

REFINING LANDSCAPE
BEYOND 2010
MALAYSIA

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Technology Symposium

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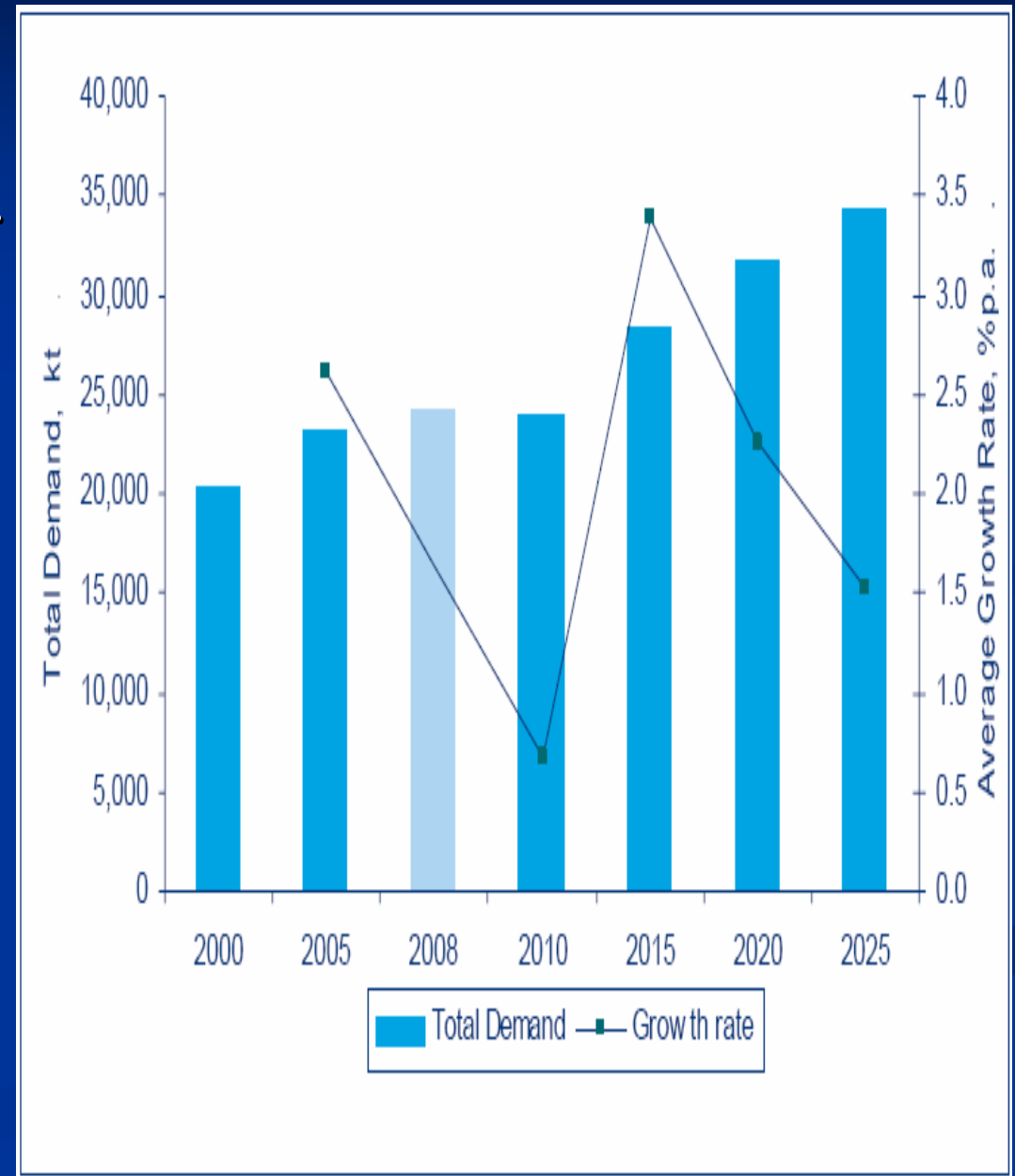
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Presentation Outline

- Projected refinery supply and demand balance
- Potential solutions to address domestic shortfall
- Product quality issues and the way forward

