# OIL SANDS PRODUCTS ANALYSIS FOR ASIAN MARKETS

Prepared For:

**ALBERTA ECONOMIC DEVELOPMENT**

**ALBERTA DEPARTMENT OF ENERGY**

**ALBERTA INDUSTRIAL HEARTLAND**

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# I. INTRODUCTION

The extensive resource base in the Alberta oil sands is expected to yield growing supplies of oil sands production. Some of this production could supply markets in Asia as well as traditional North American markets. This study focuses on specific Asian markets that are currently increasing their reliance on Middle Ease crude supplies, but could consider the Canadian oil sands as another important supply.

Alberta Economic Development (AED), Alberta Energy (ADOE), and Alberta Industrial Heartland (collectively referred to as the "Client"), are investigating the potential of Asian markets for Alberta's oil sands products. The objective of this study is to address potential Asian markets for bitumen blends, synthetic crude oil, and refined products produced from the oil sands, and to verify market assumptions, pricing methods, results, and to assess possible synergies with specific Asian refineries. Accordingly, the Client has retained Purvin & Gertz, Inc. to assist in the areas of market background for crude oil and refined products for China, Japan, Taiwan and South Korea and valuation of selected oil sands crudes in Asia including pricing netbacks for these products to Alberta.

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# Glossary

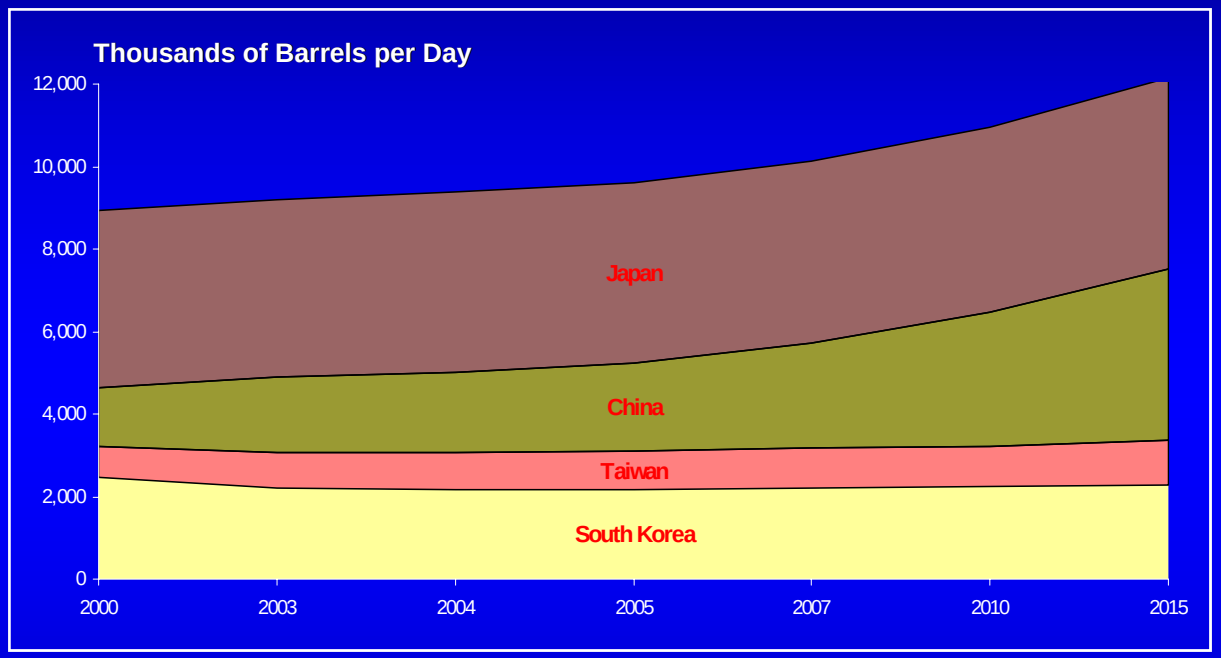
| | | |
|---|---|---|
| CRK | - | Cracking Refinery |
| FCC | - | Fluid Catalytic Cracking |
| HDS | - | Hydrodesulfurization |
| HSFO | - | High Sulfur Fuel Oil |
| HSK | - | Hydroskimming Refinery |
| KDWT | - | Thousand Dead Weight Tonnes |
| MBID | - | Thousands of Barrels per Day |
| PADD II | - | U.S. Midwest Market |
| RFCC | - | Residual Fluid Catalytic Cracking |
| SCO | - | Synthetic Crude Oil |
| SynBit | - | Canadian blend of Synthetic Crude Oil (48%) and Bitumen (52%) |
| SynSynBit | - | Canadian blend of Synthetic Crude Oil (64%) and Bitumen (36%) |
| TAN | - | Total Acid Number (mg KOH/g) |

# II. SUMMARY AND CONCLUSIONS

- ASIA MARKET BACKGROUND
- ASIA MARKET OUTLOOK FOR OIL SANDS
  - Bitumen Blends
  - Synthetic Crude Oil (SCO)
  - Refined Products
- OIL SANDS MARKET VALUES IN ASIA AND NETBACKS TO ALBERTA
  - Bitumen Blends
  - SCO
  - Refined Products

# Growth in Asian Markets for Crude Oil

**Crude Import Forecast for Japan, China, Taiwan & South Korea**




- China is the only country in the study to show significant crude oil demand increases of the four countries studied.



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# Asian Crude Oil Demand Outlook

- Between 2004 and 2015, crude oil imports are expected to increase by 2.7 million barrels per day in Japan, China, Taiwan, and South Korea.
- China is expected to increase imports of crude oil by 2.2 million barrels per day over this period, which is most of the region's increase.
- Most of the growth in crude imports is expected to be light sour crude, coming mainly from the Middle East. By 2015, Middle East crude supplies are projected to supply 68% of China's requirements.
- Japan is also very dependent on Middle East crude supplies, although it is gradually shifting towards lighter, higher value crudes such as are available from Africa.
- Taiwan has been moving towards a heavier crude oil slate from the Middle East, but is offsetting that with West African crudes.
- All of these countries are looking for alternative crude supplies so as not to increase their dependence on Middle East crude supplies.

# Crude Oil Valuation Approach to Value Oil Sands Crudes

## IDENTIFY DELIVERED COST OF CRUDES

- Bonny Light from West Africa (light sweet benchmark)
- Dubai from Arab Gulf (light sour benchmark)
- Estimate costs for transportation, credit & insurance to:
  - Japan
  - South Korea
  - China
  - Taiwan

## IDENTIFY ASIAN REFINING VALUES

- Apply benchmark refinery models for marginal configurations:
  - Hydroskimming
  - FCC Cracking
- Calculate break-even values for each crude based on product prices and refinery variable costs:
  - SCO
  - SynBit/ SynSynBit
  - Dubai
  - Bonny Light

## DETERMINE CANADIAN BLEND NETBACKS

- Estimate Asian refining values for Canadian blends based on benchmark crude CIF prices and variable break-even differentials.
- Estimate Asian netbacks for Western Canada based on:
  - Waterborne transportation costs
  - Pipeline costs

# Petroleum Product Prices Used to Calculate Crude Values

| | Singapore | Japan | South Korea | Shanghai China | Taiwan |
|---|---|---|---|---|---|
| LPG | Export | Arab Gulf Imports | Arab Gulf Imports | Arab Gulf Imports + Tariff | Arab Gulf Imports |
| Naphtha | Export | Singapore Import | Japan CIF | Singapore Import + Tariff | Singapore Import |
| Gasoline | Export | Singapore Import | Vietnam Export | Singapore Import + Tariff | Vietnam Export |
| Jet | Export | Singapore Import | S. China Export - Tariff | Singapore Import + Tariff | S. China Export - Tariff |
| Diesel | Export | Singapore Import | S. China Export - Tariff | Singapore Import + Tariff | S. China Export - Tariff |
| Fuel Oil | Export | S. China Export - Tariff | S. China Export - Tariff | Singapore Import + Tariff | S. China Export - Tariff |

- Pricing in each location is based on trade analysis.
- Singapore is a major export center and provides the basis for product pricing for most of the Asian region.
- Most product prices in China and Japan will reflect the cost of delivered imports.
- Prices in South Korea and Taiwan favor naphtha production.

# Crude Quality Assumptions

- SynSynBit is a blend of 64% SCO and 36% Bitumen, and blended to approximate the quality of Middle East light sour crudes.
- SynBit is a blend of 48% SCO and 52% Bitumen.
- These blends approximate many of the key properties of Dubai and other light sour crudes.

| | Bonny Light | Dubai | Sweet SCO | SynSynBit | SynBit | Athabasca Bitumen |
|---|---|---|---|---|---|---|
| API | 34.6 | 30.6 | 34.8 | 24.2 | 19.9 | 8.3 |
| Sulfur | 0.2 | 2.0 | 0.1 | 1.8 | 2.5 | 4.8 |
| LPG | 2.0 | 2.4 | 2.8 | 1.8 | 1.3 | 0.0 |
| Naphtha | 26.7 | 24.8 | 17.7 | 11.9 | 9.3 | 1.5 |
| Jet | 13.7 | 9.8 | 12.0 | 8.3 | 6.7 | 1.7 |
| Diesel | 26.4 | 20.5 | 33.8 | 26.6 | 23.4 | 13.9 |
| VGO | 24.3 | 25.7 | 33.4 | 32.9 | 32.6 | 31.9 |
| Resid | 6.8 | 16.7 | 0.0 | 18.3 | 26.4 | 50.8 |

# Asian Versus Chicago Pricing Drivers

- Very wide light/heavy price differentials occurred in 2004 and 2005. Future differentials expected to be higher than 1995 – 2003 period, but narrower than occurred in 2004 and 2005.
- Asian differentials did not widen as much in 2004 as in the US, but will likely remain wider in the future than historical because HSFO growth will be less than other products.
- Far East crude price premium did not occur in 2004, driven by strong Atlantic basin demand for crude oil. This premium is expected to return as the Far East continues to experience strong demand growth. This would help improve Oil Sands crude values in Asia relative to US Midwest.
- Tanker rates jumped in 2004, aggravating prices of HSFO in the US versus Asia and contributing to wider light/heavy price differentials. New tanker capacity coming on stream in next several years should bring tanker rates down somewhat closer to historical levels.
- Wider heavy light differentials in North America should support higher bitumen blend values in Asia than in North America.

# Crude Oil Price Outlook

- **Crude oil prices and light heavy differentials are expected to return to sustainable levels based on industry fundamentals.**

## BENCHMARK CRUDE OIL PRICE FORECAST (1)

*U.S. $/Bbl*

| | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2010 | 2015 |
|---|---|---|---|---|---|---|---|---|
| Tapis, FOB | 29.85 | 25.32 | 25.72 | 30.06 | 41.19 | 42.06 | 32.50 | 37.06 |
| Brent, FOB | 28.50 | 24.44 | 25.02 | 28.83 | 38.27 | 38.50 | 29.89 | 34.23 |
| WTI, Spot Cushing | 30.37 | 25.93 | 26.16 | 31.06 | 41.49 | 41.32 | 32.24 | 36.84 |
| Bonny Light FOB | 28.51 | 24.52 | 25.14 | 28.77 | 38.30 | 38.60 | 30.34 | 34.77 |
| Bonny Light, CIF Japan | 31.39 | 26.56 | 26.70 | 31.60 | 42.90 | 42.60 | 32.99 | 37.57 |
| Bonny Light, CIF South Korea | 31.06 | 26.34 | 26.55 | 31.36 | 42.50 | 42.23 | 32.72 | 37.28 |
| Bonny Light, CIF Shanghai | 30.92 | 26.25 | 26.48 | 31.25 | 42.32 | 42.06 | 32.60 | 37.15 |
| Bonny Light, CIF Taiwan | 30.88 | 26.21 | 26.46 | 31.18 | 42.20 | 41.97 | 32.55 | 37.10 |
| Dubai, FOB | 26.24 | 22.80 | 23.85 | 26.76 | 33.69 | 34.82 | 27.76 | 31.81 |
| Dubai, CIF Japan | 28.00 | 24.07 | 24.83 | 28.53 | 36.55 | 37.30 | 29.39 | 33.54 |
| Dubai, CIF South Korea | 27.79 | 23.93 | 24.73 | 28.33 | 36.22 | 37.01 | 29.21 | 33.34 |
| Dubai, CIF Shanghai | 27.65 | 23.83 | 24.66 | 28.23 | 36.06 | 36.85 | 29.09 | 33.21 |
| Dubai, CIF Taiwan | 27.62 | 23.81 | 24.64 | 28.18 | 35.97 | 36.79 | 29.06 | 33.18 |

Note: (1) Purvin & Gertz January 2005 Crude Oil Price Forecast.

# Comparison of Crude Oil Prices/Values [1] (U.S. $/Bbl)

| | Bonny Light | Dubai | Sweet SCO | SynSynBit | SynBit |
|---|---|---|---|---|---|
| **Price/Value** | | | | | |
| In Japan - 2000 | 31.39 | 28.00 | 31.54 | 26.31 | 24.67 |
| In Japan - 2010 [2] | 32.99 | 29.39 | 32.99 | 26.88 | 24.26 |
| In China - 2000 | 30.92 | 27.65 | 31.25 | 26.21 | 24.72 |
| In China - 2010 [2] | 32.60 | 29.09 | 32.77 | 26.73 | 24.17 |
| **Netback Price in Alberta** | | | | | |
| From Japan - 2000 | - | - | 28.51 | 23.25 | 21.54 |
| From Japan - 2010 [2] | - | - | 29.92 | 23.78 | 21.21 |
| From China - 2000 | - | - | 28.07 | 22.99 | 21.44 |
| From China - 2010 [2] | - | - | 29.56 | 23.49 | 20.99 |
| From U.S. Midwest - 2000 | - | - | 30.29 | 23.18 | 21.62 |
| From U.S. Midwest - 2010 [2] | - | - | 30.78 | 24.26 | 21.30 |

**Notes:**

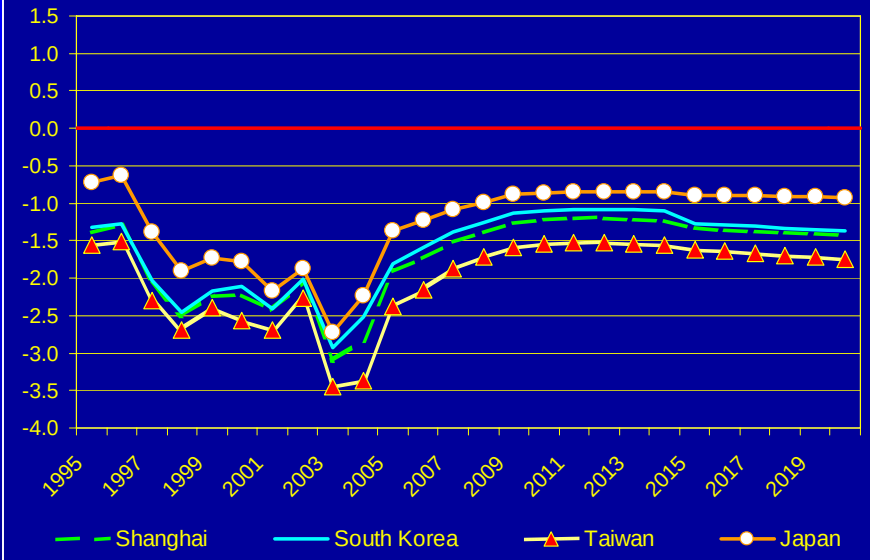
(1) Oil sands crude values in Asia are estimated from relative hydroskimming refining values. Both SynSynBit and SynBit also experience TAN penalties.

(2) Based on Purvin & Gertz price forecast.

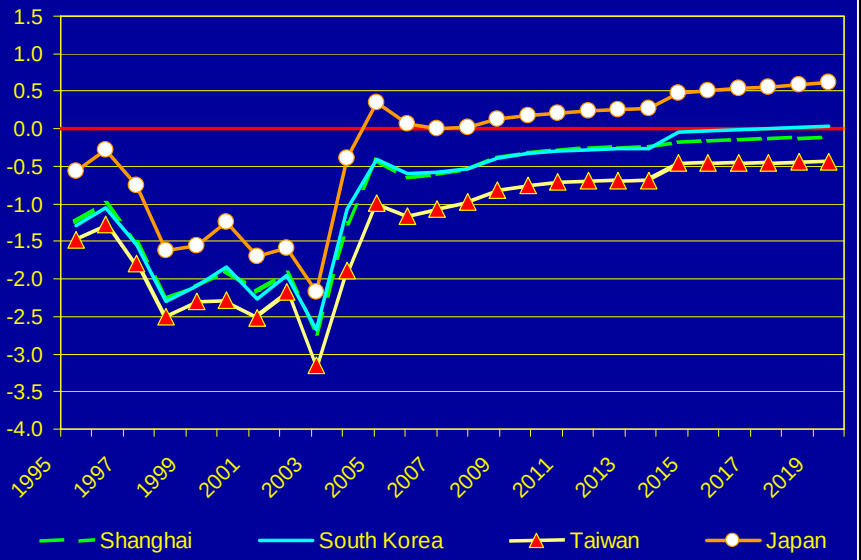
# SCO Asian Netbacks At Edmonton

- Hydroskimming is the marginal refinery mode in Asia
- Asian hydroskimming netbacks for SCO relative to Bonny Lt. are projected to be slightly below Chicago netbacks at Edmonton.

