

MTBE and Clean Gasoline in Asia

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Who is ACFA?

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.**

THE IMPORTANCE OF MTBE TO ASIA

Most Immediate: Cutting Vehicle Emissions



Where is Asia now in gasoline quality

- **Despite the sharp increase in demand for clean fuels (more than seven-fold in 19 years or +11.2% per annum), the gasoline quality in many Asian countries is far from being satisfactory.**
- **In fact, major Asian cities are still among the most polluted in the world. 13 in 15 of the world's most polluted cities are in Asia.**

Clean Gasoline in Asia



- 1990s: Middle East and Asia/Pacific.
- **In Asia/Pacific the main driving force was the real necessity of clean air through cleaner fuels legislation.**
- MTBE begun to be commonly imported in Taiwan, Thailand, Indonesia, and largely produced and consumed in Saudi Arabia, South Korea.
- The main driving force in Middle East was the need of MTBE for lost octane from lead phase out and as high sulphur levels are gradually reduced in gasoline.

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	15	16	17	18
European Union	E1	Euro 2				Euro 3			Euro 4			Euro 5				Euro 6								
Hong Kong, China	Euro 1	Euro 2				Euro 3			Euro 4			Euro 5												
South Korea												Euro 4		Euro 5										
China ^a						Euro 1			Euro 2			Euro 3		Euro 4										
China ^e					Euro 1			Euro 2		Euro 3			Euro 4		Euro 5									
Taipei, China						US Tier 1							US Tier 2 Bin 7 ^f											
Singapore ^a	Euro 1					Euro 2																		
Singapore ^b	Euro 1					Euro 2							Euro 4					Euro 5						
India ^c							Euro 1			Euro 2				Euro 3										
India ^d					E1	Euro 2			Euro 3			Euro 4												
Thailand	Euro 1					Euro 2			Euro 3							Euro 4								
Malaysia			Euro 1										Euro 2 ^g											
Philippines								Euro 1			Euro 2							Euro 4						
Vietnam												Euro 2					Euro 4							
Indonesia											Euro 2													
Bangladesh ^a											Euro 2													
Bangladesh ^b												Euro 1												
Pakistan															Euro 2 ^a		Euro 2 ^b							
Sri Lanka								Euro 1																
Nepal						Euro 1																		

Notes:

*The level of adoption vary by country but most are based on the Euro emission standards

Italics – under discussion; a – gasoline; b – diesel; c – Entire country; d – Delhi, Mumbai, Kolkata, Chennai, Hyderabad, Bangalore, Lucknow, Kanpur, Agra, Surat, Ahmedabad, Pune and Sholapur; Other cities in India are in Euro 2; e – Beijing [Euro 1 (Jan 1999); Euro 2 (Aug 2002); Euro 3 (2005); Euro 4 (1 Mar 2008); Euro 5 (2012)], Shanghai [Euro 1 (2000); Euro 2 (Mar 2003); Euro 3 (2007); Euro 4 (2010)] and Guangzhou [Euro 1 (Jan 2000); Euro 2 (Jul 2004); Euro 3 (Sep-Oct 2006); Euro 4 (2010)]; f – Equivalent to Euro 4 emissions standards; g – for gasoline vehicles only

Source: CAI-Asia. December 2011. Emission standards for new light-duty vehicles

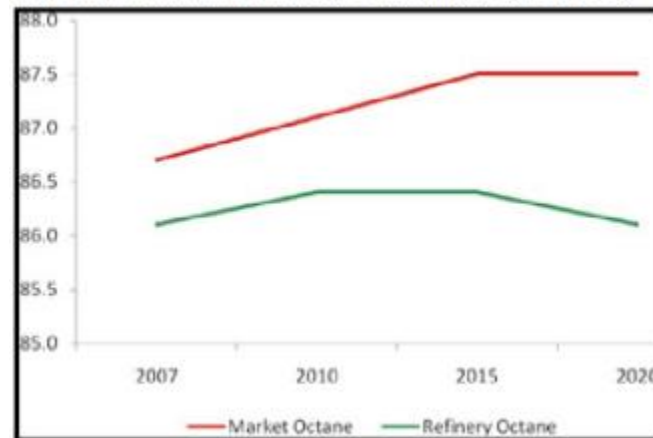
Gasoline Specifications (Asia)