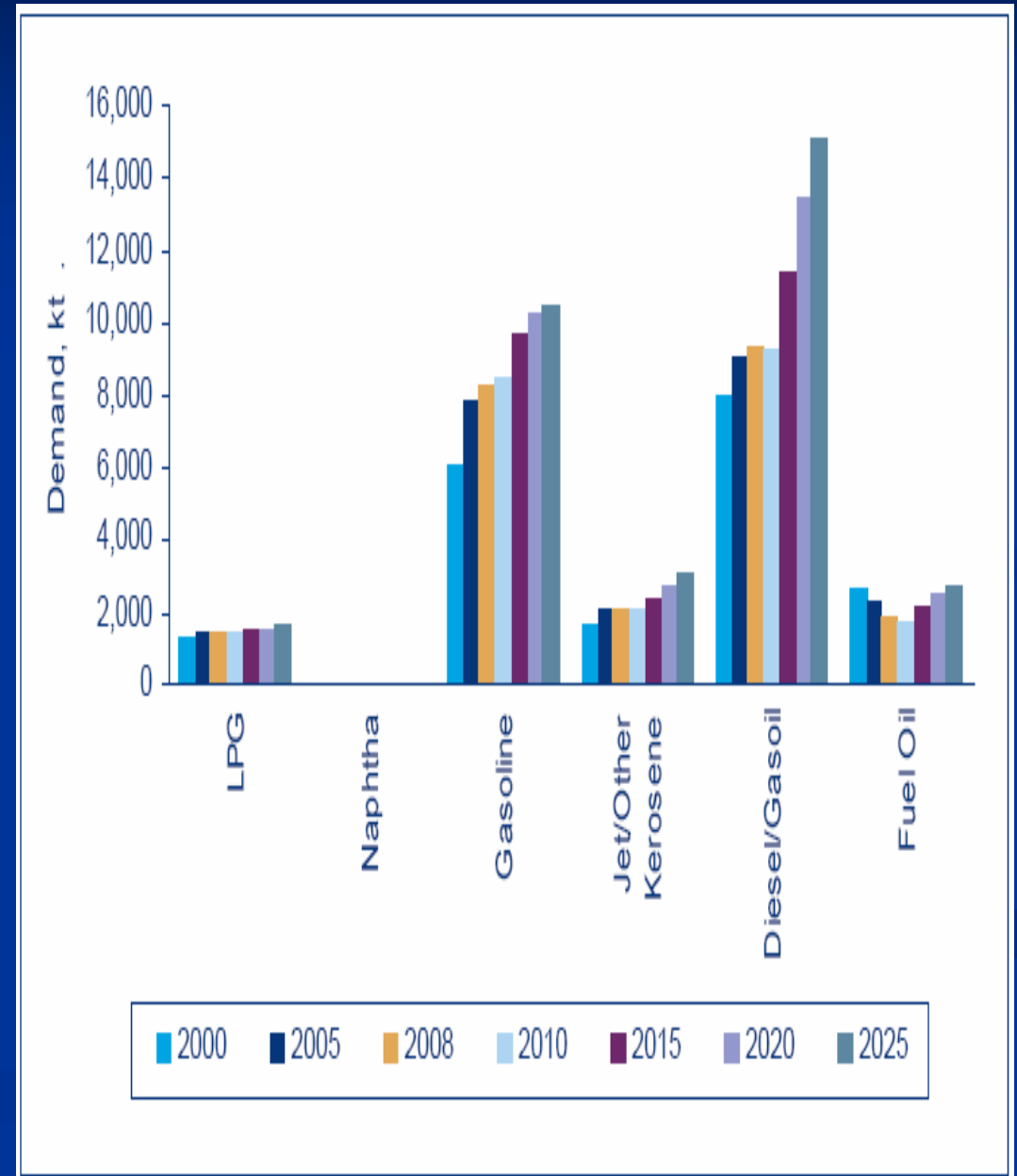
Malaysia Refinery Products Demand

- Total product demand forecasted to grow from 24 Mt in 2008 to 32 Mt in 2025.
- Transport fuel and industrial demand in diesel and gasoil are the main driver for the growth.
- Fuel oil demand growth rate expected to return to a positive path after 2010 as industrial switch back to diesel & gasoil for energy source.