***Asian Hydroskimming Versus Chicago Netback, (U.S. $/Bbl)***




***Asian Cracking Versus Chicago Netback (U.S. $/Bbl)***



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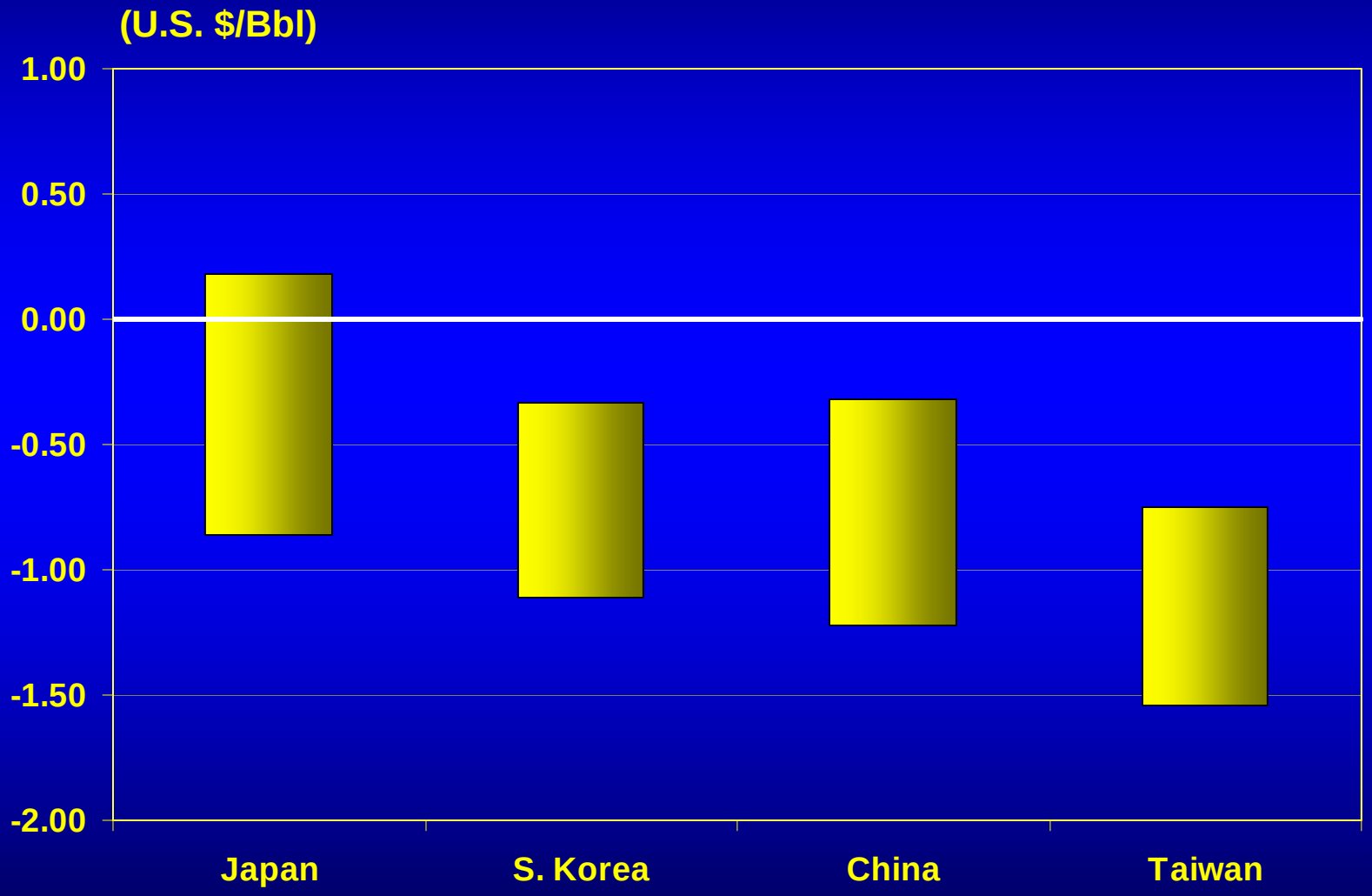
# SCO Netbacks at Edmonton Relative to Chicago Netback - 2010(1)

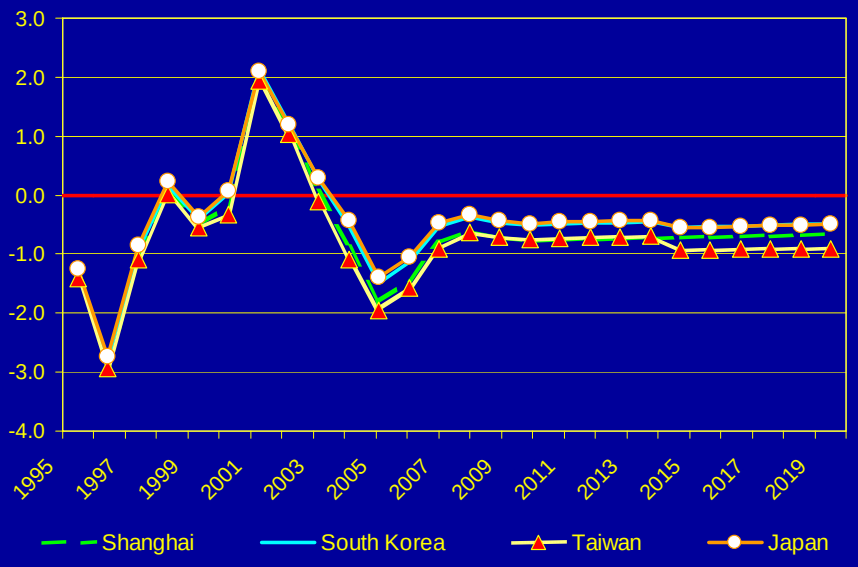



(1) Cracking value is top of range; hydroskimming value is lower end of range.

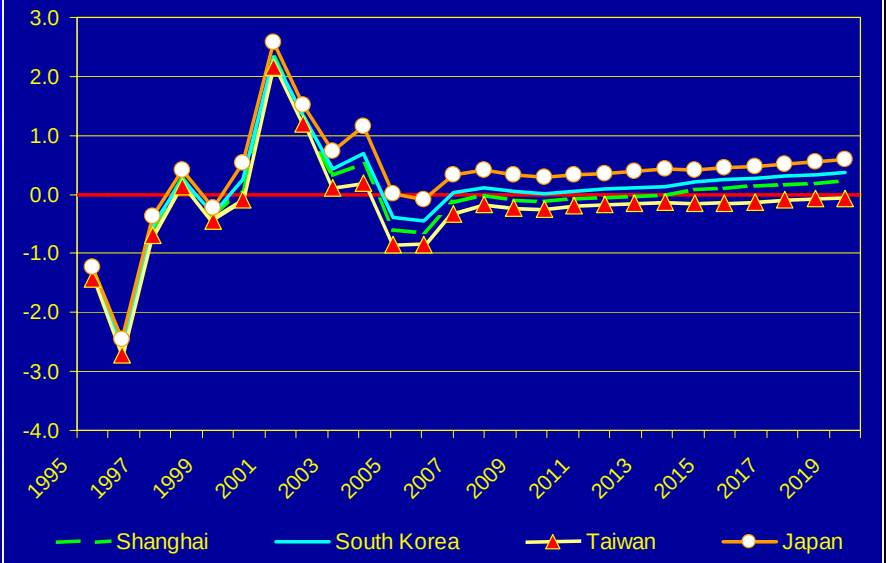
# SynSynBit Asian Netbacks At Edmonton

- **Despite the relative strength of the Asian fuel oil market, Asian hydroskimming netbacks are projected to be slightly weaker than Chicago netbacks for SynSynBit at Edmonton.**

***Asian Hydroskimming Versus Chicago Netback, (U.S. $/Bbl)***




***Asian Cracking Versus Chicago Netback (U.S. $/Bbl)***



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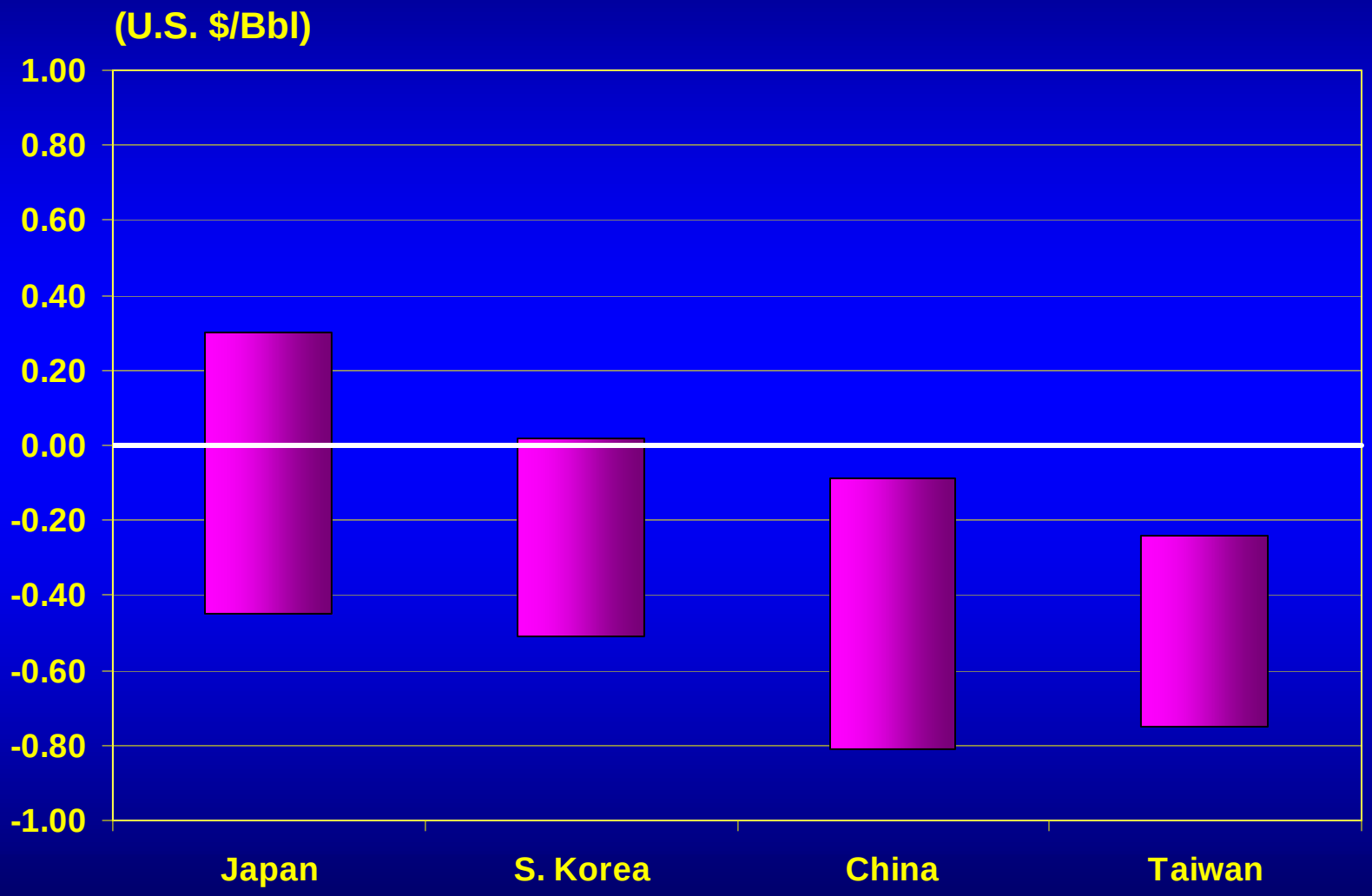
# SynSynBit Netbacks at Edmonton Relative to Chicago Netback - 2010(1)

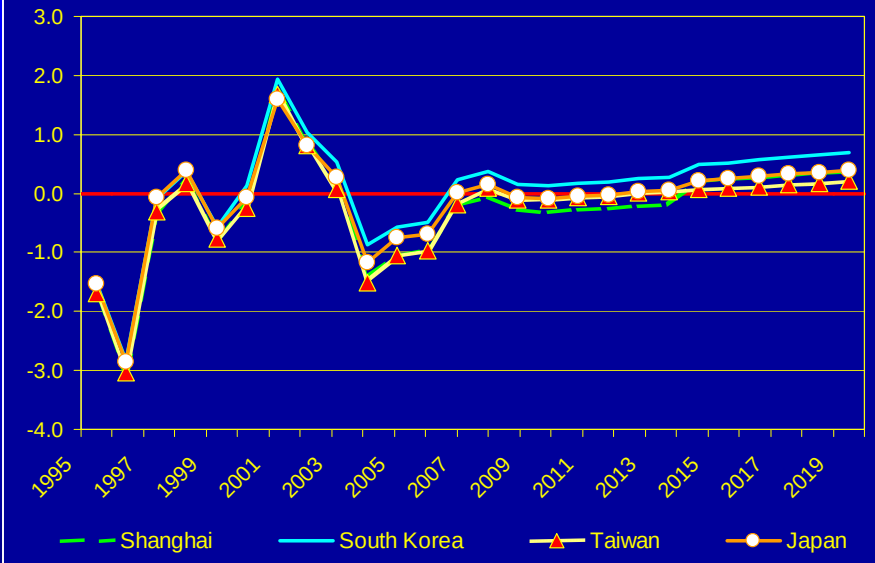



(1) Cracking value is top of range; hydroskimming value is lower end of range.

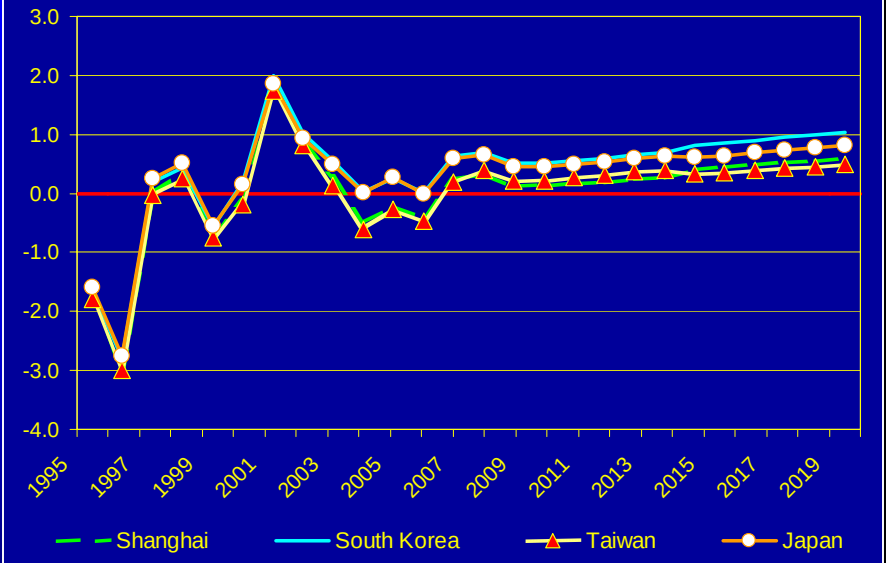
# SynBit Asian Netbacks At Edmonton

- Hydroskimming is the marginal refining mode in Asia.
- Cracking mode valuations for SynBit are roughly $0.50/Bbl higher (relative to Dubai), and reflect possible upside in crude values.

***Asian Hydroskimming Versus Chicago Netback, (U.S. $/Bbl)***




***Asian Cracking Versus Chicago Netback (U.S. $/Bbl)***



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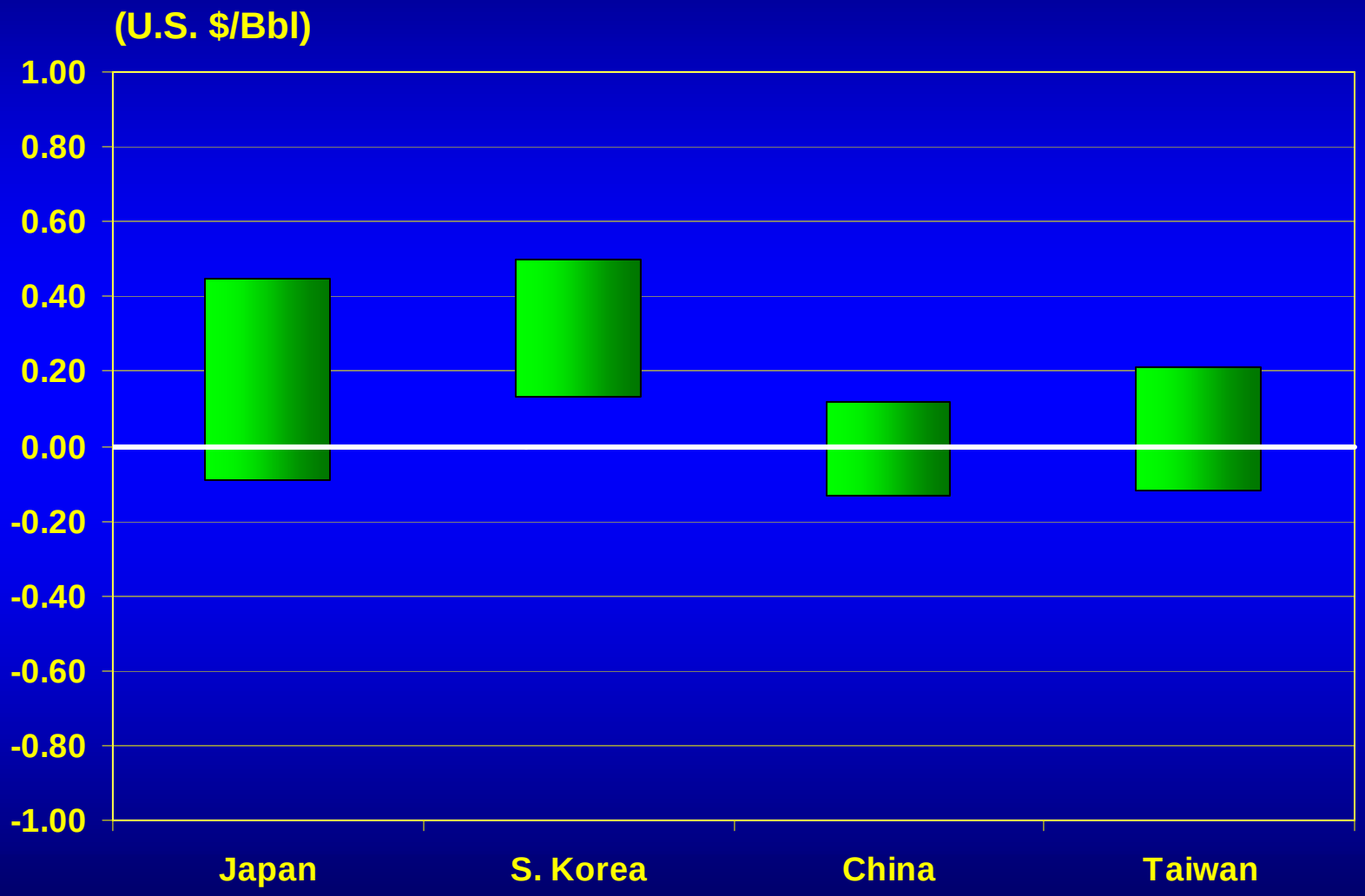
# SynBit Netbacks at Edmonton Relative to Chicago Netback - 2010(1)




(1) Cracking value is top of range; hydroskimming value is lower end of range.



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# General Conclusions - SCO

- Sweet SCO should find its best value in the Japan market, which is gradually lightening its crude slate. It is forecast to be around $0.80/Bbl less than its Midwest value to $0.20/Bbl above. Other Asian markets would value SCO to be lower.
- As SCO supplies increase, further price discounts in the U.S. Midwest may result. Should SCO experience further price discounting in the U.S. Midwest, Asia could become the incremental market of choice for SCO.
- Markets in China may be less interested in SCO because of their interest in residual fuel oil and asphalt. SCO does not yield any residual fuel oil. SCO seems to best fit the Japan market.
- Cracking refineries in Asia will value SCO higher than hydroskimming refineries, and this provides potential for further improvements above hydroskimming values in netback prices from Asia.

# General Conclusions - SynSynBit

- SynSynBit (64% SCO, 36% Bitumen) has a yield profile that is somewhat similar to Middle East sour crudes. Thus, it could fit many of the refineries in Asia.
- Its highest values were found to be refineries in Japan and South Korea.
- Historically, between 1998 and 2003, SynSynBit should have provided a higher netback than Chicago. In the forecast,due mainly to an outlook for wider price differentials, the forecast netbacks are slightly less in a hydroskimming mode than from Chicago.
- SynSynBit has only been marketed to U.S. Midwest refineries in a minor way so far. This blend may experience more discounts in Chicago than forecast in order to obtain significant market penetration. Further discounts could result in Asia providing better netbacks.

