vol% max and olefins 19 vol% max.  
*** Jun-Aug 60kPa; Oct-Mar 96kPa  
**** If total aromatics and olefins content is controlled, the maximum allowable aromatics limit is 41 vol%.
**Current Select Gasoline Standards (Southeast Asia)**

<table>
<thead>
<tr>
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</tr>
</thead>
<tbody>
<tr>
<td>RON</td>
<td>90/92/95</td>
<td>88</td>
<td>91</td>
<td>95</td>
<td>91/95</td>
<td>81/93/95</td>
</tr>
<tr>
<td>Aromatics vol%, max</td>
<td>40</td>
<td>no limit</td>
<td>50</td>
<td>40</td>
<td>35</td>
<td>35</td>
</tr>
<tr>
<td>Olefins vol%, max</td>
<td>38</td>
<td>no limit</td>
<td>no limit</td>
<td>no limit</td>
<td>no limit</td>
<td>no limit</td>
</tr>
<tr>
<td>Benzene vol%, max</td>
<td>2.5</td>
<td>no limit</td>
<td>5.0</td>
<td>5.0</td>
<td>3.5</td>
<td>2.0</td>
</tr>
<tr>
<td>Oxygen wt%, max</td>
<td>2.7</td>
<td>2.7</td>
<td>2.7</td>
<td>2.7</td>
<td>11*</td>
<td>2.0</td>
</tr>
<tr>
<td>Sulphur ppm, max</td>
<td>500</td>
<td>500</td>
<td>500</td>
<td>500</td>
<td>500</td>
<td>500</td>
</tr>
<tr>
<td>Lead g/l, max</td>
<td>0.005</td>
<td>0.3</td>
<td>0.013</td>
<td>0.013</td>
<td>0.013</td>
<td>unleaded</td>
</tr>
<tr>
<td>RVP kPa</td>
<td>43-75</td>
<td>69 (max)</td>
<td>45-60</td>
<td>45-60</td>
<td>62</td>
<td>85/62</td>
</tr>
</tbody>
</table>

* Oxygenates content vol% maximum 11
Fuel Specifications by 2012 (Asia Pacific)

**EURO V equivalent**
Australia, Hong Kong, Japan, New Zealand, South Korea, Taiwan

**EURO IV equivalent**
Singapore, Thailand

**EURO III equivalent**
China, India

**EURO II equivalent**
Brunei, Fiji, Indonesia, Laos, Malaysia, Philippines, Sri Lanka, Vietnam

**PRE-EURO or EURO I equivalent**
Bangladesh, Burma, Cambodia, Nepal, Pakistan

Source: IFQC, June 2010
Growing interest in biofuels in Asia following USA and EU

- Supporters: energy security, rural development and climate change reasons
- Critics: competition with food, not cost effective in reducing emissions, implementation requires huge financial support, impact biodiversity negatively

Most biofuels programs comprise ethanol component in gasoline and biodiesel

Biofuel policies, mandates and targets set in a number of Asian countries but need to overcome several obstacles in practice
Global Ethanol Blending Limits

Source: HART’s Global Biodiesel Centre: February 2010

- 25 vol % max
- 24 vol % max
- 7-10 vol % max
- 5 vol % max
- 3 vol % max
- No Blends/Data
What are the drivers for Fuel market evolution

• International
  – Kyoto Protocol
  – CO, NOx, VOC, PM
• Environment and health
• Refining Industry and technology
• Vehicle park / engine technologies
• Age of vehicle fleet
• Gasoline and diesel
• After treatment technology
• Direct injection
• Hybrids
• Fuel cells
• Energy security
• Politics
• Local economic conditions: government interests, taxes, subsidies, fuel adulteration
• Fuel specifications: lead, sulphur, distillation, aromatics, octane, additives, oxygenates, lubricants
• Alternative fuels
Is there a need for cleaner fuels?

- The air pollution problem in most Asian metropolitan areas is significant, in some places chronic.
- Both fuels and motor vehicles are the major contributor to the air pollution problem.
- Experience from the USA, EU, Japan shows that improving fuel quality and controlling vehicle emissions results in better air quality.
- Modern vehicles need cleaner fuels to meet the stricter emissions standards and to operate as designed.
- Euro 4 or better fuels are preferred.
5-10 Years Fuel Quality Outlook in Asia

- Continued demand increase for vehicles and fuels
- Fuel standards closely related to vehicle emission standards
- Continued pressure to reduce urban air pollution
- Continued lead phase-out
- Reduced benzene, aromatics and olefins in gasoline
- Progressive reduction in sulphur
- Growing role of biofuels but not enough to replace conventional transport fuels
- On-road engines remain key focus in Asia
- Growing policy focus on reducing CO2, greenhouse gas emissions and increasing vehicle efficiency
Clean Fuel Investments

- Between 2007-13, approx. ~368 refinery projects are announced in Asia Pacific alone
- Around 35% of announced projects are product quality related and mainly for Clean Fuel
- % Investment type categorized as

  - By 2011 – Most countries are ambitious to achieve Cleaner diesel & gasoline
  - Short term excess capacity build up affect refining margins
  - Some projects may be delayed
  - Environment pressures continue to drive investment

Source: Wood Mackenzie
In Europe legislations on fuels along with fuel quality standards, pollutant emissions limitations are being developed.

The philosophy of this development is about having the right vehicle for the right fuel. One could not do with one without the other.

These legislations could be a source of inspiration for Asia as

These developments are closely being followed by Asia.
• ACFA covers a huge region going from the Middle east right up to Australia
• Fuel standards are far from being the same in all regions
• Asia is moving towards improving fuel quality and controlling vehicle emissions for better air quality

• Thank you for your attention!