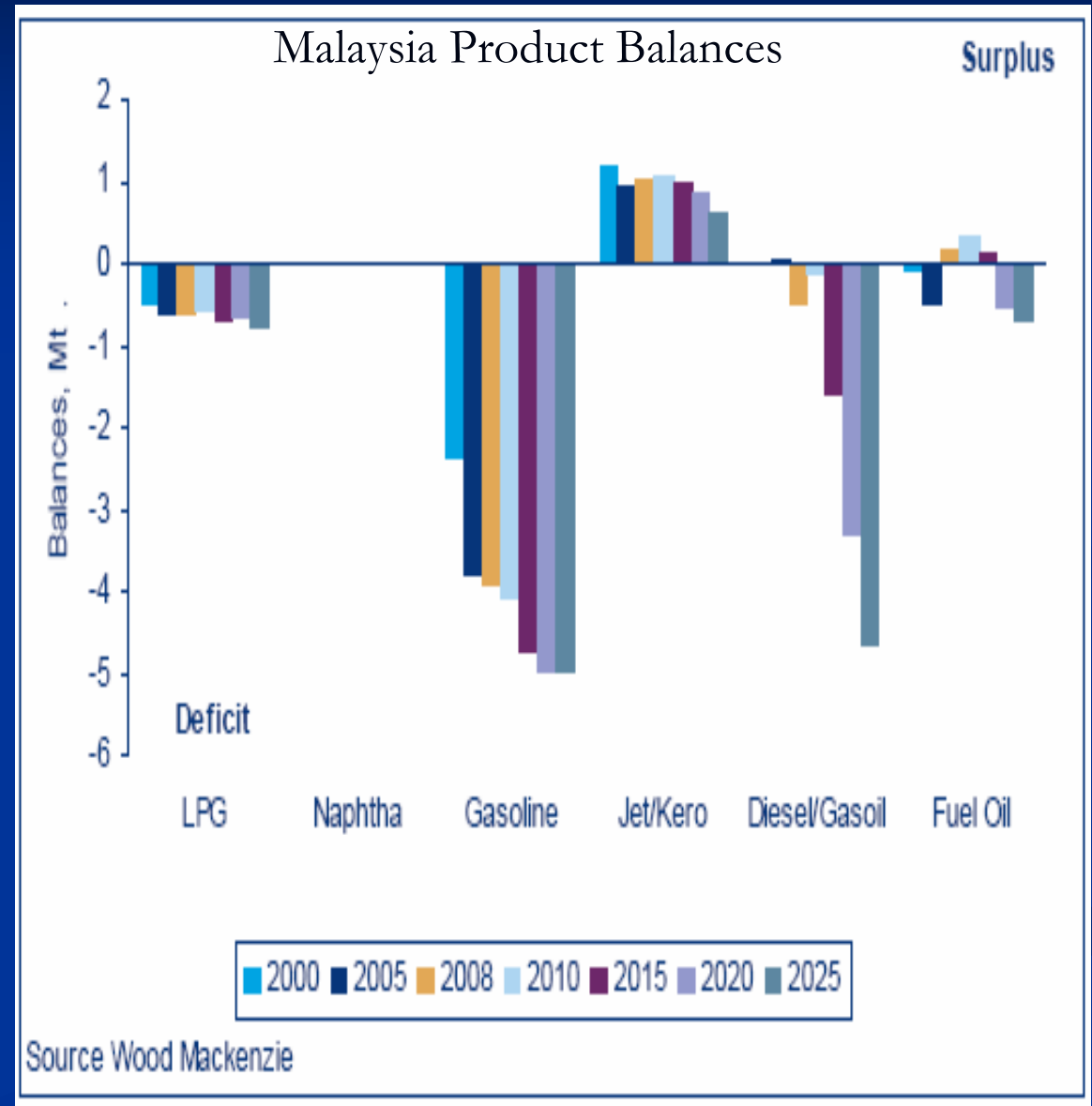
Refinery Products Demand Trends

- Demand on the refinery product expected to strengthen in the long run
- Gasoline demand is expected to increase by 1.4% per annum mainly coming from transportation sector.
- Diesel/gasoil demand is expected to increase nearly 3% per annum, mainly due to high demand from transportation & industrial sectors.