Markets	As at Sep 2011	Target 2012-2014
Bangladesh	Pre Euro	Pre Euro
Brunei	Pre Euro	Euro II
Burma	Pre Euro	Pre Euro
Cambodia	Pre Euro	na
Nepal	Pre Euro	Pre Euro
Pakistan	Pre Euro	Pre Euro
Sri Lanka	Pre Euro	Euro II
Indonesia	Euro II	Euro II
Malaysia	Euro 2M	Euro 4M
Philippines	Euro II	Euro IV
Thailand	Euro II	Euro IV
Laos	Euro II	Euro II
Vietnam	Euro II	Euro IV
India (national)	Euro II	Euro II
India (cities)	Euro IV	Euro IV
China (national)	Euro IV	Euro IV
Hong Kong	Euro IV	Euro IV
Taiwan	Euro IV	Euro V
Japan	Euro V	Euro V
S. Korea	Euro V	Euro V

Octane Trends 2007-2020

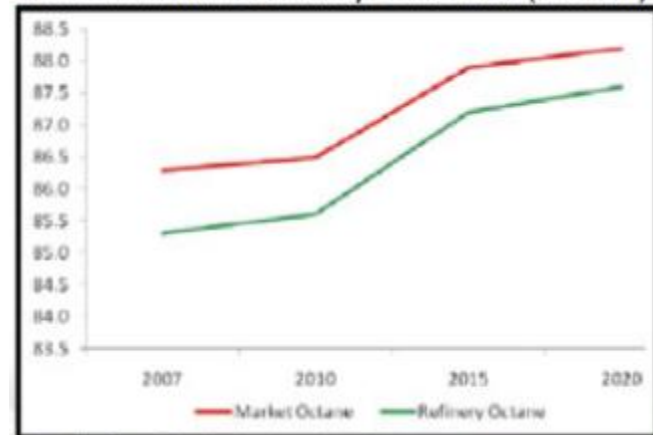
- Octane replacement due to fuel quality improvements (lead phase-out, reduction in sulphur, benzene, aromatics, olefins).
- Expanding vehicle fleet and growing gasoline demand.
- Vehicle technology advances need cleaner fuels to meet the stricter emissions standards and to operate as designed.
- Increase in minimum octane grade.
- Growing demand for higher grade gasoline.
- Market is octane-short (especially clean octane.)

Asia Pacific Market & Refinery Octane Trends (2007-2020)



Source: Hart Energy Consulting (www.hartwrfs.com)

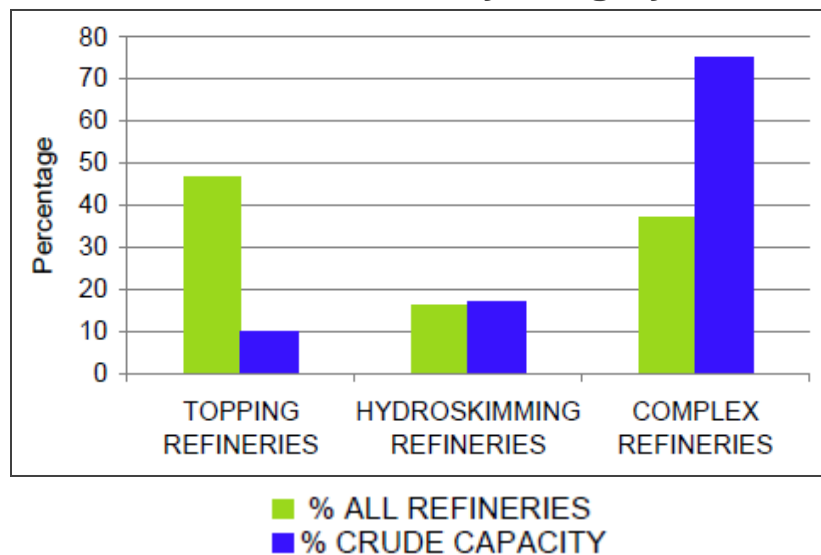
Middle Eastern Market & Refinery Octane Trends (2007-2020)