# General Conclusions - SynBit

- SynBit (52% bitumen, 48% SCO) has a yield profile that is somewhat heavier than Middle East Light Sour (Dubai), but likely similar to Arab Heavy. The residual yield is important to Asia which has large residual fuel oil markets.
- SynBit prices historically between 1997 and 2003 would have been better than Chicago netbacks. Between 2003 and our forecast to 2007, Asian hydroskimming values would be less than from Chicago, as relative wider light/heavy differentials in Asia reduced SynBit values. After 2007, differentials should narrow somewhat, and stronger HSFO prices in Asia should provide higher SynBit values than from Chicago.
- Future Chicago prices reflect significant price discounts to encourage the market to use more bitumen blends. This gives higher netback prices from Asia.
- Cracking refineries in Asia will find SynBit to have higher values than hydroskimming refineries, and provides potential for further improvements in netback prices from Asia.
- Markets for SynBit are expected to be more limited than SynSynBit because of the large residual yield and its high sulfur content. Only a few refineries will be capable of using substantial volumes of SynBit, although new refineries in China could be designed to run SynBit.

# Potential for Refined Product Imports

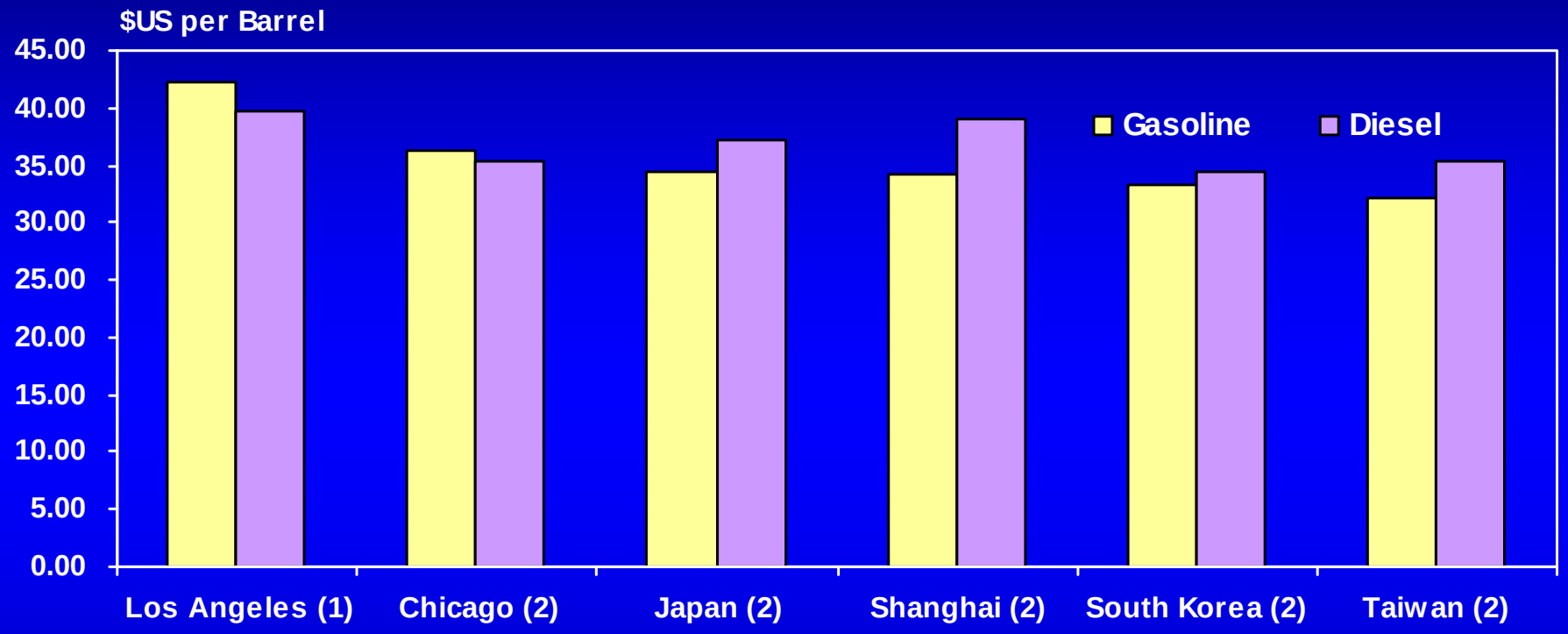
- These Asian countries try to produce most of their domestic requirements for refined products. They tend to use small volumes of imports, and sometimes exports, for balancing purposes. Distillate imports will be higher than gasoline.
- China is not expected to be a major importer of products, but this assumes that it constructs the equivalent of six 200,000 barrels per day (B/D) refineries by 2015.
- China's largest imports are residual fuel oil; around 425,000 B/D in 2003. It could import over 350,000 B/D of distillate by 2015.
- South Korea is a large importer of naphtha for petrochemical use; minor for other products. It exports distillate and residual fuel oil.
- Japan is expected to increase imports of gasoline. Naphtha is largest imported product, mainly for petrochemical feedstock.
- Taiwan is expected to be mainly an exporter, with only minimal imports.
- The only significant potential for product imports into this region would occur in China if this country is not able to build all the refining capacity that it needs.

# Export of Refined Products from Alberta

- If bitumen is upgraded all the way to gasoline or diesel fuel, netbacks from Asia to Alberta would provide higher returns than if upgraded to SCO[(1)].
- The resulting netback prices from Asia were compared to exporting products to Chicago and Los Angeles [(1)].
- Diesel fuel netbacks are higher from Asia than from U.S. Midwest.
- Diesel demand growth in Asia will continue to outpace gasoline. Further, diesel production from the oil sands is easier to produce than gasoline.
- Asia market could grow to accept refined products from Alberta, but there may be merit in sharing output with California market in order to achieve an orderly market development.

(1) Purvin & Gertz, "Phase II - Refined Products and Petrochemicals from Bitumen", December 17, 2004, prepared for the Government of Alberta and an Industry Group.

# Petroleum Product Prices Netback to Edmonton From U.S. and Asia Markets - 2010




1) CARB Specifications. Gasoline is CARBOB (prepared for ethanol blending).
2) Low Sulfur Specifications

- This analysis assumes refined products are produced in Alberta and exported.
- Diesel prices from Japan, China, and Taiwan are higher than netbacks from Chicago.
- Gasoline prices from Asia slightly lower than U.S. netbacks.



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# Canadian Oil Sands – Potential to Supply Asia

- The Canadian oil sands could become a significant supplier of crudes to the Asian market. They would likely be sweet SCO and bitumen blends.
- SCO/bitumen blends could be suitable substitutes for Middle East sour crude supplies. The Asian countries studied are seeking to reduce their dependence on Middle East crude.
- SCO may have the highest value to cracking refineries in Japan.
- Bitumen blends high TAN values may limit the amount of bitumen blend that Asia refineries can process.
- High sulfur content of residual fuel may limit the market acceptability of bitumen blends.
- Refined products produced from an export refinery based on oil sands could find outlets in Asia ; distillate to China, gasoline to Japan.
- Potential to serve Asian markets is subject to achieving a satisfactory price for these products relative to traditional North American markets.
- Cracking or coking refineries should be prime targets to maximize the value of oil sands crudes.

# General Conclusions

- Asian netbacks for Canadian oil sands crude blends are expected to be fairly close to competitive with Midwest netbacks at Edmonton.
  - Hydroskimming values are the most likely results, and are slightly less.
  - Cracking values are comparable or even superior to Chicago netbacks.
  - Cracking value represents an upside to be shared between buyer and seller.
- Further discounts in the U.S. Midwest are possible as supplies grow. If this happens, hydroskimming values from Asia could be better than Midwest results.
- While the Asian refining base is generally less sophisticated, the relative strength of the Asian fuel oil market and the Far East premium for crudes provides economic support for Canadian deliveries such that Asia should be a viable alternative for bitumen blends.
- SCO should be a good substitute for light sweet crude, except that its naphtha will be less desirable for petrochemical production.
- Cracking or coking refineries should be targeted customers, as they should be in best position to provide highest values for oil sands crudes.
- If Far East premium does not continue, netback prices from Asia would be lower.

# Other Conclusions

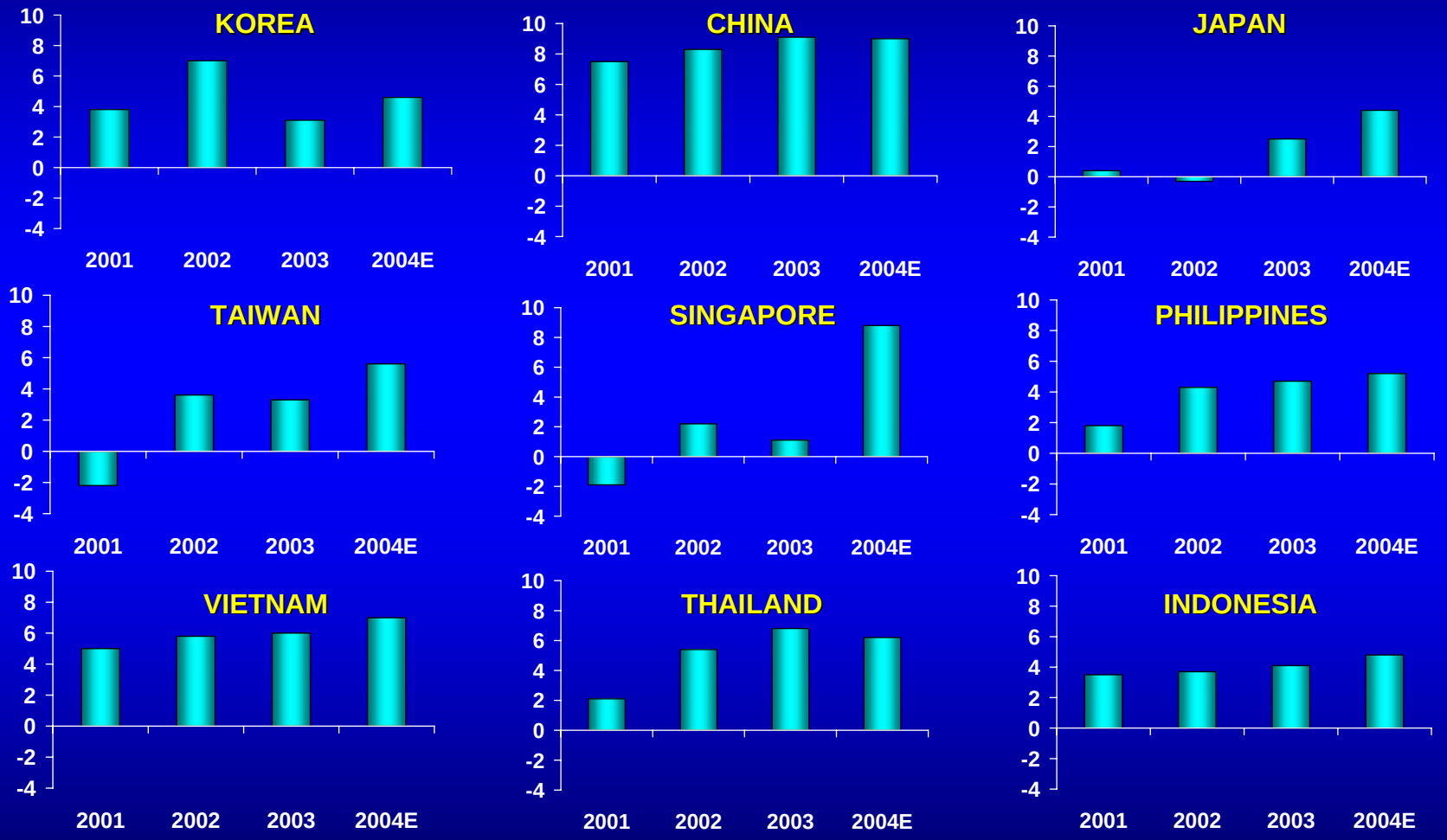
- If China develops refineries that are designed for oil sands, the amount of oil sands crudes that can be processed should not be constrained.
- Asia market could grow to accept refined products from Alberta, but likely would need California market to take some of the exports, at least initially.
- There may be merit in an Alberta upgrader exporting gasoline to the U.S. and diesel to Asia, as these are the products each area prefers.
- Another upgrading option would be to produce diluent for use in Alberta to blend with bitumen, and distillate for export.
- Potential to achieve a lower pipeline shipping cost on light crudes from Edmonton to Kitimat would help improve netbacks for SCO and SynSynBit.

# III. ASIA MARKET BACKGROUND

- ECONOMIC REVIEW
- COMPARISON OF ASIAN REFINED PRODUCT MARKETS TO OTHER REGIONS
- COMPARISON OF ASIAN REFINERIES TO OTHER MARKETS
- ASIA REFINING SYSTEM
- CHINA
- JAPAN
- SOUTH KOREA
- TAIWAN

# Economic Growth (GDP) in Asia

Real GDP Growth, %




- Economic growth has returned to nearly all countries in Asia.



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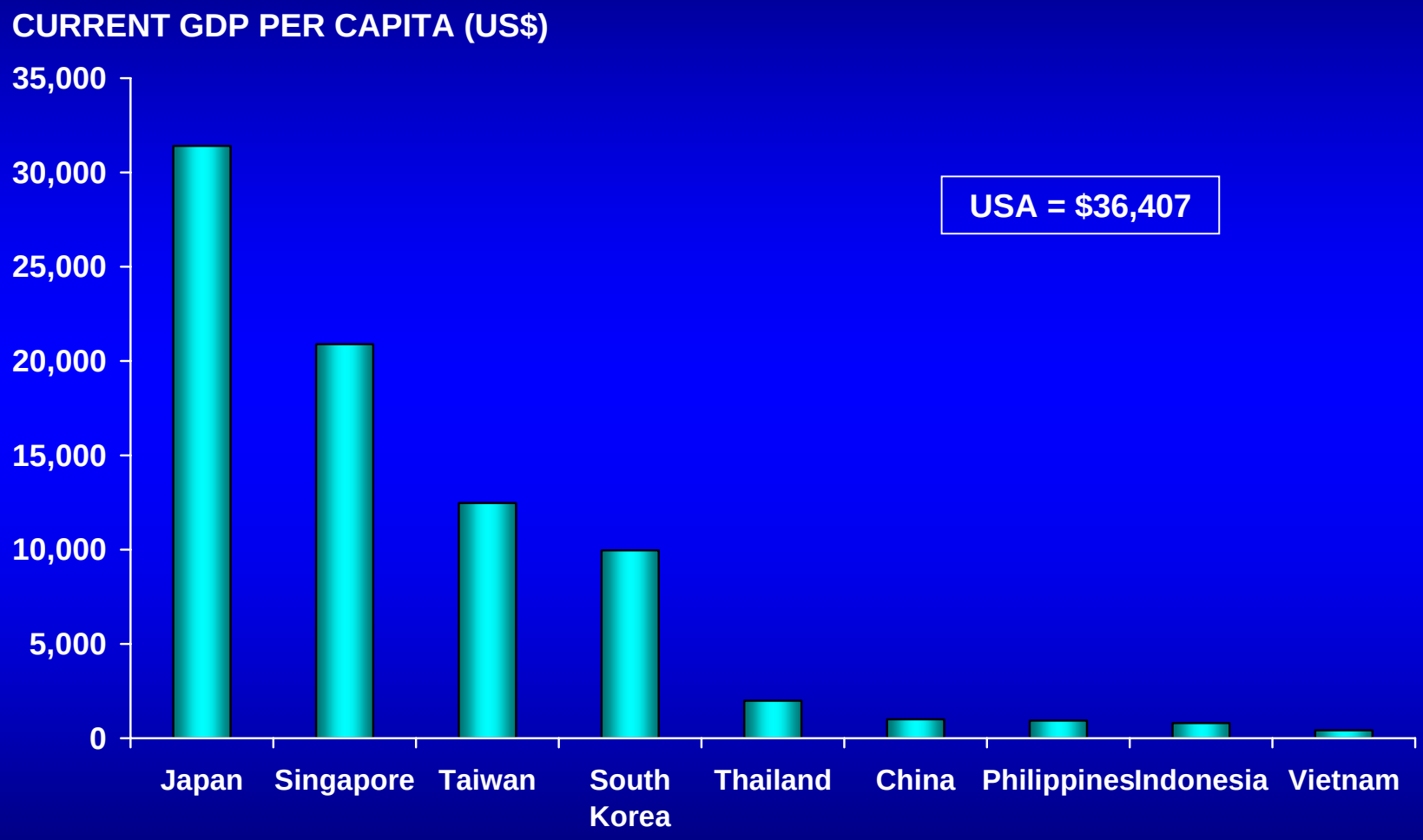
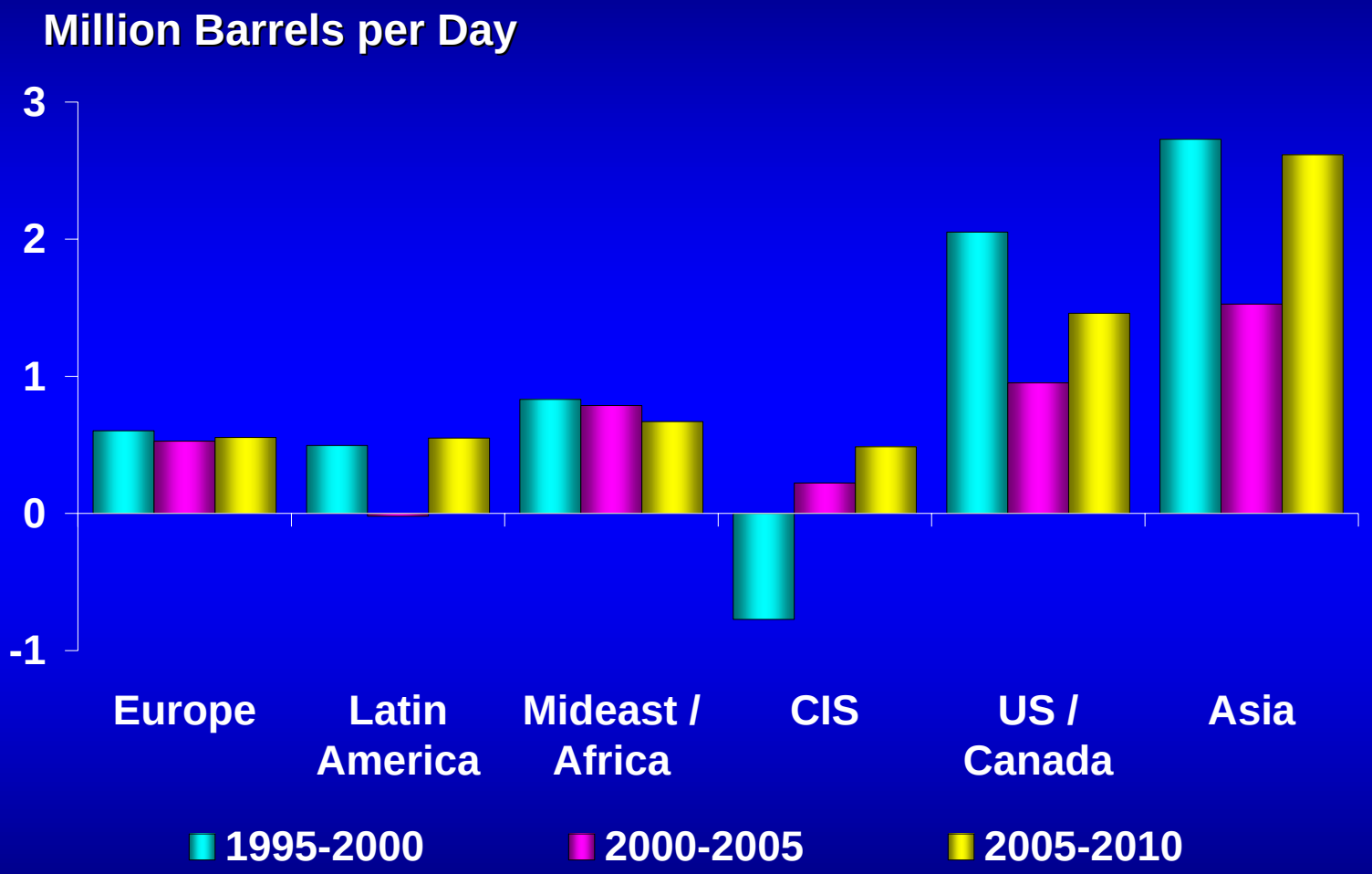
# Current Relative Economic Status of Asian Countries




- Significant growth potential for many Asian markets to catch up with Japan and Singapore.