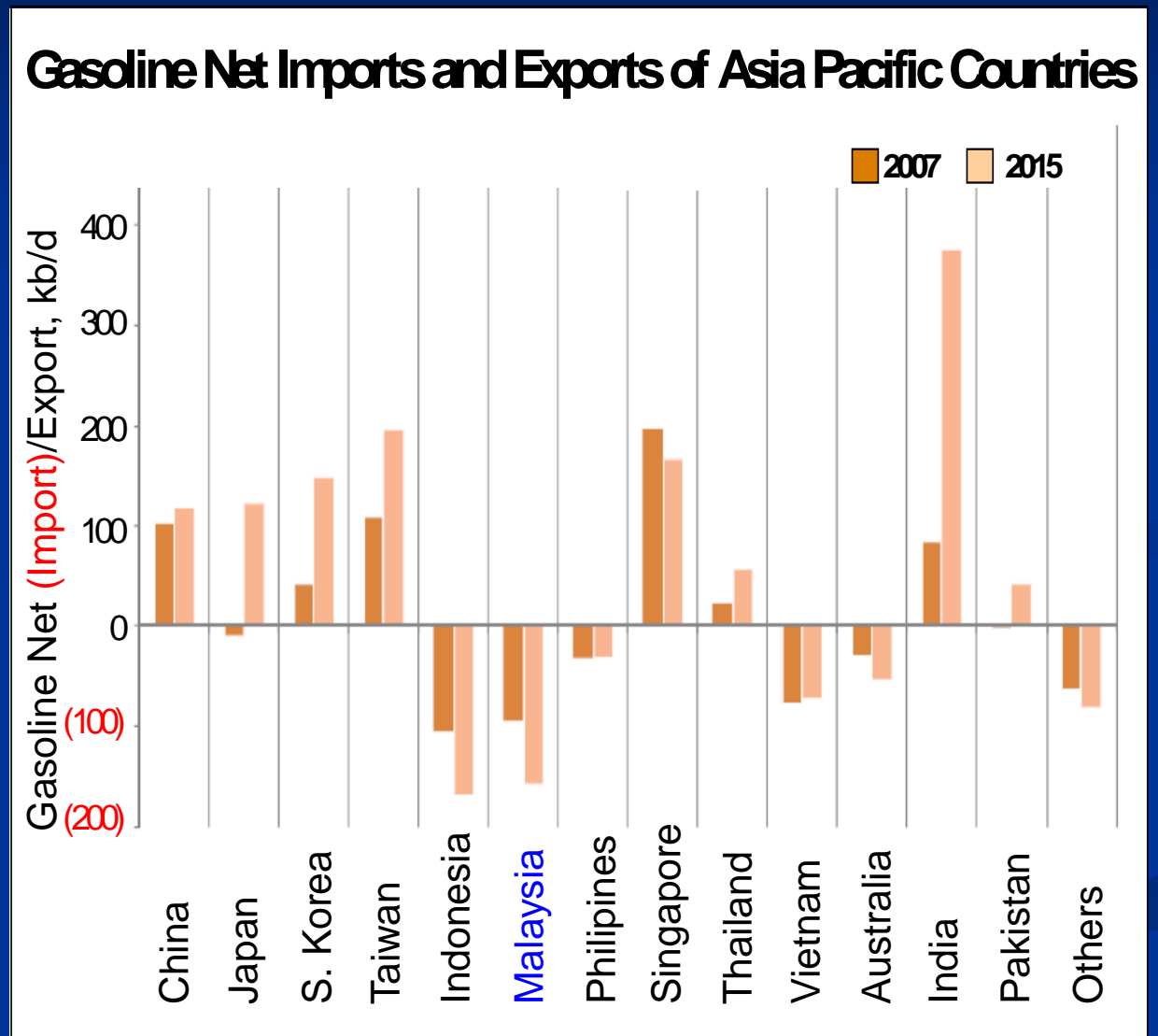
Refinery Supply / Demand Balance

- Gasoline remains deficit through to 2020, demand growth at an average of 3.2% p.a.
- Diesel/gasoil remains balanced up to 2010. Slow supply growth vs increase demand resulted in deficit beginning to open up by 2020.
- Fuel oil remains deficit through to 2020, demand and supply remain unchanged.