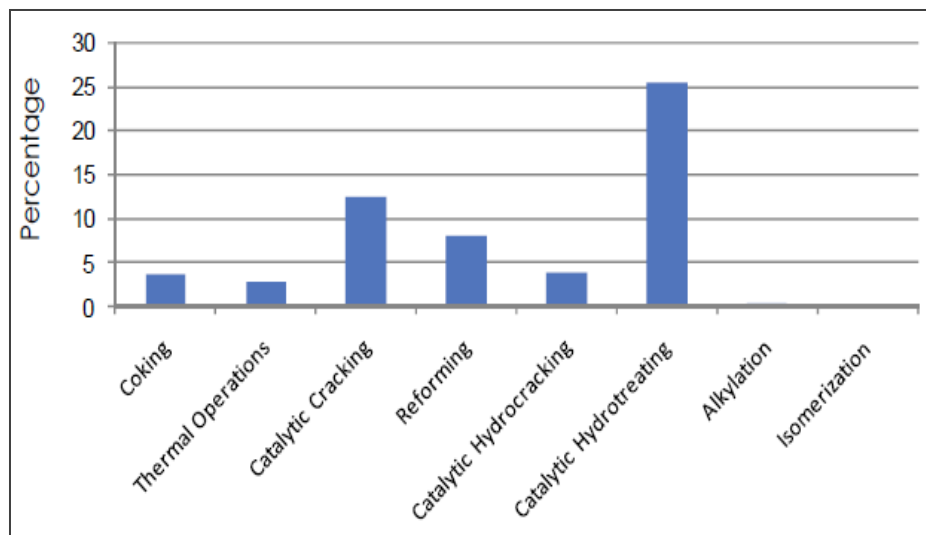
Source: Hart Energy Consulting (www.hartwrfs.com)

Snapshot of Asian refineries

Asian refineries by category



Refinery complexity as a % of crude capacity in Asia (exclude Japan)



Source: J. Courtis in CAI-Asia: A Roadmap for Cleaner Fuels and Vehicles in Asia, Nov 2008

Octane Boosting Options

- Ethers
 - Methyl-tert-butyl ether (MTBE)
 - Ethyl-tert-butyl ether (ETBE)
- Alcohols
 - Ethanol
 - Methanol
 - Tert-butyl alcohol (TBA)
- Hydrocarbons
 - Aromatics (benzene, toluene)
 - Iso-octane (2,2,4 – trimethylpentane)
 - Alkylates
- Metallic additives
 - Lead (tetra-ethyl lead)
 - MMT (methylcyclopentadienyl manganese tricarbonyl)

- *Economics & regulations are the deciding factor on octane selection to meet specifications.*
- *Each octane component has benefits & limitations when blended into gasoline.*

Air Quality: Gasoline Emissions Impact

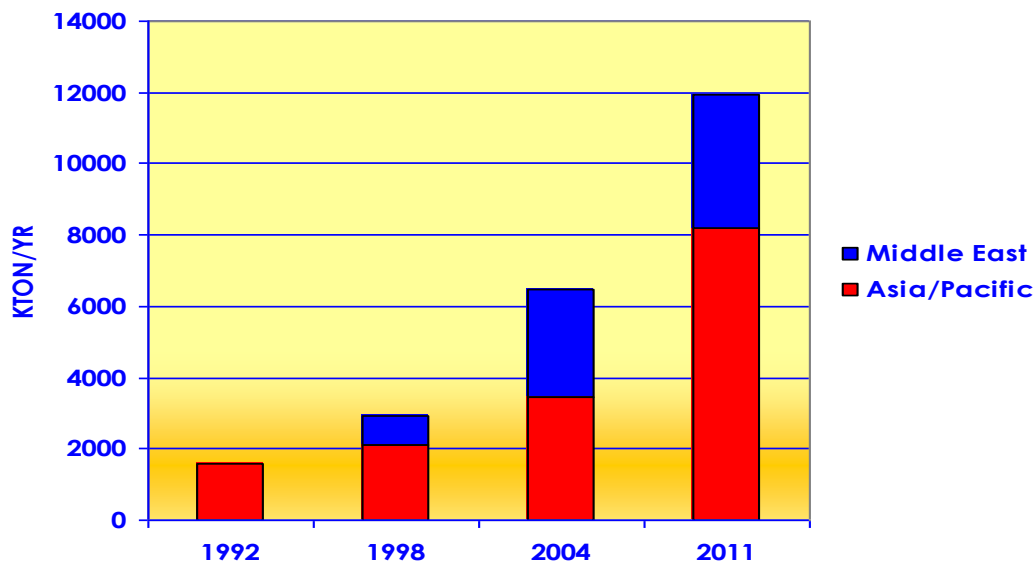
	Emission Impact		
	VOC	NO _x	Toxics
Reformate	Moderate	Low/Mod	High
Alkylate	Moderate	Low	Low
Isooctane	Low	Low	Low
Benzene	Low	Low	Very High
Toluene	Moderate	Low	High
MTBE	Reduction	Low	Reduction
ETBE	Reduction	Low	Reduction
Ethanol	High	Moderate	Reduction
Methanol	High	Moderate	Reduction
t-Butanol	Low	Low	Reduction
MMT	None	Reduction	Unclear