# Global Refined Product Demand Growth

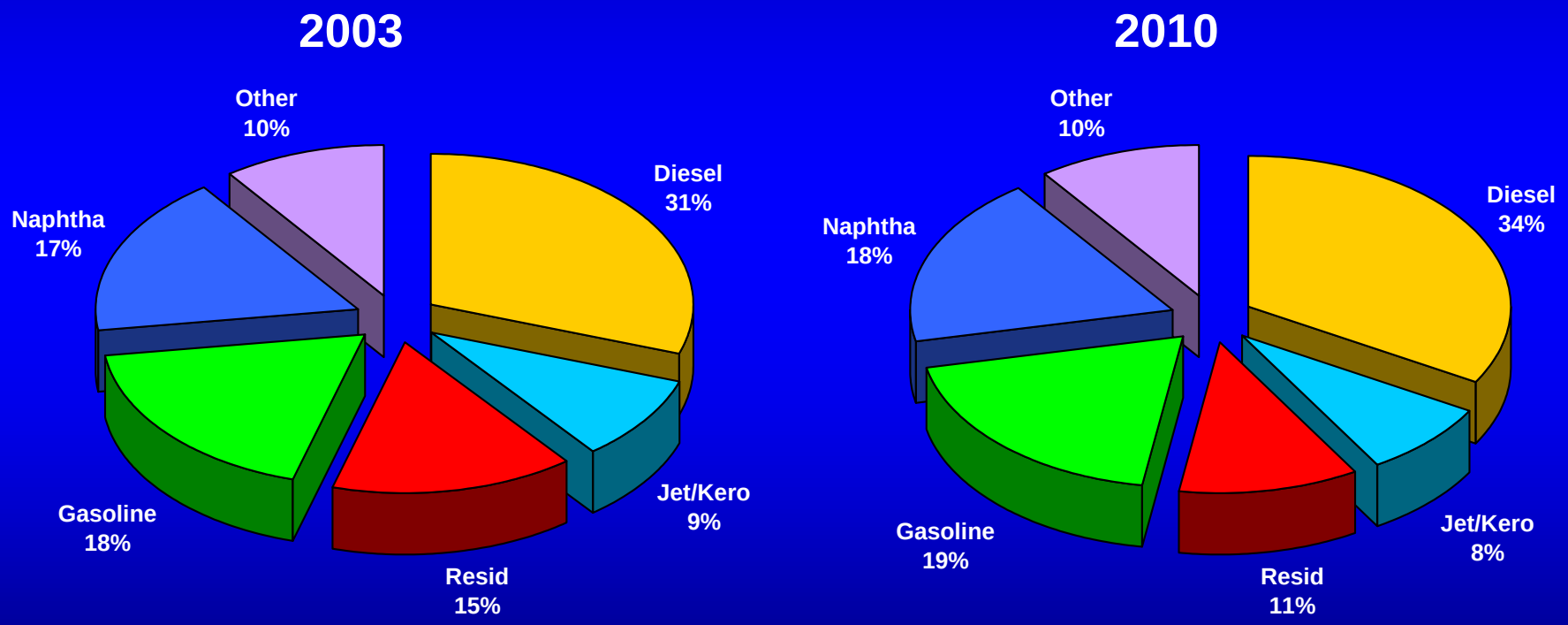



- Asian countries are expected to outpace demand growth in other regions.

# Asian Refined Product Slate

## Asian Product Demand By Type

### Percent of Demand




- Natural gas and transport fuel growth will further product shift slate to light products.



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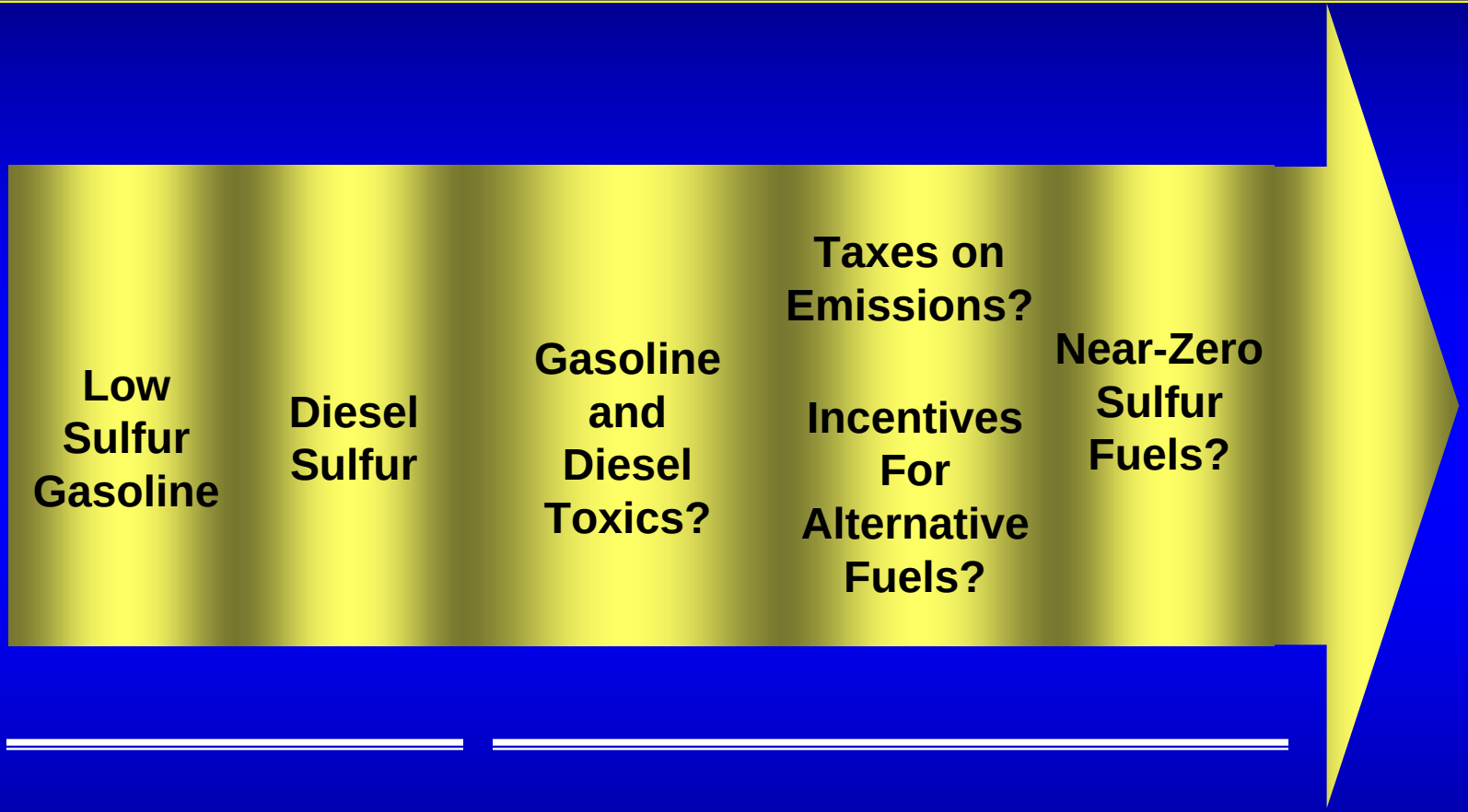
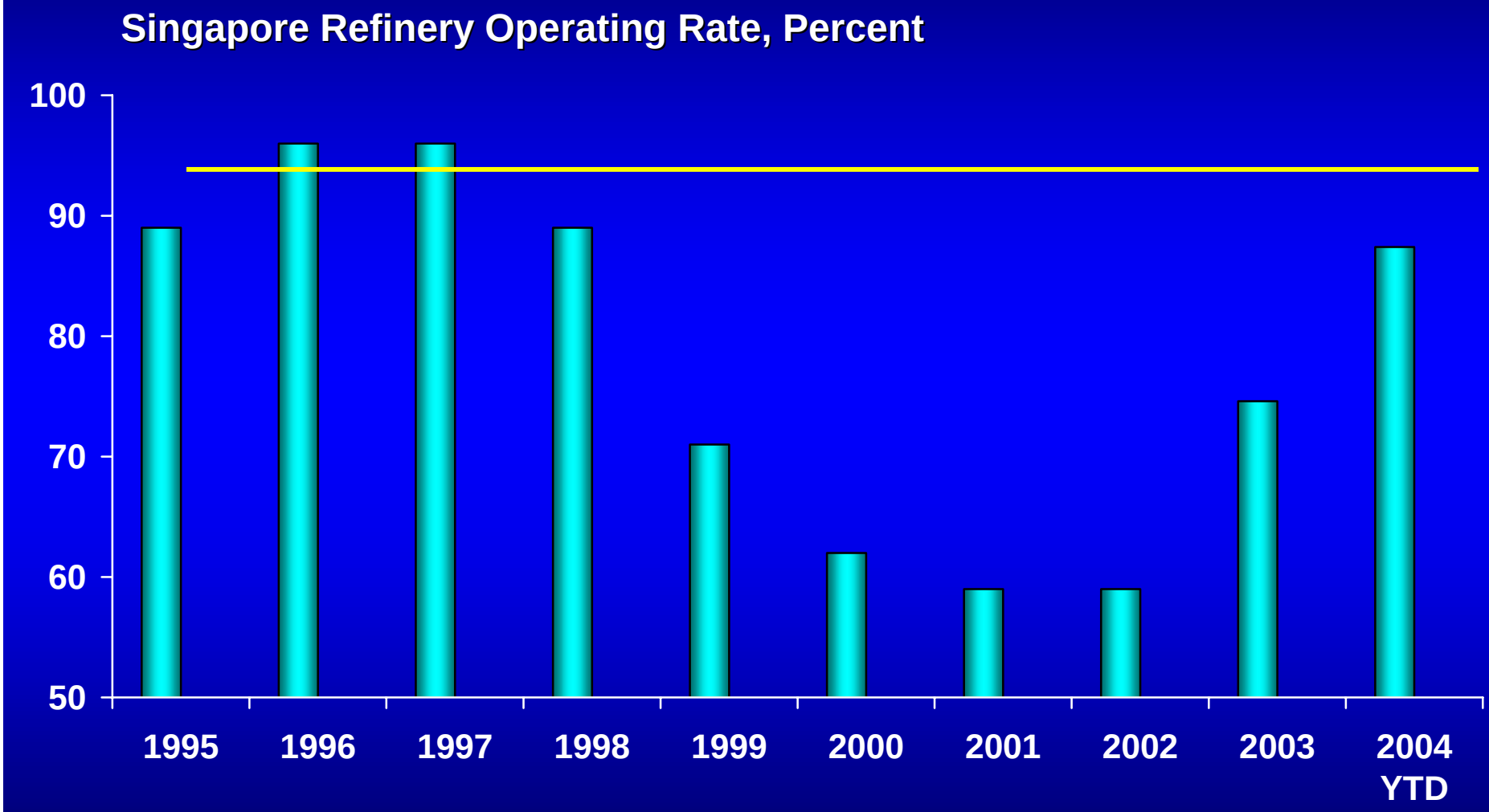
# Asian Product Specification




- Asian nations adopting clean fuels programs similar to those in US and Europe.

# Asian Regional Refinery Utilization




- Refinery throughput has increased since 2001 in response to stronger demand for petroleum products.



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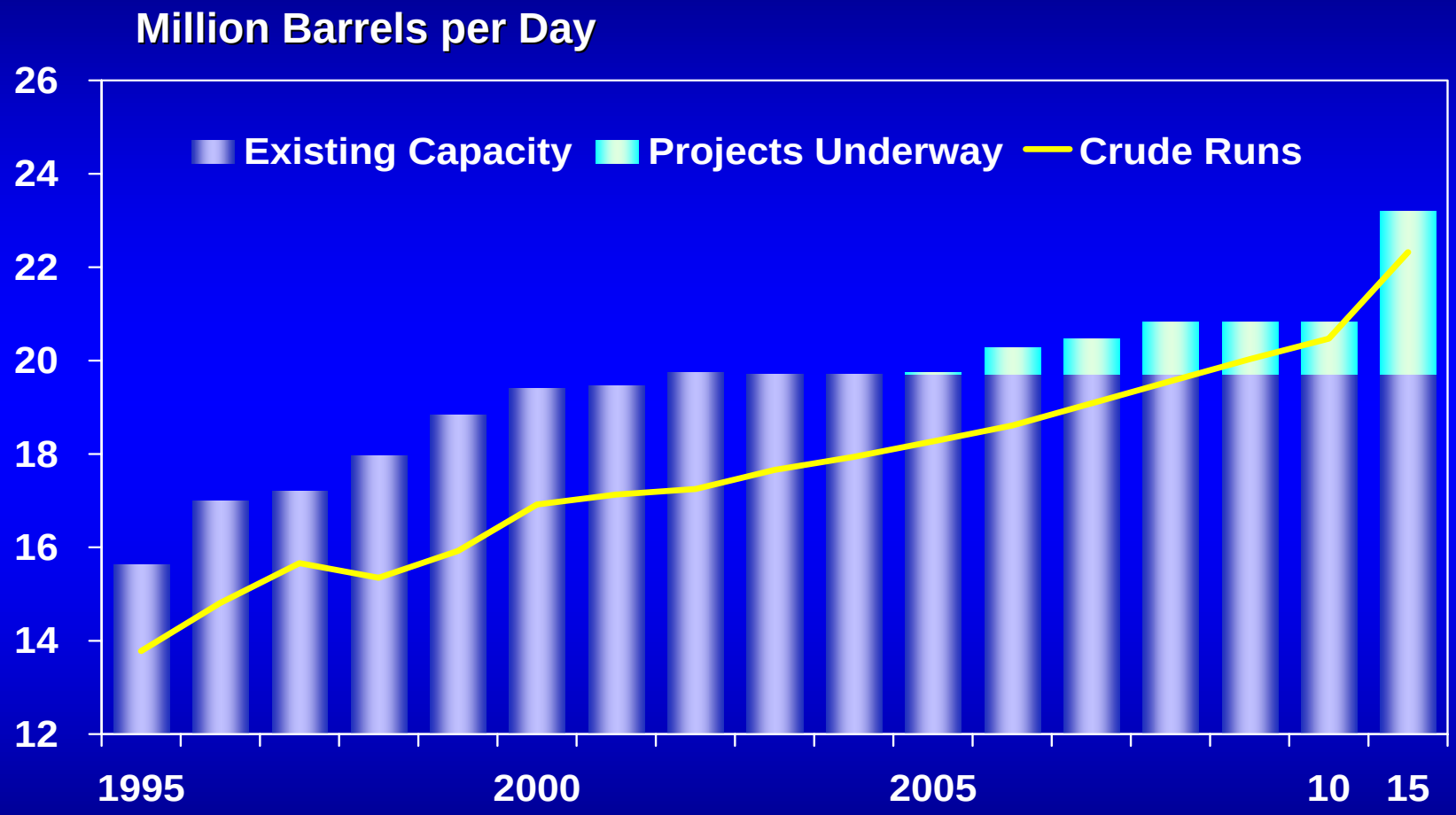
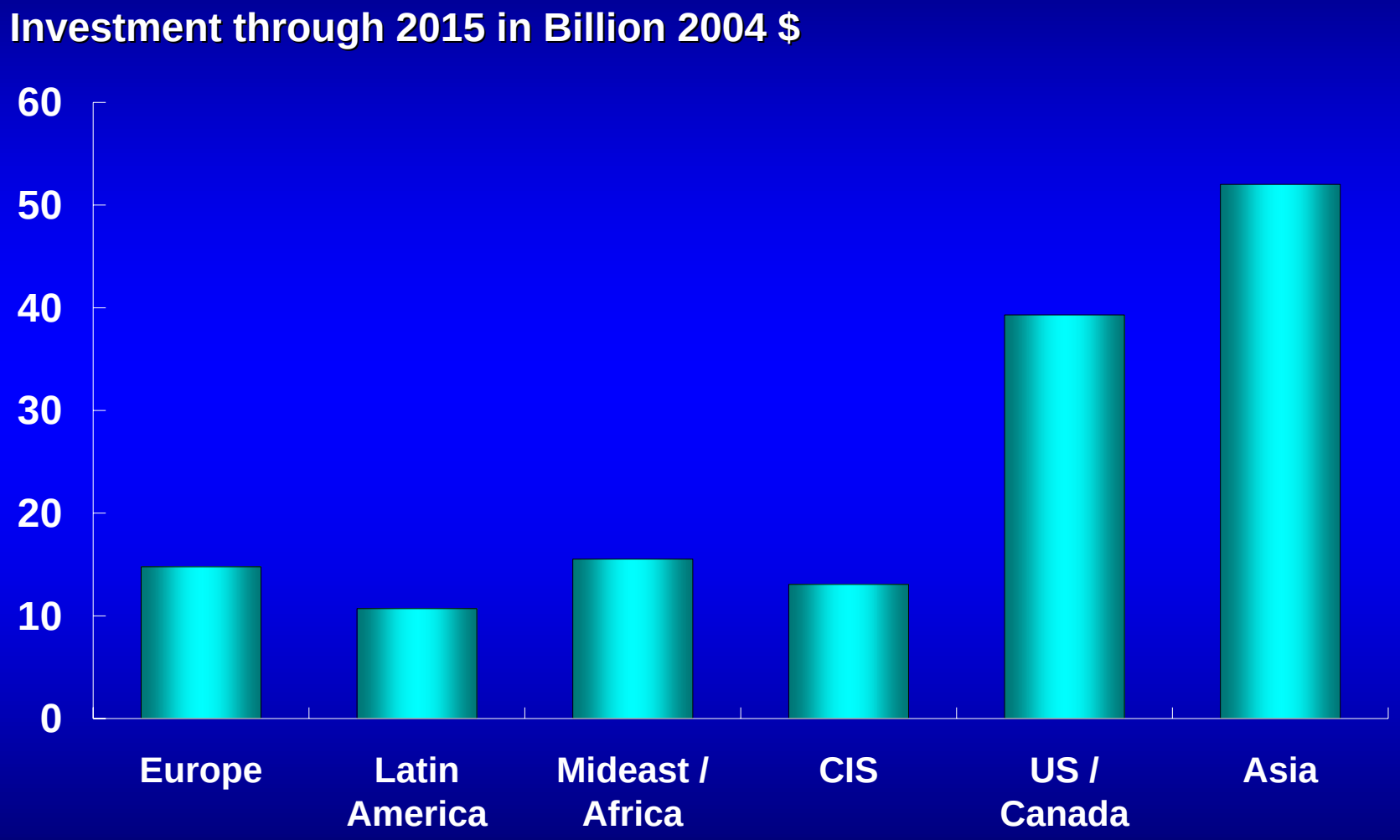
# Asian Refinery Capacity Versus Crude Runs