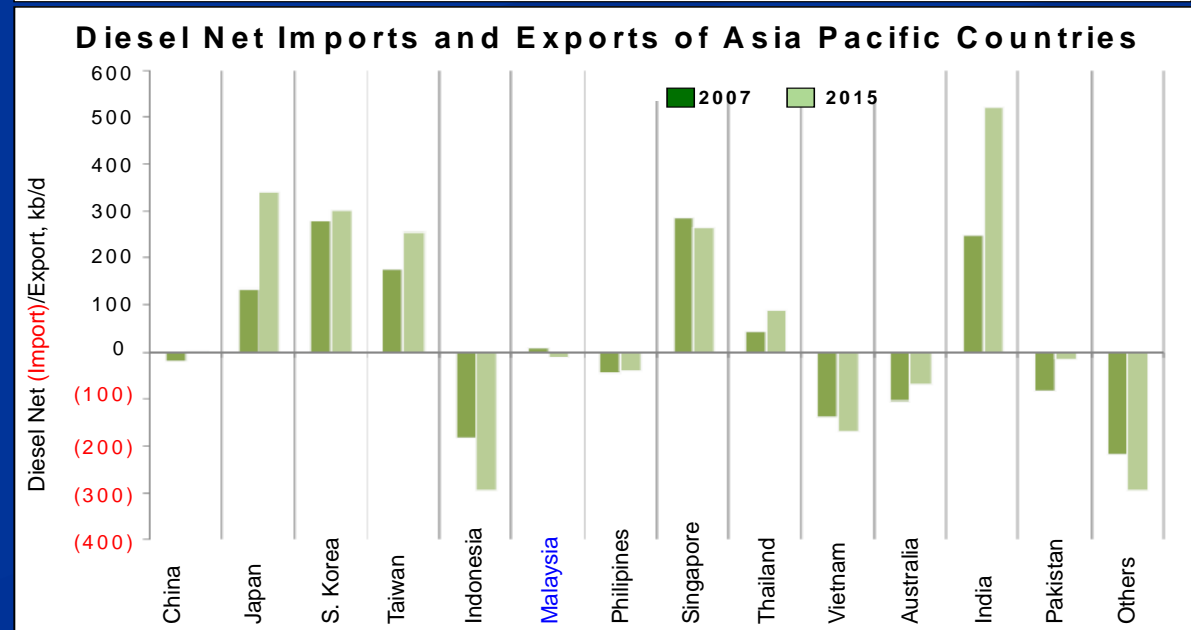
Gasoline Balance : Imports/Exports

- 2nd largest gasoline importer in Asia Pacific
- 40% increase in imports over 8 yrs
- Demand growth will diminish with higher pump price



Mid Distillate Balance : Imports/Exports

- Balanced position for the foreseeable future if quality specs remain unchanged
- Tightening of sulphur specs to 50ppm will result in dramatic drop in supply position.



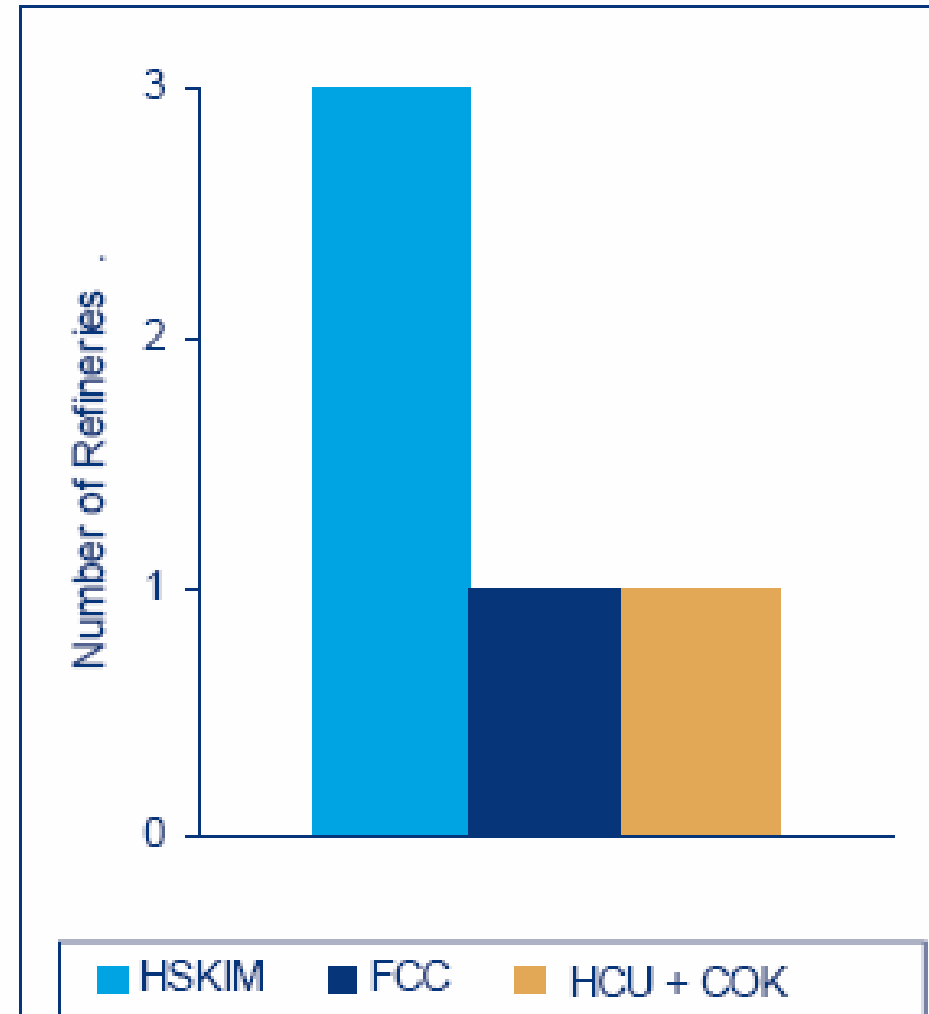
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Present Malaysia Refining Capacity