Source: Hart Energy Consulting

MTBE IN ASIA

History of MTBE in Asia

FUEL ETHERS DEMAND IN ASIA 1992-2011



Sources: DeWitt & Co, Inc. 1995, 1999, 2006-2007 JJ&A 2010

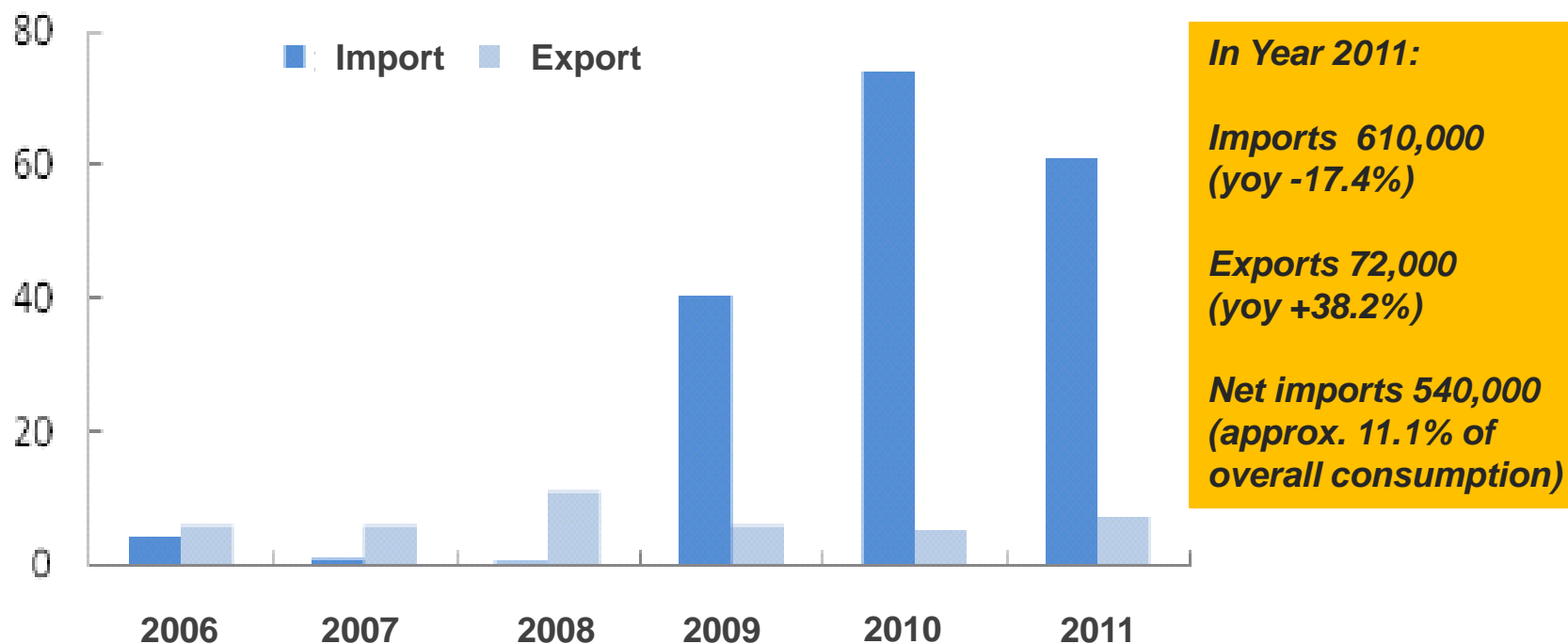
- In 1992, MTBE demand in Asia 1.6M ton, or 16.5% of world demand. (DeWitt)
- This increased to 2.9M ton in 1998 and 6.5M ton in 2004. (DeWitt)
- In 2011 the expected cumulative demand of MTBE+ETBE in Asia is set at 11.9M ton or 56.4% of world demand. (JJ&A)