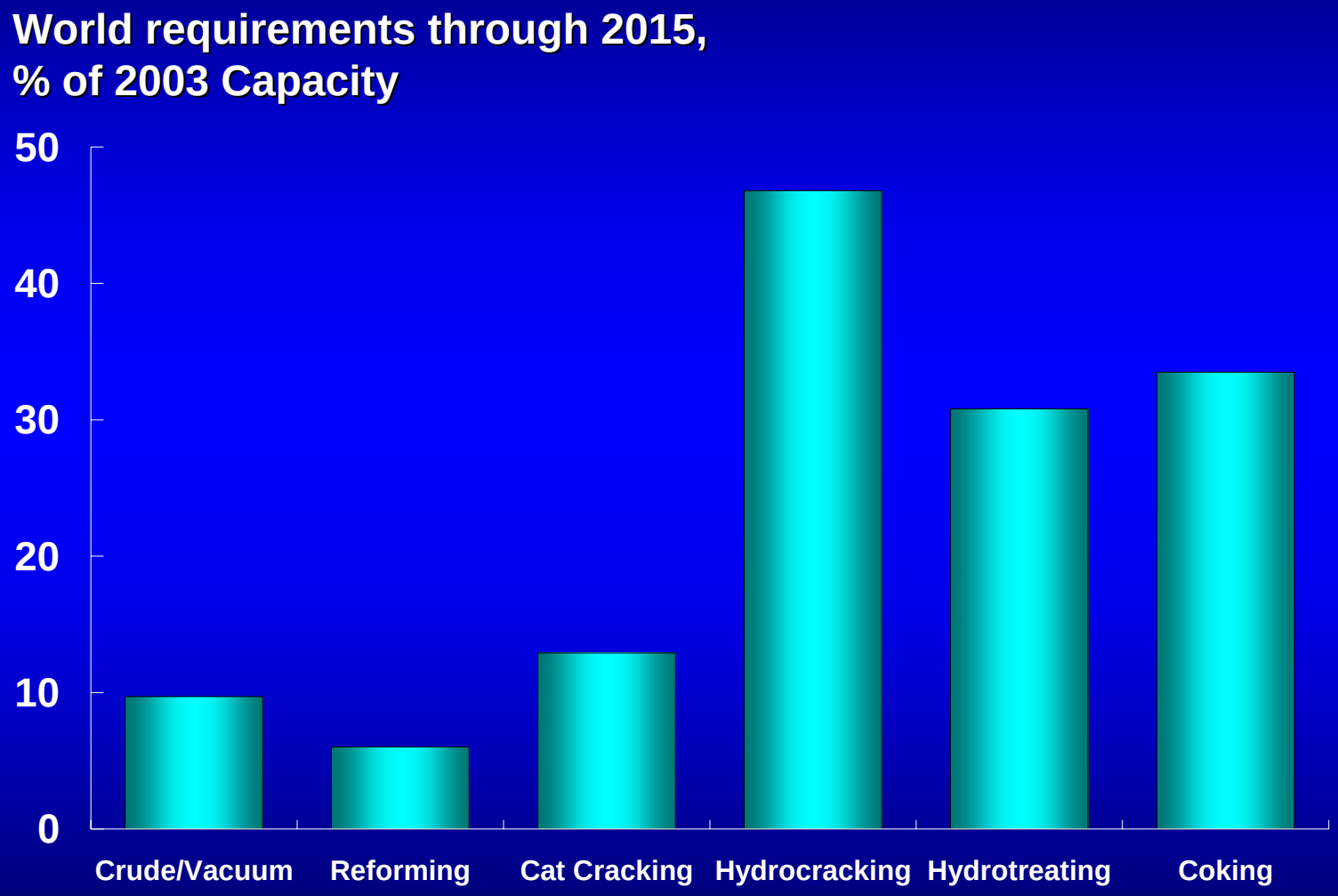

- Asian refinery capacity utilization has improved and required expansion projects are now underway.

# Expected Refining Investments Comparison



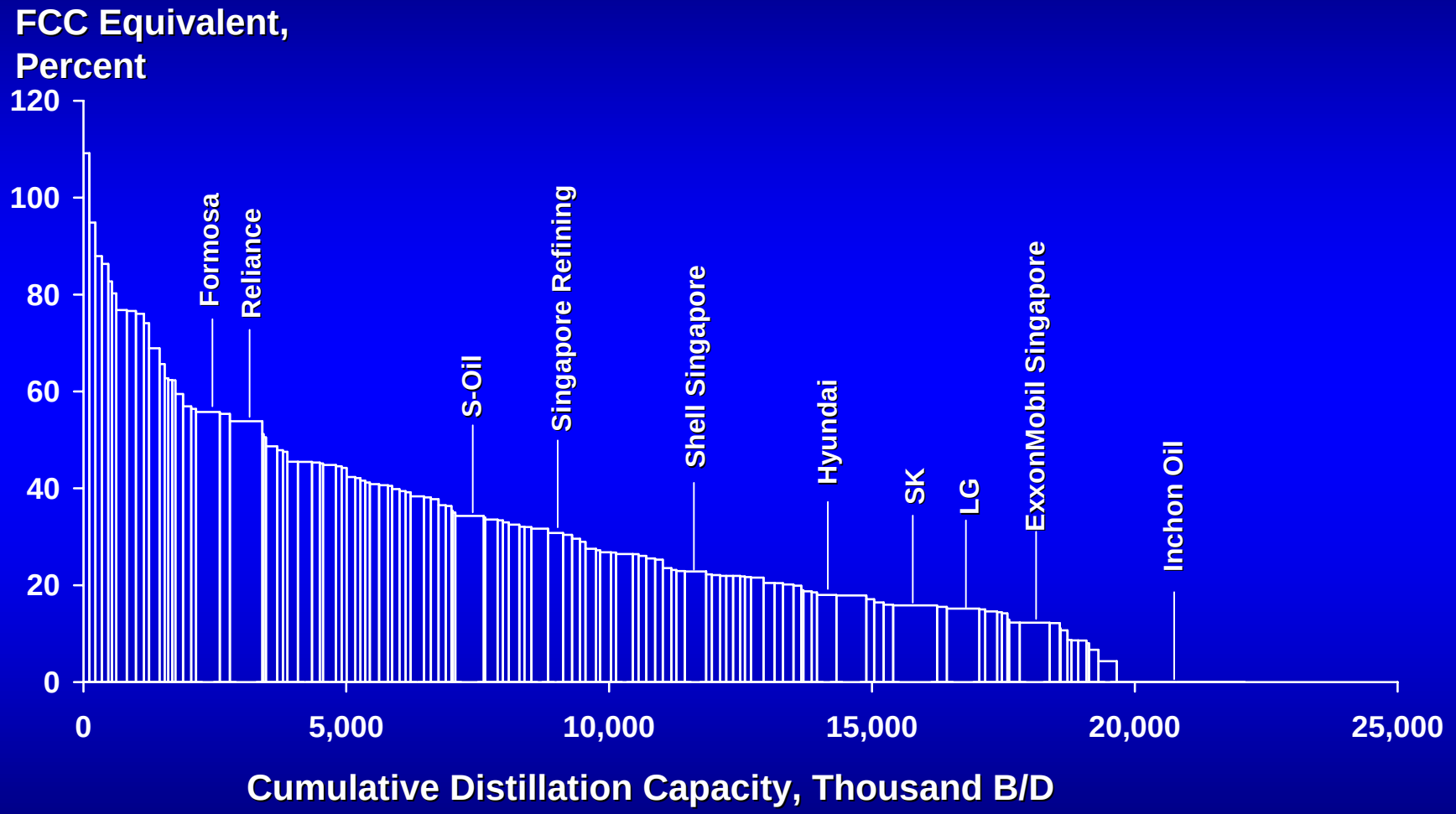

- Asia to receive greatest amount of future refining investment.

# Expected World Refining Investments



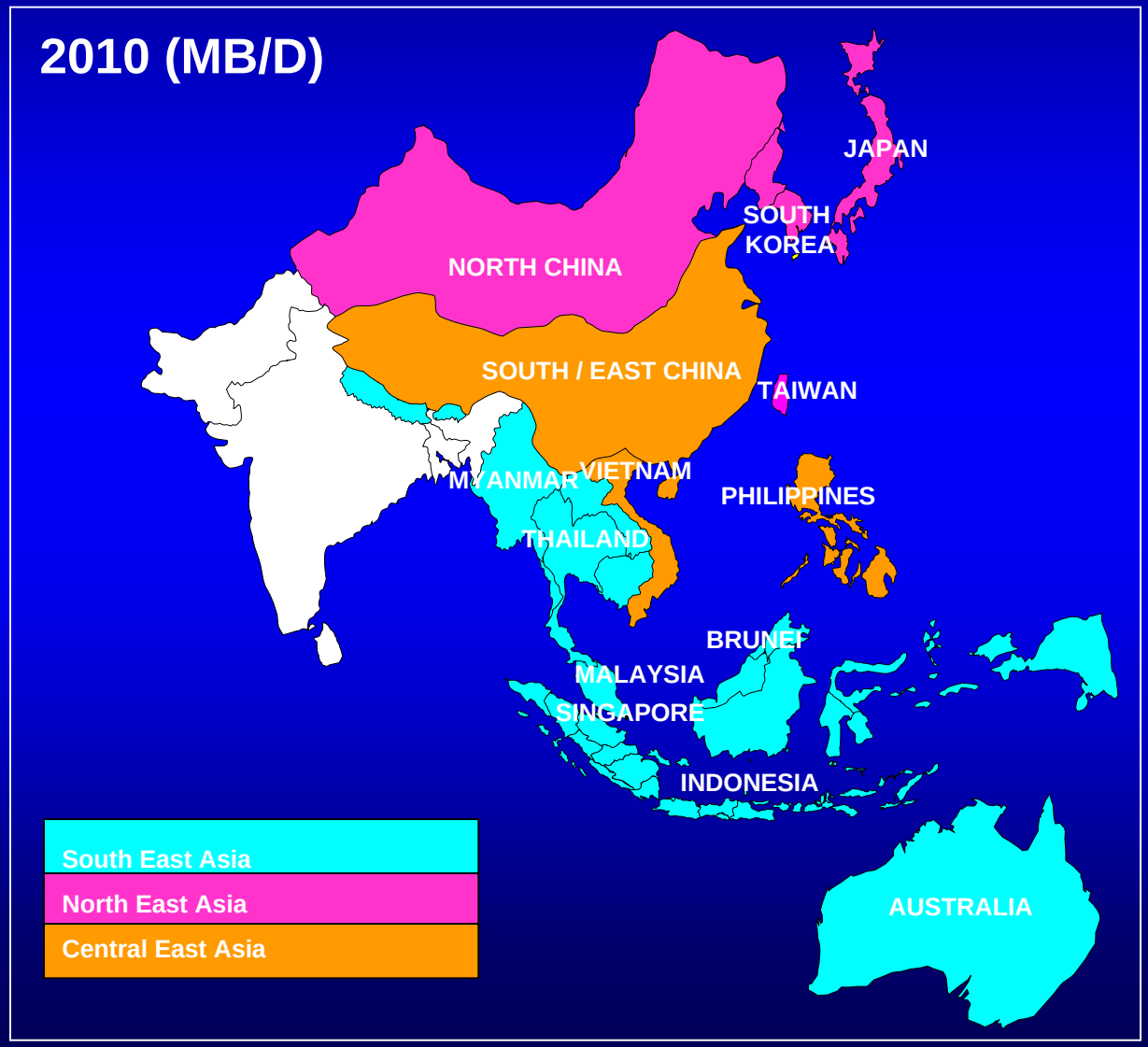

- Hydroprocessing and bottoms conversion to see the greatest capacity increases.

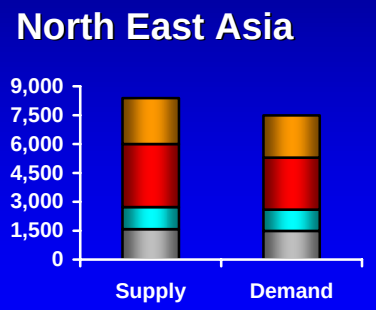
# Asian Refinery Profile (Bottoms Upgrading Capability)

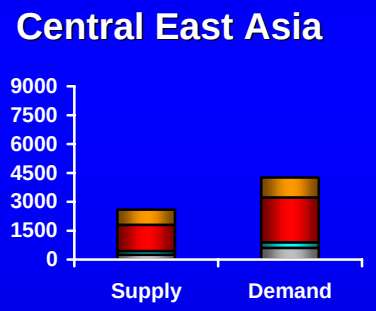


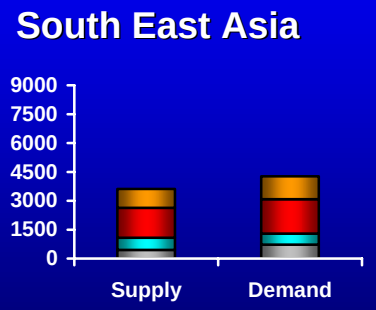

- Higher conversion refineries in Asia to profit more from widening light/heavy spread.

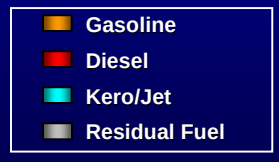
# Central East Asia Key Regional Destination Market

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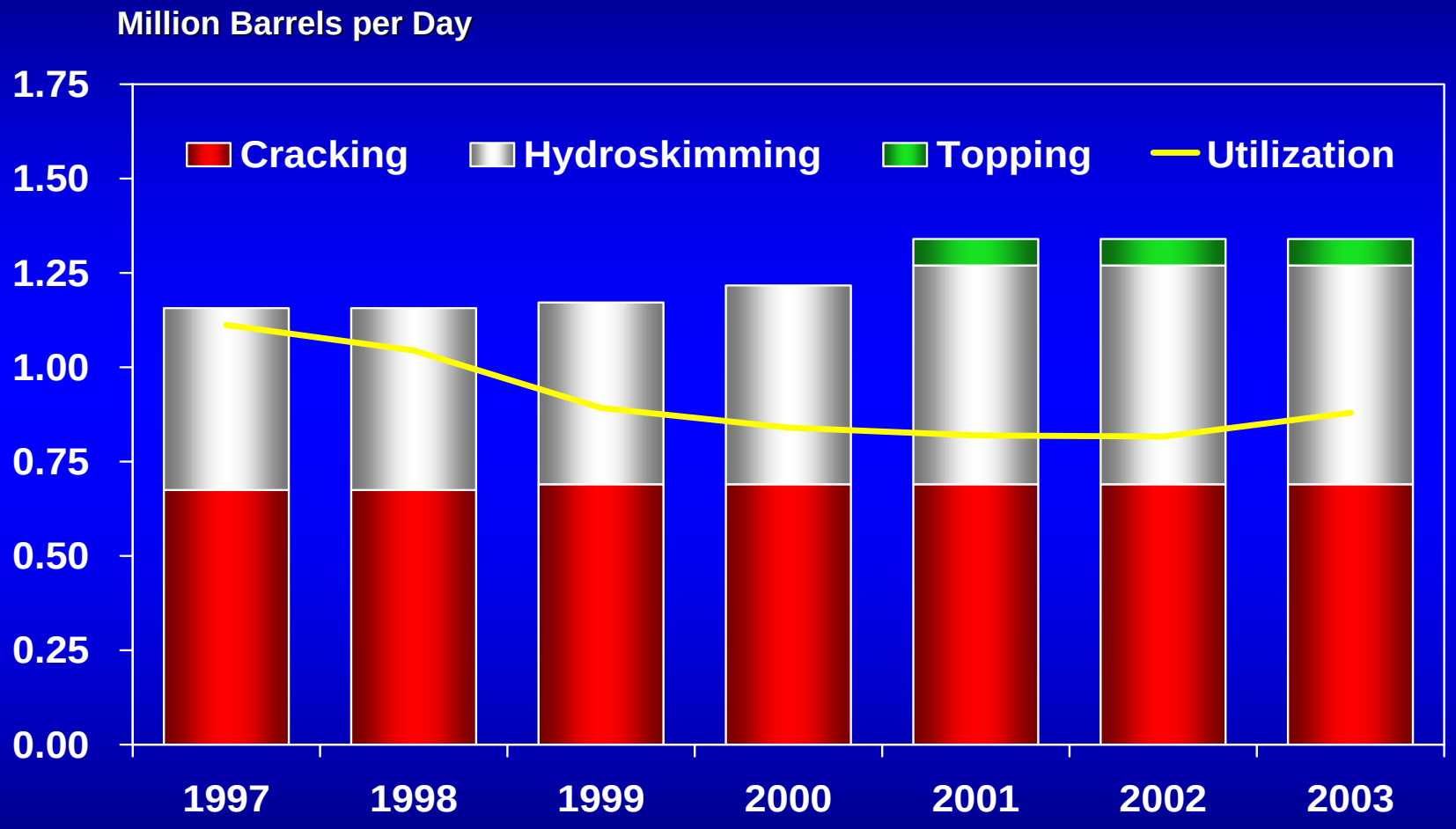
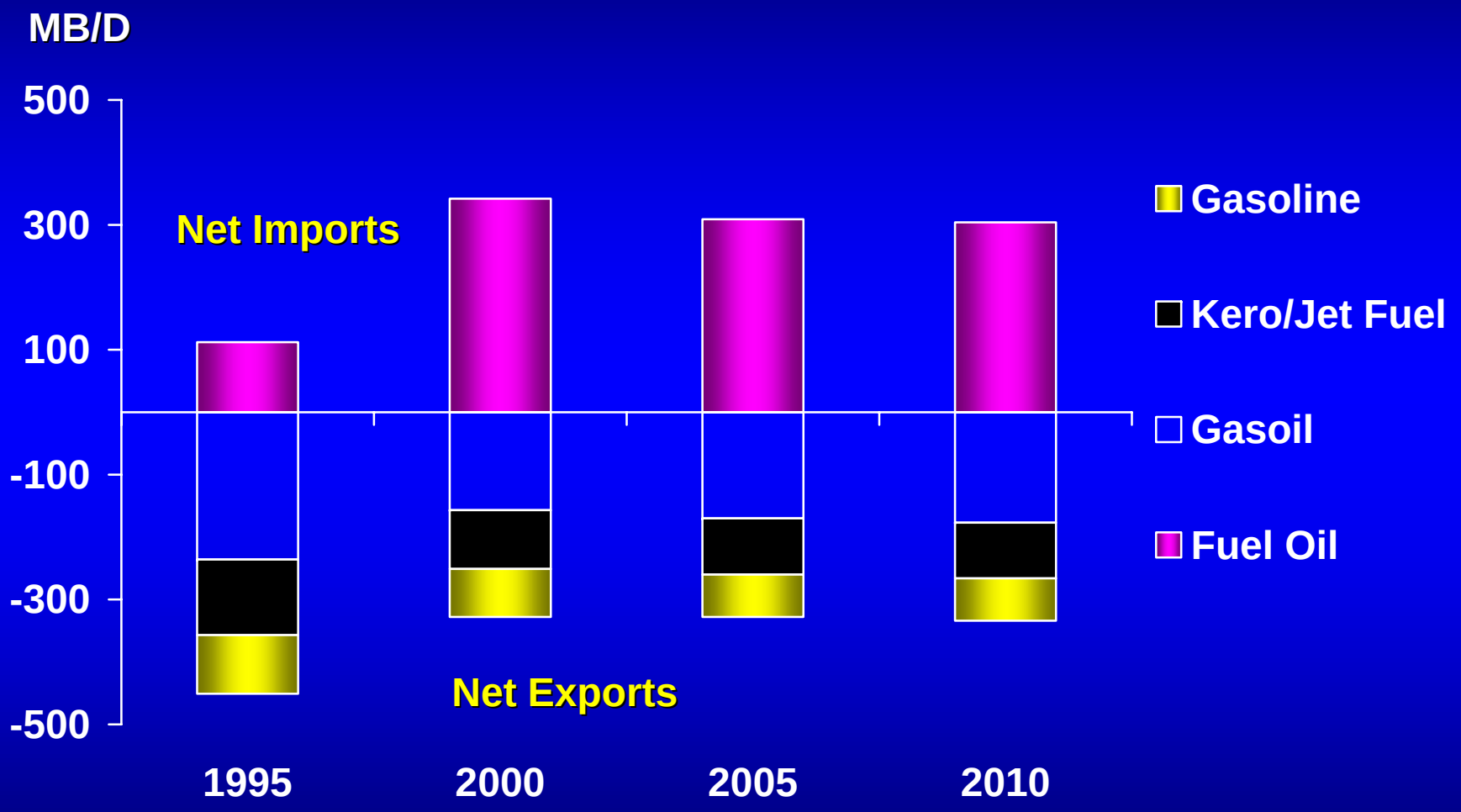
# Singapore Refining Capacity Versus Crude Runs