- No of refineries : 5
- Total refining capacity : 0.6 Mbcd
- Average refinery size : 113 kbcd
- Three hydroskimmers account for 51% of total capacity.
- Two of the hydroskimmers are integrated with adjacent complex refineries.

Number of Refineries by Type



Source Wood Mackenzie

Product Imbalance or Deficit

- Small middle distillate surplus ~30kbd
- Potential residue for upgrading ~20kbd
- Gasoline shortfall ~150-180kbd

Therefore, not much room for residue conversion units, additional refining capacity required.

Refinery Investment

Confirmed refinery expansion and capacity creep projects to increase product supply.

Refinery	Sponsor	Unit	Capacity (kbd)	Completion
Melaka I	Petronas	Lubes	7	2008
Melaka II	JV Petronas & Conoco Phillips	CDU expansion	45	2010
		VDU expansion	22	2010
		DHCU expansion	10	2010

Announced Projects

- SKS Refinery, Bukit Kayu Hitam, Kedah state
 - 200-250 kbd complex refinery
 - Iranian crude, China/Northeast Asia market
 - FEED in beginning Sept'2008
- Gulf Petroleum, Manjung, Perak state
 - 100-150 kbd refinery and petrochemical complex
 - PG crude, 60% export and 40% domestic market
 - Feasibility study end-October'2008
- China-Malaysia Oil Refinery, Pulau Carey, Selangor state
 - 200 kbd refinery
 - Unknown crude, China market
 - JV agreement signed Sept'2007

Possible Short Term Options

- Market-related pump prices
 - Significant hike in diesel, relative to gasoline
(pro-gasoline)
- Postpone Euro-II implementation
 - No (0.05-0.30%) sulphur premium for diesel
(pro-diesel)
- Bio-diesel implementation in February 2009
(pro-diesel)
- Encourage NGV and hybrids

Medium Term: Buy or Build?

BUY

- ✓ Substantial medium-term Asian capacity additions = cheaper products
- ✓ Product quality heading towards a global standard

BUILD

- ✗ Crude sourcing can be an issue
- ✗ Poor refining margins likely
- ✗ Only deep conversion refineries will survive
- ✗ Requires economies of scale
- ✗ High capital costs investment

Possible Long Term Options

- Investment in quality upgrading such as isomerization units for naphthas and hydrotreaters for middle distillates
- Conversion units to upgrade remaining residue from existing hydroskimmers
- New refining capacity with maximum conversion e.g. grassroots refinery

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Product Quality Scenarios

- Generally, quality lagging in Asia-Pac region (Euro-I level)
- Gasoline RON 95 can be considered over-specified for majority of the car population
- Implementation of some Euro-III/IV specs problematic as current capacity is not geared for stringent product specifications.
- Gasoline produced in Malaysia contains less than 150 ppm sulphur, complies to Euro-II specification
- Diesel however has sulphur levels between 200 to 2800 ppm.