Asia needs MTBE

- **Asia has surpassed the 50% share of world demand for fuel ethers (MTBE + ETBE).**
 - China is the world's largest MTBE producer with approx 6.8M ton/yr of installed capacity at the end of 2010.
 - In 2009 China turned net importer of MTBE, importing approx. 400 Kton. In 2010 this increased to 740 Kton.
 - Despite the announcement of new units being in construction or projected, China is likely to remain a net importer for the medium-long term.

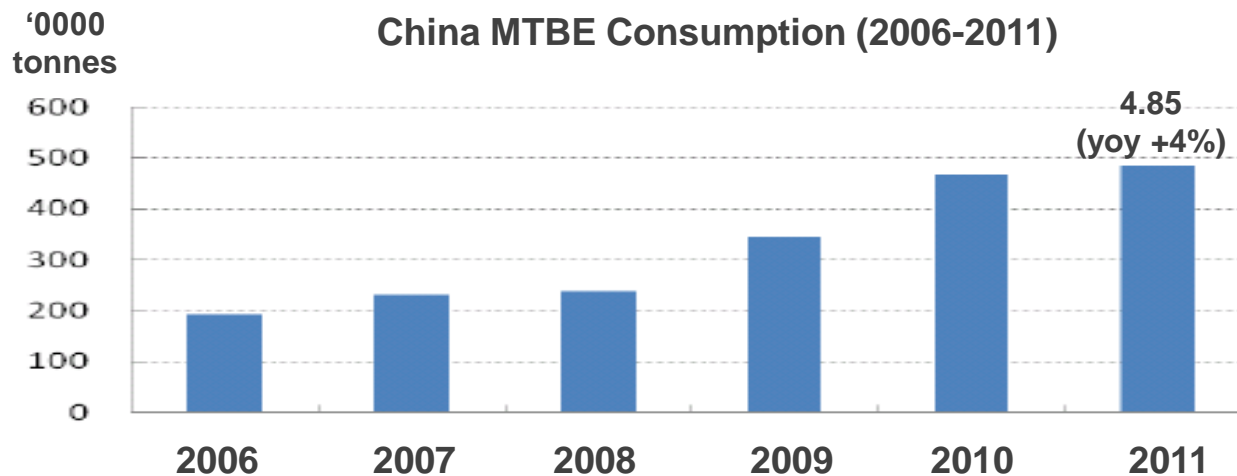
China MTBE Import/Export

China MTBE Imports versus Exports (2006-2011)



Source: C1 Energy

China: Asia's fastest growing and largest MTBE market



	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2013	2015
Nationwide	Euro I		Euro II				Euro III (Gasoline)		Euro IV (Gasoline)			Euro IV
Beijing	Euro I	Euro II		Euro III		Euro IV				Euro V		
Guangzhou	Euro I		Euro II			Euro III		Euro IV			Euro V	
Shanghai	Euro I		Euro II				Euro IV				Euro V	

MTBE in Asia

- **Besides China there are other three Asian markets where MTBE is largely imported: Singapore, South Korea and Taiwan.**
 - They have both domestic production and import.
 - Overall, their 2009 imports were in excess of 800 Kton.
 - On top of this demand, the three countries have an installed capacity of 1.75M ton/yr.
- **Malaysia owns the biggest MTBE merchant unit in Asia/Pacific.**
 - Installed capacity close to 350 Kton/yr.
 - Used to be exporter but became medium-sized importer in the last few years.

Concluding Remarks

- **Clean gasoline is critical in the battle for clean air.**
- **Tighter fuel quality requirements will support MTBE's long term viability and sustainability in Asia's fuels landscape.**
- **Fuel quality improvements require clean-burning blending components such as MTBE.**
- **MTBE is a proven clean fuel component that has more than 30 years of track record.**

Thank You!

If you have any queries, please contact:

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