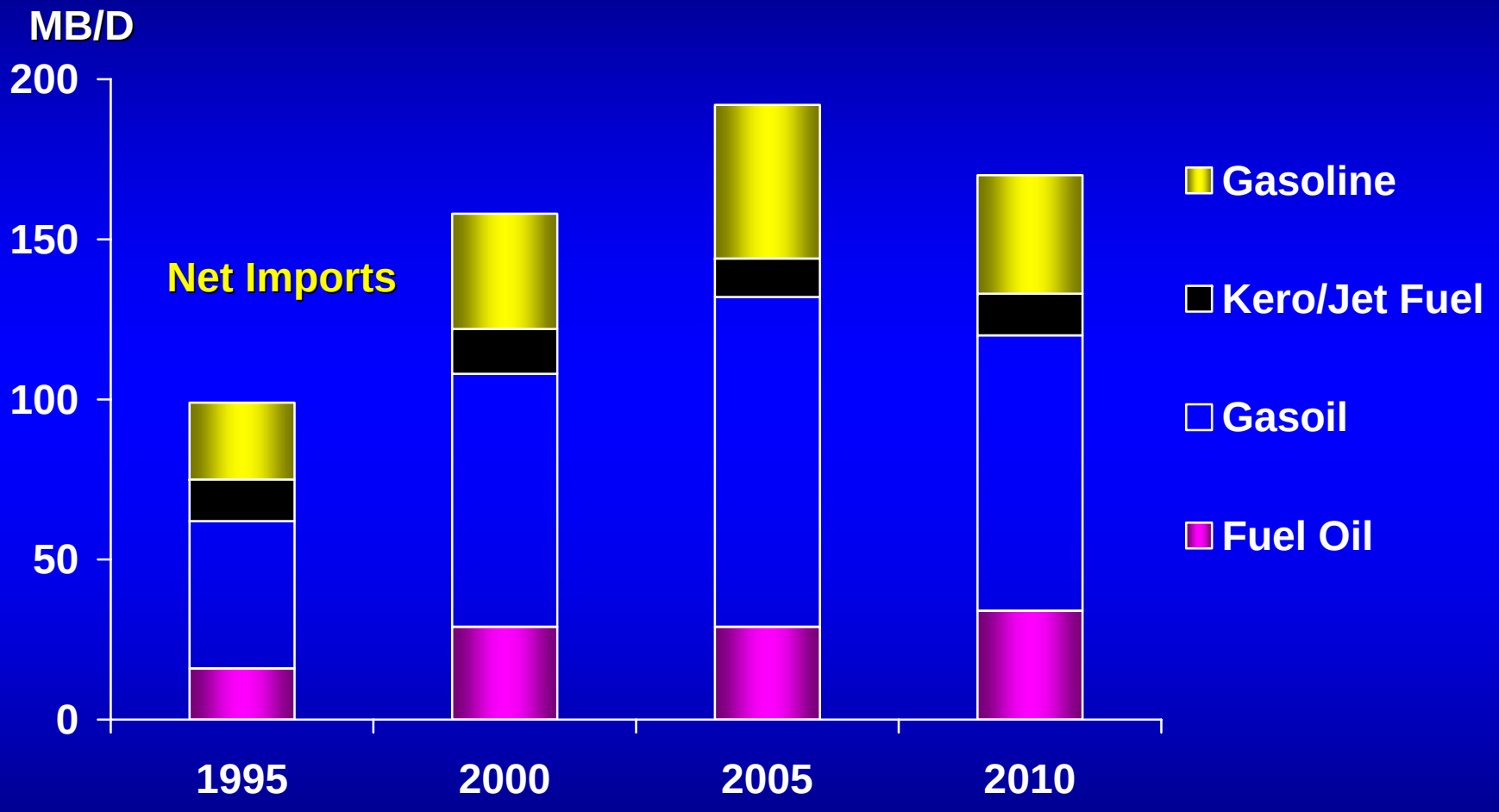

- Hydroskimming is the regional price-setting configuration.

# Singapore Petroleum Products Supply and Demand




- Singapore's role as bunkering center to ensure continuing imports of residual fuel.

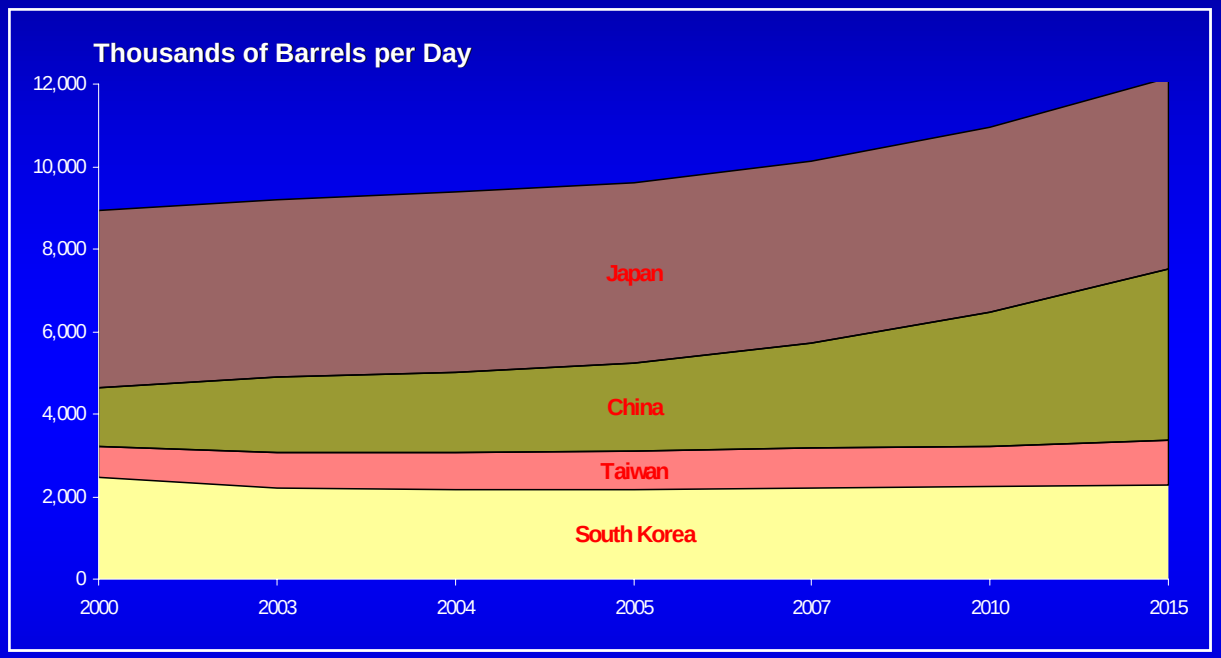
# Vietnam Imports of Petroleum Products




- Vietnam to remain an importer even assuming one grassroots refinery later this decade.

# Growth in Asian Markets for Crude Oil

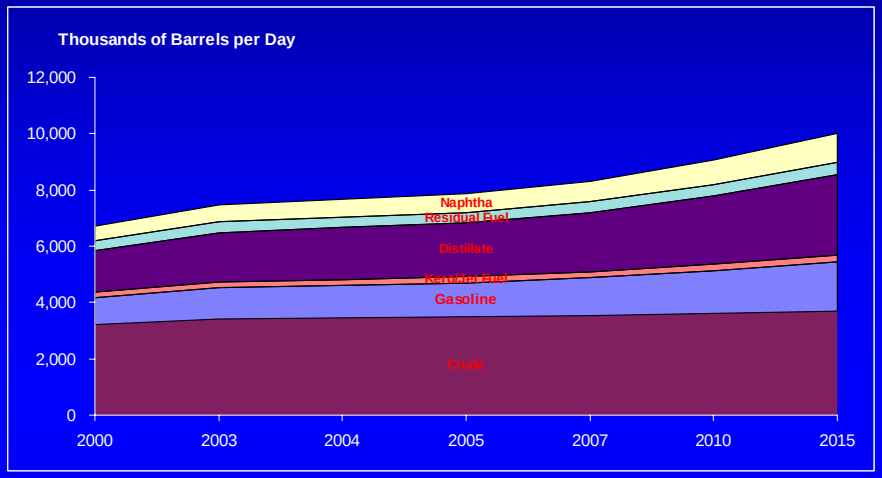
**Crude Import Forecast for Japan, China, Taiwan & South Korea**



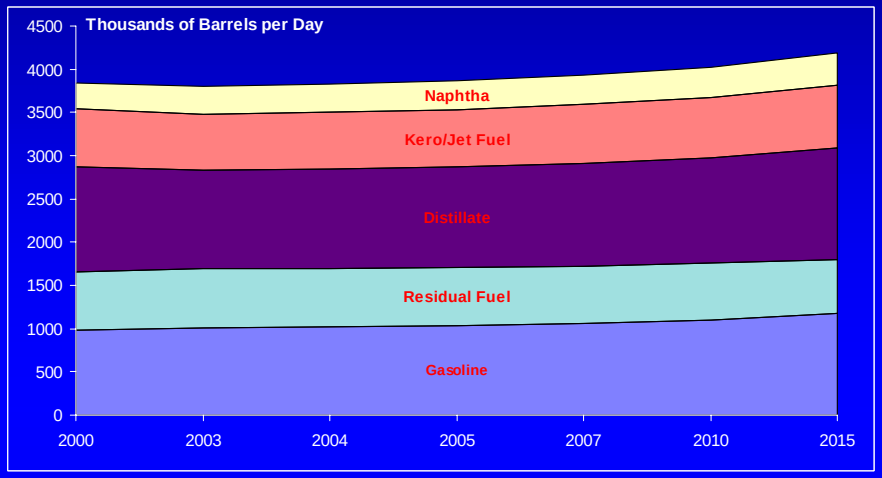

- China is the only country in the study to show significant crude oil demand increases of the four countries studied.
- Much of future Chinese demand for crude oil is expected to be supplied by light sour crude from the Middle East.

# Petroleum Product Production Outlook - Japan, China, Taiwan & South Korea

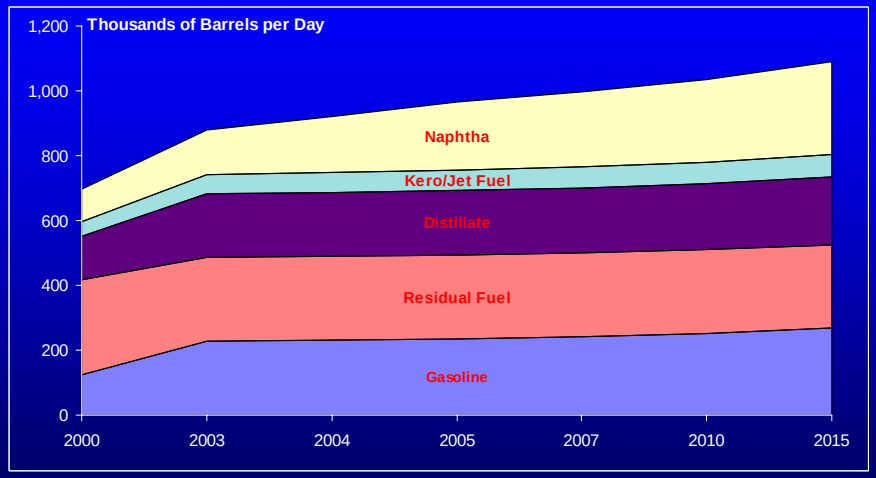
## CHINA



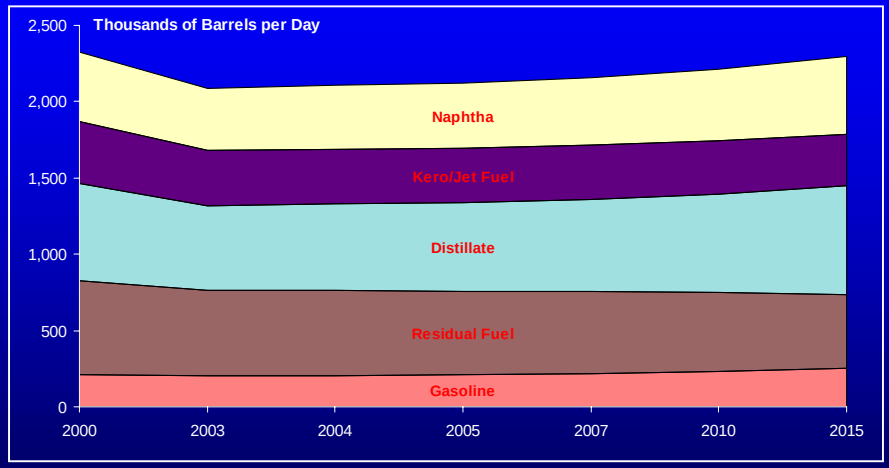

## JAPAN




## TAIWAN




## SOUTH KOREA



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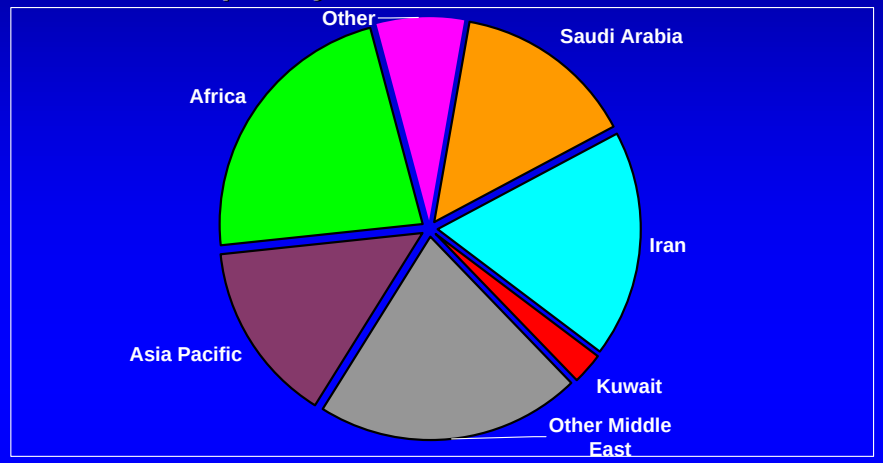
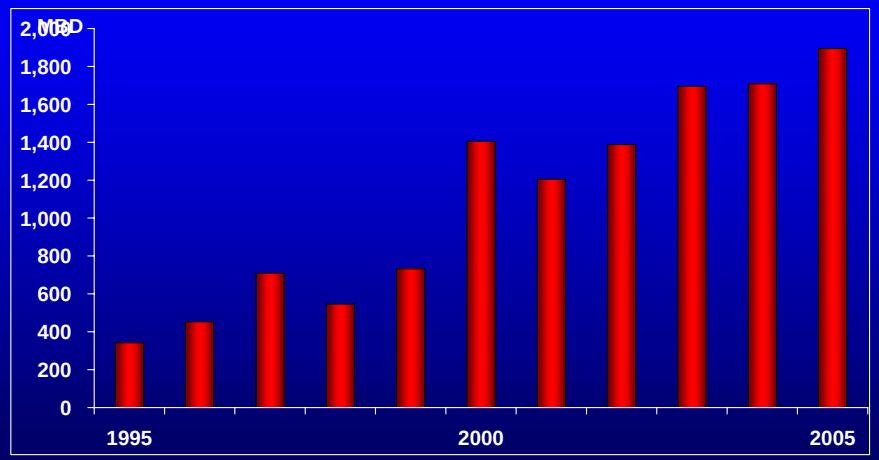
# China Crude Oil Imports Outlook

Crude Import by Source




Crude Imports



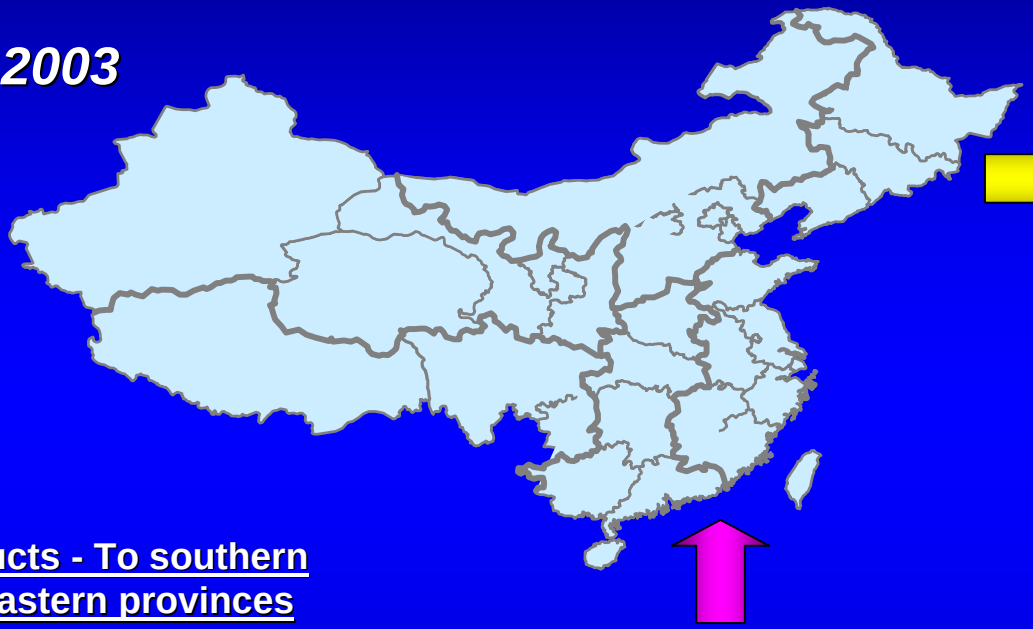

- China's crude imports are from a relatively diverse sources
- Historically, with no crude imports, refineries were configured for domestic crude
  - Generally, heavy, sweet with small naphtha yield
  - RFCC/coking configurations with small reforming and little HDS
- Most available import grades do not fit this configuration and investment is needed
  - Reforming for naphtha
  - HCU in lieu of FCC for distillate/gasoline ratio
  - HDS for sulfur removal
- Product qualities are relatively loose, but expected to tighten to Euro II soon in metro areas

# China Crude Oil Imports Outlook (continued)

- China produced 3.4 million B/D of crude oil in 2003 and imported 1.8 million B/D. By 2015, domestic production is forecast to reach 3.7 million B/D, but imports are expected to reach 4.2 million B/D.
- Light sour crude from CIS expected to increase by over 300,000 B/D between 2004 and 2015.
- China also exports 200,000 B/D, mainly to Japan for direct burning.
- China is now a significant crude oil importer, and its dependence on the Middle east is expected to increase.
- Ensuring long-term oil supply security is of major concern to the Chinese government.
- The Chinese government plans to strengthen both domestic and international E&P activities.
- Joint ventures with non-OPEC producers likely to occur.