Gasoline (Sulphur) Specification Trends in Asia Pacific

	Sulfur (ppm)											
	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Australia	500	150	150	150	50	50	10	10	10	10	10	10
Bangladesh	1,000	1,000	1,000	1,000 - 500	1,000 - 500	1,000 - 500	1,000 - 500	1,000 - 500	500	500	500	500
China	800 - 500	500 - 150	500 - 150	500 - 150	500 - 150	150 - 50	150 - 50	150 - 50	150 - 50	50	50	50
Hong Kong	150	50	50	50	50	10	10	10	10	10	10	10
India	1,000 - 500	500 - 150	500 - 150	500 - 150	500 - 150	500 - 150	150 - 50	150 - 50	150 - 50	150 - 50	150 - 50	50
Indonesia	2,000	2,000	2,000 - 500	500	500	500	500	500	50	50	50	50
Japan	100	50	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10
Malaysia	1,000	1,000	1,000	1,000 - 500	500	500	500 - 50	50	50	50	50	10
New Zealand	500	150	150	150	50	50	10	10	10	10	10	10
Pakistan	10,000	10,000 - 1,000	1,000	1,000	1,000 - 500	500	500	500	150	150	150	150
Philippines	1,000	1,000 - 500	500	500	500	500	50	50	50	50	50	50
Singapore	500	500 - 50	50	50	50	10	10	10	10	10	10	10
South Korea	130	130	50	50	50	10	10	10	10	10	10	10
Sri Lanka	1,000	1,000	1,000	1,000	1,000 - 500	1,000 - 500	500	500	500 - 150	150	150	150
Taiwan	275	180	150	50	50	10	10	10	10	10	10	10
Thailand	500	500	500	500	500	500	500	500	50	50	50	10
Vietnam	10,000 - 5,000	5,000	1,500	500	500	500	150	150	150 - 50	150 - 50	150 - 50	50



Countries with Changes in Fuel Specifications Becoming Effective in 2007

Malaysia (2007)

- Gasoline**
- Sulfur 1,000ppm → 500ppm
 - RVP 70 kPa → 65 kPa
 - IBP 40°C → to report
 - **Density 725-780 kg/m³**

- Diesel**
- Sulfur 3,000ppm → 500ppm
 - Cetane number 45 → 49
 - Cetane index 47 → 49
 - T90 370°C → T95 370°C
 - Cloud point 18°C removed
 - **Density 810-870 kg/m³**
 - **Lubricity 460 μm**
 - **Conductivity 50 pS/m**

Taiwan (January 2007)

- Gasoline**
- Sulfur 180ppm → 50ppm
 - **Aromatics 36 vol%**
 - **Olefins 18 vol%**
 - Oxygen 2.0 wt% → 2.7 wt%
 - RVP 61 kPa → 60 kPa

Japan (January 2007)

- Diesel**
- Sulfur 50ppm → 10ppm

Vietnam (January 2007)

- Gasoline**
- Sulfur 1,000ppm → 500ppm
 - Benzene 5 vol% → 2.5 vol%
 - Oxidation stability 240 min → 480 min
 - RVP 43-80 kPa → 43-75 kPa
 - **Aromatics 40 vol%**
 - **Olefins 38 vol%**
 - **Oxygen 2.7 vol%**
 - **Metal 5 mg/l**

Diesel (phased out 5,000ppm grade):

- Cetane index 45 → 46
- Flash point 50°C → 55°C
- **Density 820-860 kg/m³**
- **Lubricity 460 μm**
- **Particulates 10 mg/l**
- T90 370°C → 360°C
- Pour point 9°C → 6°C
- Water 0.05 wt% → 0.02 wt%
- Viscosity 1.6-5.5 cSt → 2-4.5 cSt

New specifications shown in red



ENERGY CONSULTING

Way Forward

- Government to firm up implementation date of Euro 2M, target 2009.
- Firm up the plan to implement Euro IV quality fuel within five years of implementation of Euro II. Early notification to refiners will smoothen the implementation.

Conclusion

- Malaysia currently has a very small deficit of refinery output versus domestic demand
- Stronger economic growth post 2010 expected to move deficit all supply of total products just prior to 2015
- Mogas account for bulk of product shortfall (35%), a new 150 kbd complex refinery needed by 2015
- There are still residue upgrading opportunities of >20kbd.
- Implementation of Euro II post no major impact to gasoline supply however some adjustment on operation and blending facilities needed to reduce sulphur level in diesel.

THANK YOU