# China's Integration with Global Oil Markets

*2003*



**EXPORTS**

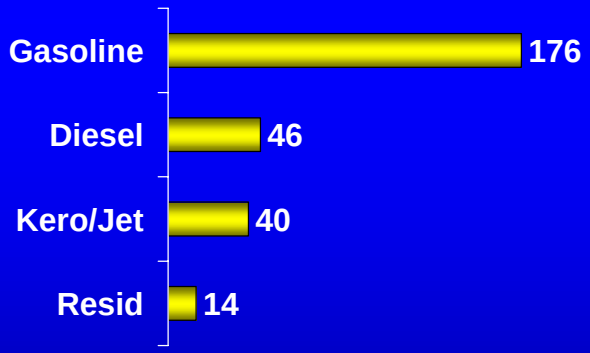
**Crude**

**163 MB/D**

**- Mostly to Japan**

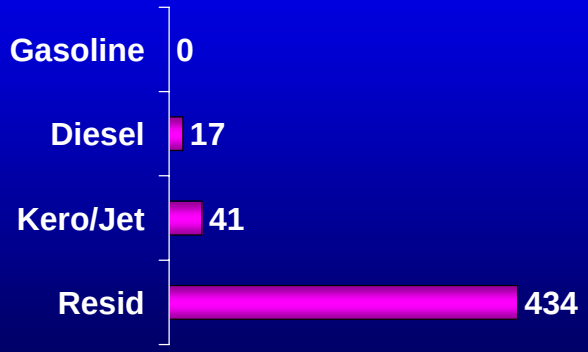
**Products - To Southeast Asia**

**MB/D**




**Products - To southern and eastern provinces**

**MB/D**




**IMPORTS**

**Crude**

**1,823 MB/D**

**- Mostly from Africa and Middle East**

**- Increasing rapidly**

**- Primarily to large coastal refineries**



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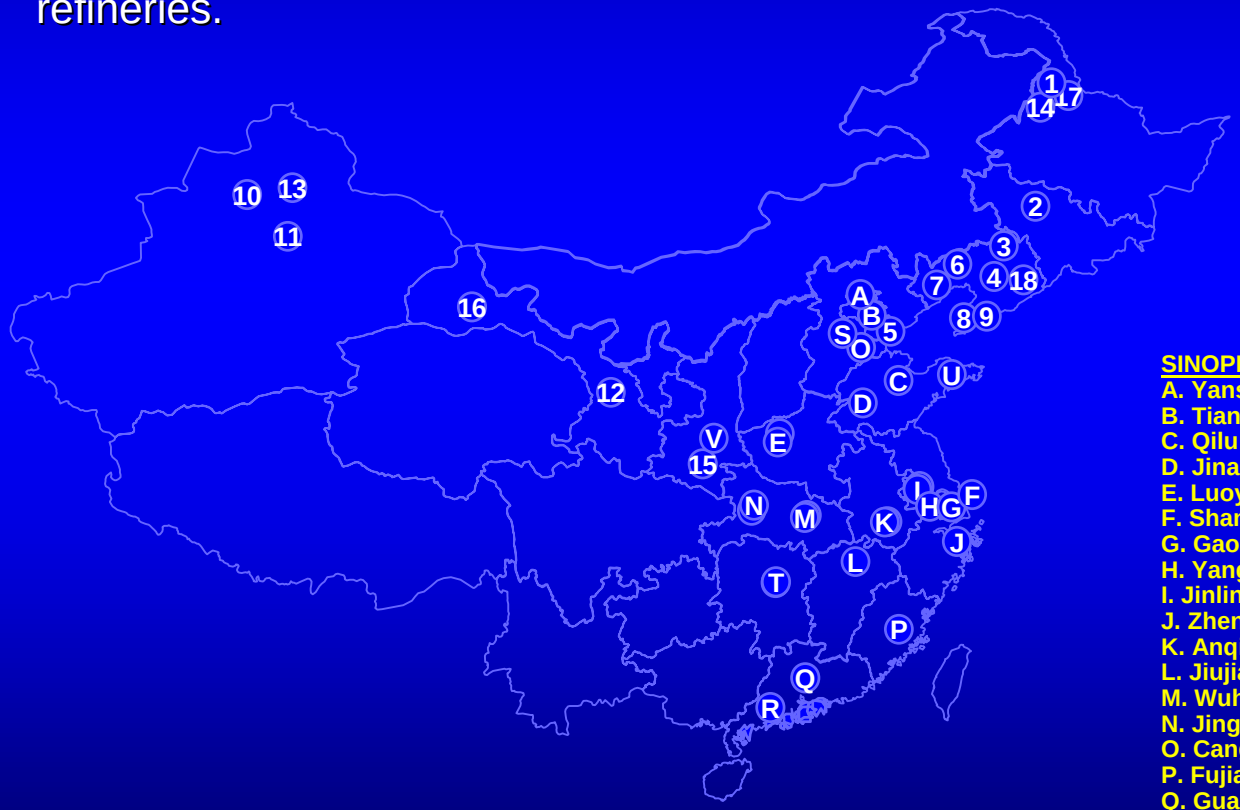
# Chinese Refinery Locations

- A majority of China's refineries are at inland locations where domestic production is used.
- Efficient access to waterborne crudes is mostly limited to coastal refineries.




**Note: Only refineries with capacities greater than 50 MB/D are shown**

**CNPC GROUP**
1. Daqing Petrochemical
2. Jilin Chemical
3. Fushun Petrochemical
4. Liaoyang Chemical Fiber
5. Dagang Petrochemical
6. Jinzhou Petrochemical
7. Jinxi Petrochemical
8. Dalian Petrochemical
9. WEPEC
10. Dushanzi Refinery
11. Urumqi Petrochemical
12. Lanzhou Refinery
13. Kalamayi Petrolchemical
14. Harbin Petrolchemical
15. Yanchang Oil Industry Group
16. Yumen Refinery
17. Daqing Oilfield Accessory
18. Liaohe Oilfield Asphalt

**SINOPEC GROUP**
A. Yansan Petrochemical
B. Tianjin Petrochemical
C. Qilu Petrochemical
D. Jinan Refinery
E. Luoyang Petrochemical
F. Shanghai Petrochemical
G. Gaoqiao Petrochemical
H. Yangzi Petrochemical
I. Jinling Petrochemical
J. Zhenhai Refinery
K. Anqing Petrochemical
L. Jiujiang Refinery
M. Wuhan Petrochemical
N. Jingmen Petrochemical
O. Cangzhou Refinery
P. Fujian Petrochemical
Q. Guangzhou Petrochemical
R. Maoming Petrochemical
S. Shijiazhuang Refinery
T. Changling Refinery
U. Qingdao Petrochemical
V. Xinxing Petroleum Corp.



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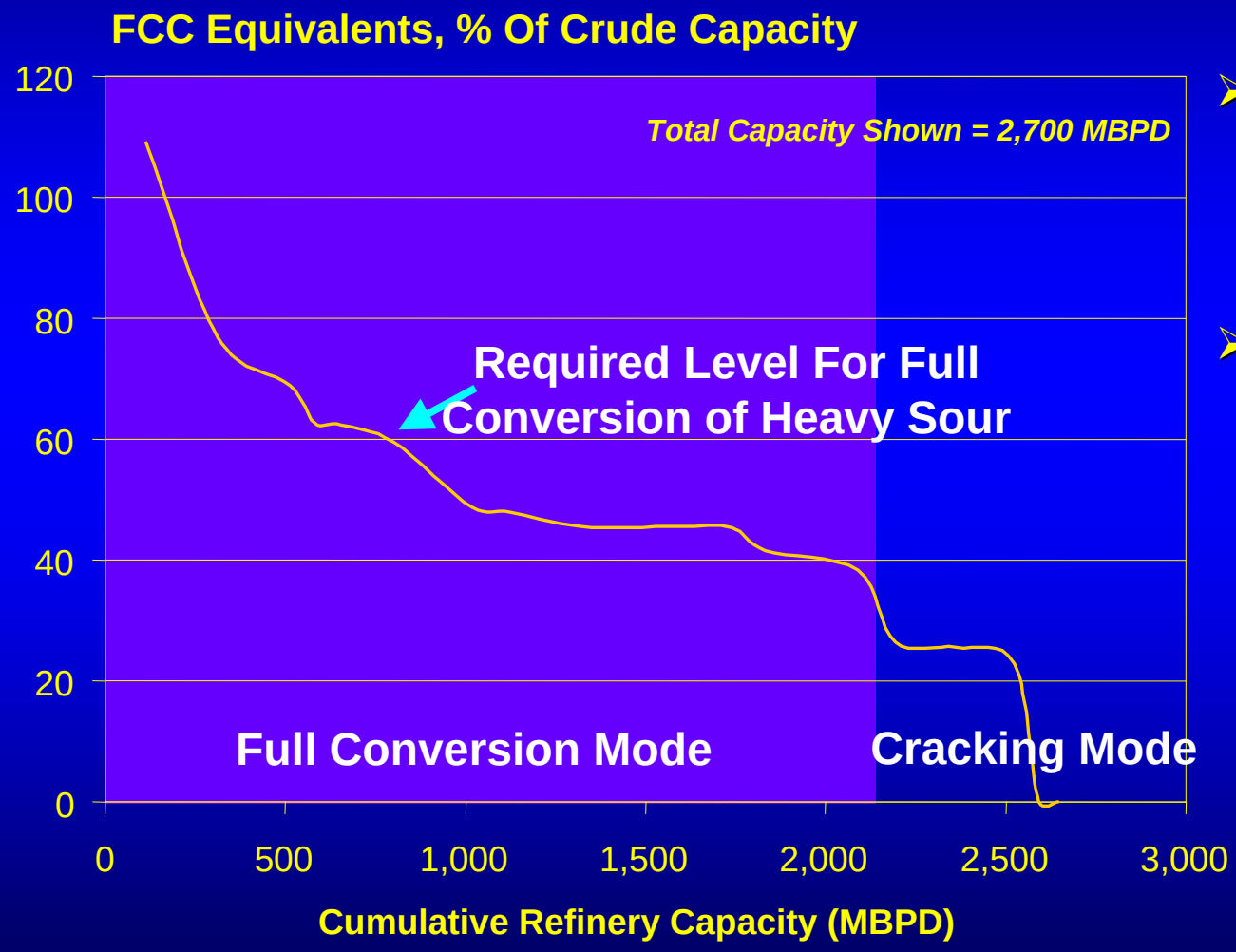
# Coastal Chinese Refineries

| Crude Slate Type | Refinery Type | Company | Location | Agency | Crude Capacity (MB/D) | Avg. Nelson Complexity (Comp/Bbl) | FCC Equivalents (MB/D) | FCC Equivalents (% Crude) |
|---|---|---|---|---|---|---|---|---|
| SWT | TOP | Qingdao Petrochemical Plant | Qingdao | Sinopec | 57 | 1.00 | 0 | 0.0 |
| SWT | TOP | Dagang Refinery | Dagang | Sinopec | 67 | 1.00 | 0 | 0.0 |
| SWT | CRK | Tianjin Petrochemical | Tianjin | Sinopec | 95 | 5.44 | 40 | 41.6 |
| SWT | CRK | Jinxi Chemical | Jinxi | CNPC | 105 | 4.70 | 28 | 26.4 |
| SWT | CRK | Yangzi Petrochemical | Yangzi | Sinopec | 162 | 4.91 | 37 | 22.9 |
| SWT | CRK | Dalian Petrochemical | Dalian | CNPC | 200 | 7.57 | 153 | 76.8 |
| LSR | COK | Cangzhou Oil Refining | Cangzhou | Sinopec | 67 | 6.03 | 42 | 62.7 |
| LSR | COK | Fujian Oil Refining | Fujian | Sinopec | 76 | 4.88 | 47 | 62.4 |
| LSR | COK | Jinzhou Petrochemical | Jinzhou | CNPC | 105 | 4.08 | 50 | 47.8 |
| LSR | COK | Daqing Petrochemical | Daqing | CNPC | 114 | 14.88 | 124 | 109.2 |
| LSR | COK | Guangzhou Petrochemical | Guangzhou | Sinopec | 146 | 5.85 | 87 | 59.5 |
| LSR | CRK | West Pacific Petrochemical | Dalian | CNPC | 152 | 7.62 | 69 | 45.3 |
| LSR | COK | Shanghai Petrochemical | Jinshan | Sinopec | 167 | 2.72 | 43 | 25.5 |
| LSR | COK | Jinling Petrochemical | Jinling | Sinopec | 200 | 4.30 | 91 | 45.5 |
| LSR | COK | Qilu Petrochemical | Qilu | Sinopec | 200 | 7.61 | 137 | 68.9 |
| LSR | COK | Shanghai Gaoqiao Petrochem | Shanghai Gaoqiao | Sinopec | 215 | 4.94 | 104 | 48.7 |
| LSR | COK | Maoming Petrochemical | Maoming | Sinopec | 257 | 5.41 | 98 | 38.4 |
| LSR | COK | Zhenhai Petrochemical | Zhenhai | Sinopec | 266 | 4.98 | 121 | 45.5 |

- While significant upgrading exists, sour crude infrastructure is limited.
- Largest refineries along coast are being upgraded/expanded for light sour crudes.
- Inland refineries are less complex and rely on domestic sweet crude.

# Coastal Chinese Refinery Capacity (Illustrative Purposes Only)




- Crude runs consist of 50% light sweet and 50% light sour crude.
- Roughly 28% of the existing refinery capacity has sufficient upgrading to fully convert a heavy sour crude.



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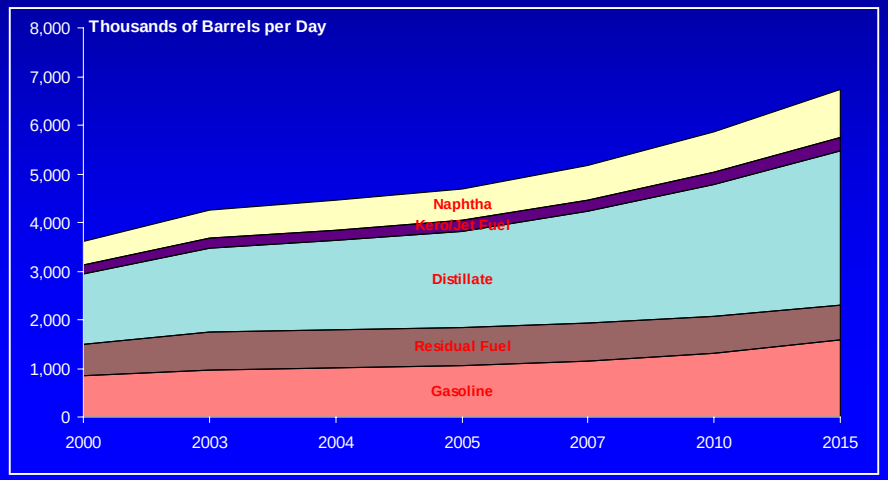
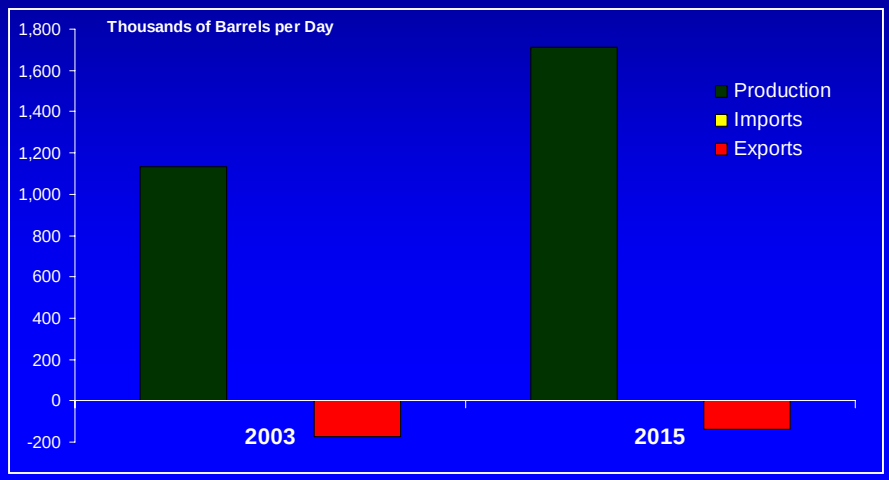
# China Product Demand - Gasoline

**Forecasted Net Demand All Products**




**Gasoline**




- **China currently exports surplus gasoline. Future demand is expected to be satisfied through domestic production with small volumes of exports continuing.**
  - Gasoline is the primary transportation fuel used both in trucks and automobiles.
  - The private automobile market has expanded rapidly with sales rising 75% in 2003 alone. This is expected to continue to support gasoline demand growth as the economic forecast remains positive.
  - A government ban on importing gasoline and distillate imposed in late 1998 was lifted when China entered the WTO in late 2000.
- **The Chinese government in the past has been reluctant to allow imports of petroleum products. With entry into the WTO however, import bans were dropped. Import tariffs on petroleum products encourages production from domestic refineries.**



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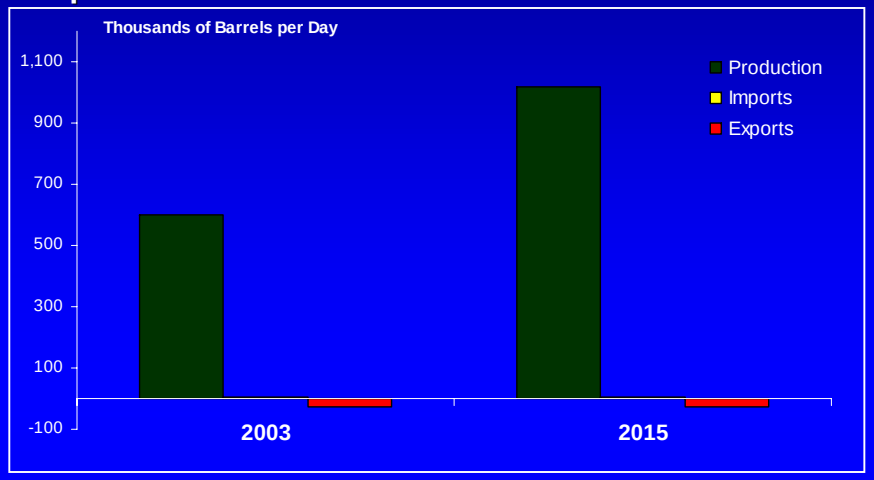
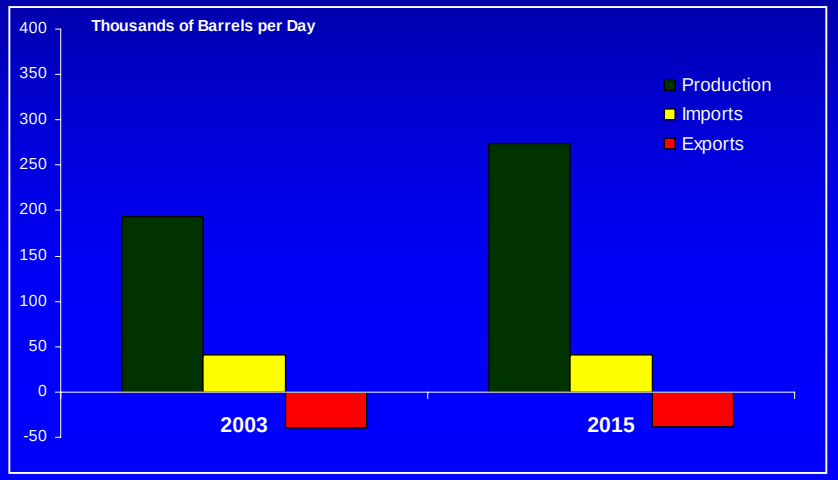
# China Products – Naphtha, Kero/Jet Fuel

**Naphtha**



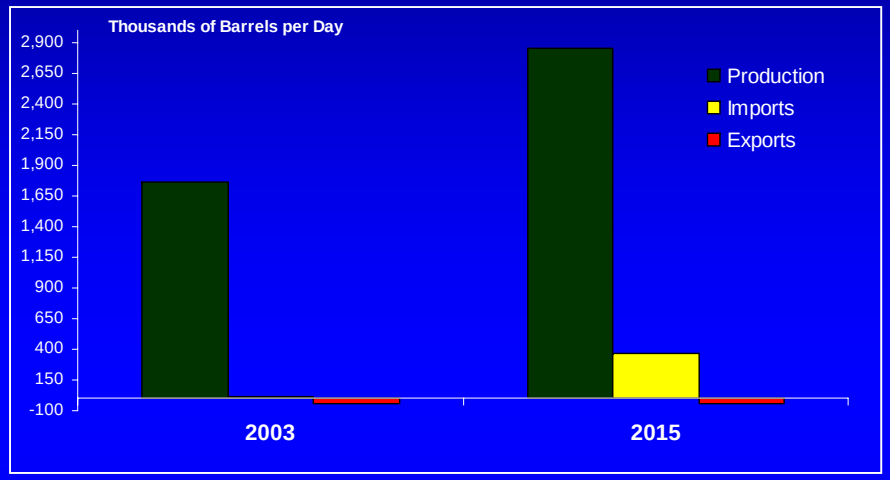

**Kero/Jet Fuel**



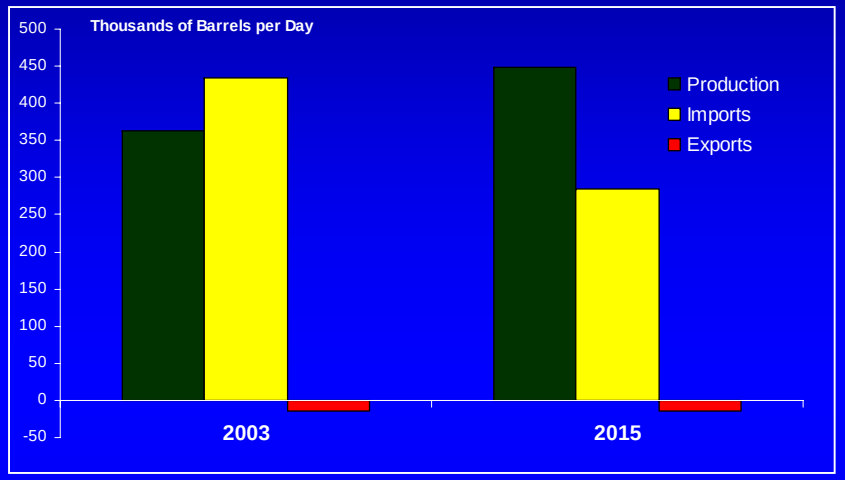

- **China currently exports very small volumes of naphtha. Future demand for naphtha is expected to increase because of growth in the petrochemicals industry.**
  - Although not an importer of naphtha, China is a net importer of end products as it is unable to meet demand through domestic petrochemical manufacturing.
  - Demand growth for naphtha is supported by government and foreign investment into the petrochemical sector. Chinese government policy does not encourage large volumes of naphtha imports, therefore requirements will be met by local refineries running more crude.
- **Jet fuel demand is growing as Chinese policy encourages tourism.**

# China Products – Distillate, Residual Fuel

**Distillate**




**Residual Fuel**




- **Distillate demand is expected to increase significantly driven by growth in transportation services.**
  - Currently a large percentage of trucks are gasoline-powered. This is changing as more diesel-powered trucks are going on road.
- **Current demand for residual fuel oil is satisfied by significant volumes of imports.**
  - Chinese refineries has reduced fuel oil production through increased fuel oil conversion investment over the last 20 years. Fuel oil yield is now at 7.5% of crude run and could trend lower.

# China Potential Interest in Oil Sands

- **China's Coastal refineries have around 2.65 million B/D of capacity.**
- **Around 560,000 B/D of capacity is sweet cracking.**
  - Good candidates to use SCO, potential 100,000 - 150,000 B/D.
  - SCO could help meet cold flow properties that are limited using domestic crude.
- **Close to 2 million B/D of capacity are light sour coking refineries with FCC capacity.**
  - Coking capacities are small compared to crude rates, so some SCO could also be used in these refineries.
  - Should have potential to process some SynBit or SynSynbit blends.
  - The amount of bitumen blends that likely can be run dependent on the ability to handle high sulfur residue and blend it off after the coking units are filled.
  - Hydrogen treating capabilities are limited.
- **China will need to add around 1.2 million B/D of new refinery capacity over the next 10 years. Such capacity is expected to be oriented towards heavy, sour crude.**
  - Could provide substantial outlets for bitumen blends.
  - Will likely include substantial hydrotreating.

# China Refining Industry Analysis

**WTO Member**

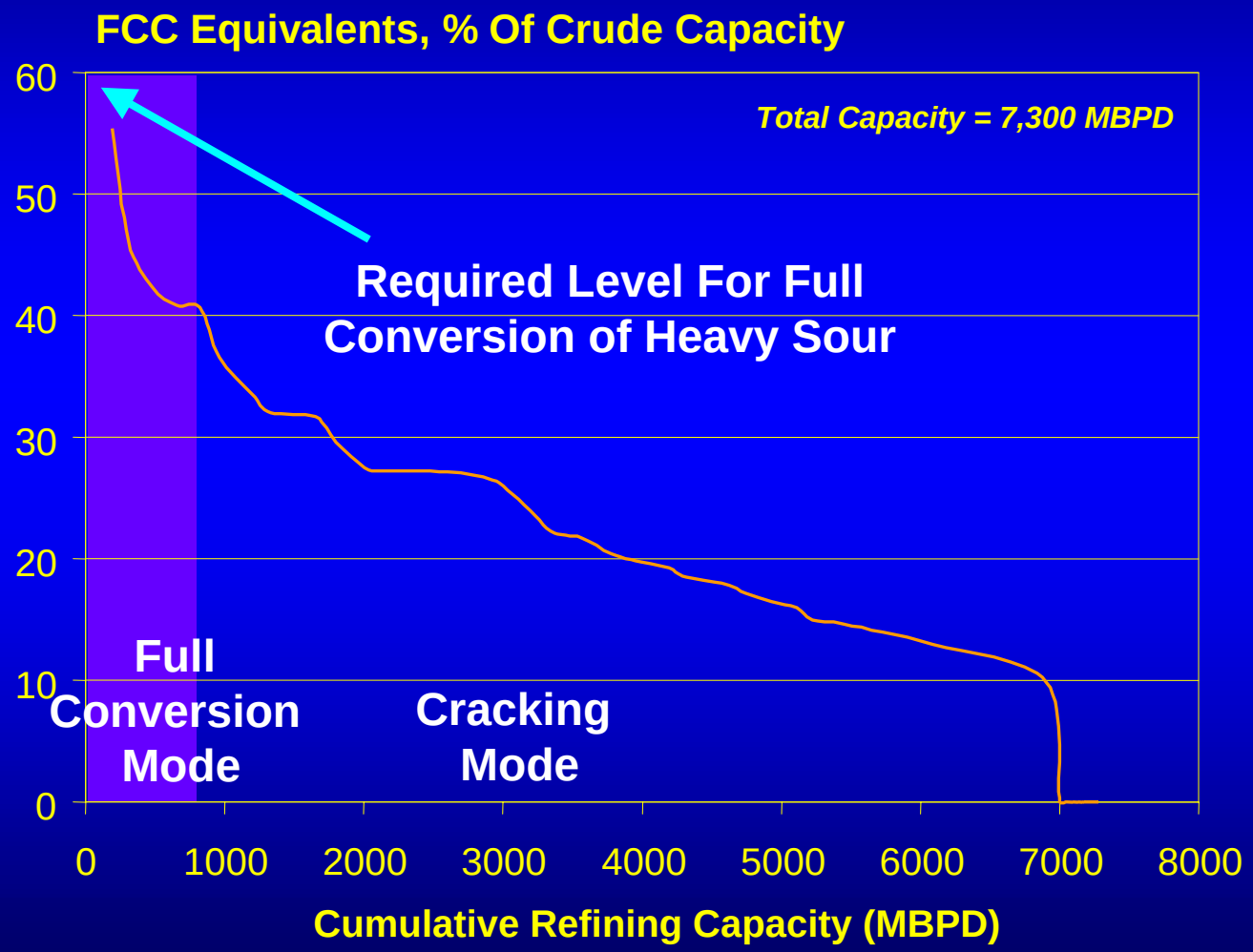
**Growing demand for petroleum products**

**Significant reliance on Middle East crudes**

- **The Chinese government currently imposes high tariffs on energy imports.**
- **China's entry into the WTO in 2001 committed them to trade and investment liberalization which if fully implemented will open the economy to foreign firms.**
- **Refinery utilization was 94% in 2003 and is expected to hit full utilization in the period between 2007 and 2010.**
- **The demand increase by 2015 is equivalent to six new 200,000 B/D refineries.**
- **Middle East Crude supplies account for 51% of all crude imports and is expected to increase to 68% by 2015.**
- **Lack of adequate refining capacity suitable for heavier crudes is forcing China to rely more on Middle East light sour crudes.**

- China is entering a growth phase that will likely see increased imports of petroleum products.

# Japan/Korea Refinery Capacity (Illustrative Purposes Only)




- Many Japanese refineries have resid desulphurization.
- Utilization of many Korean refineries is low.
- Overall crude slate includes
  - 10% Light Sweet
  - 83% Light Sour
  - 7% Heavy Sour

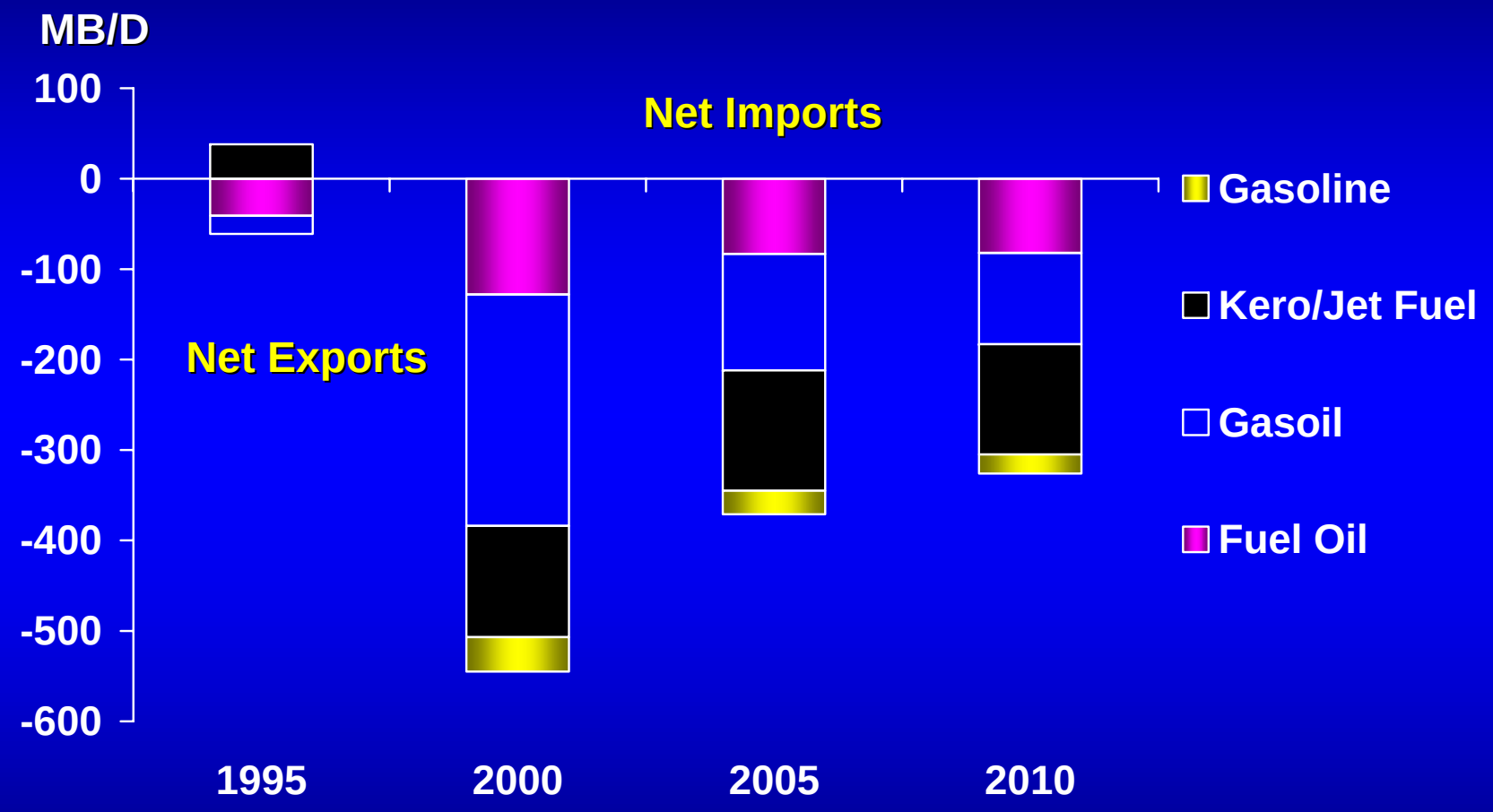
# South Korea Refining Capacity

**South Korea Refining Capacity[(1)]**
(Barrels per Day)

| Refinery | Location | Crude | Vacuum Distillation | Coking | Catalytic Cracking | Reforming | Hydro-cracking | Distillate Hydro-treating | Resid Hydro-treating | Cat Feed Hydro-treating |
|---|---|---|---|---|---|---|---|---|---|---|
| Hyundai Oil Refinery Co | Daesan | 310,000 | 41,000 | 19,000 | | 20,000 | 22,000 | 12,000 | | |
| Hyundai Oil Refinery Co | Inchon | 270,000 | 18,000 | | | 27,900 | | 86,850 | | |
| LG-Caltex | Yoso | 650,000 | 11,000 | | 82,000 | 75,400 | | 36,000 | 180,000 | |
| S-Oil Corp | Onsan | 520,000 | 160,000 | | 60,000 | 43,000 | 71,000 | 85,000 | 50,000 | 40,000 |
| SK Corp | Ulsan | 817,000 | 78,850 | | 94,500 | 20,070 | 27,000 | 213,300 | 27,000 | |
| Total | | 2,567,000 | 308,850 | 19,000 | 236,500 | 186,370 | 120,000 | 433,150 | 257,000 | 40,000 |

Note :1) Oil & Gas Journal, Dec 20, 2004; 2004 Worldwide Refining Survey

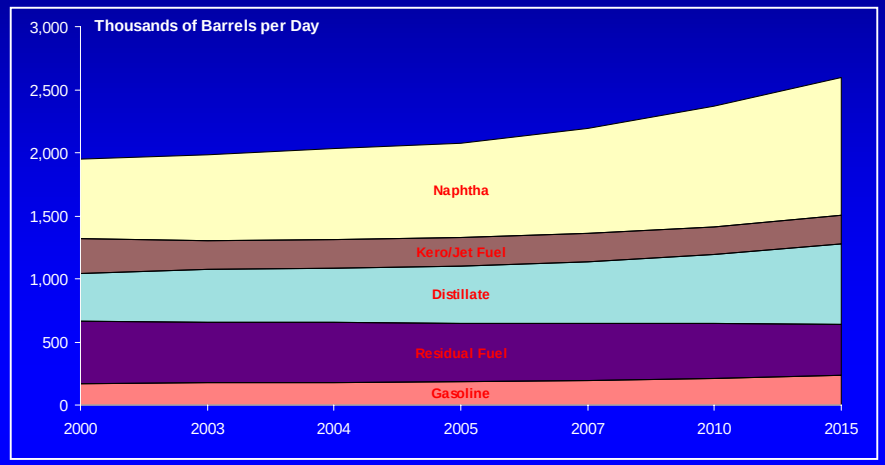
# South Korea Petroleum Product Supply and Demand



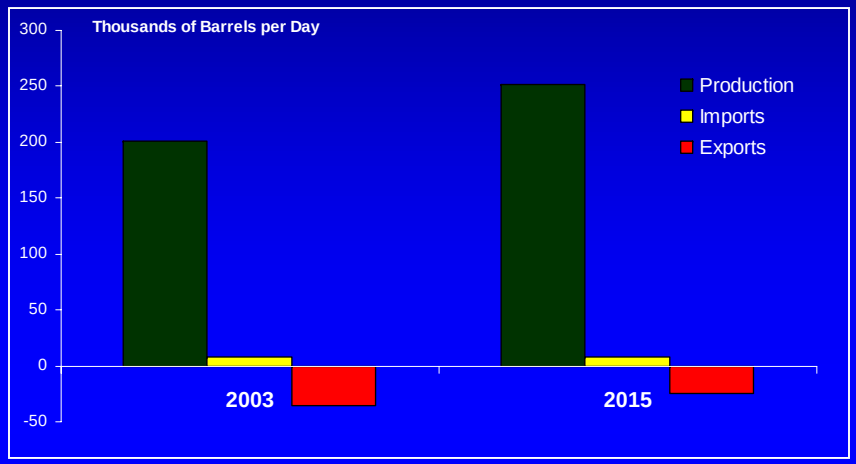

- South Korea is a major exporter of petroleum products.
- Korean product surplus to decline as domestic market grows.

# South Korea Product Demand - Gasoline

**Forecasted Net Demand All Products**



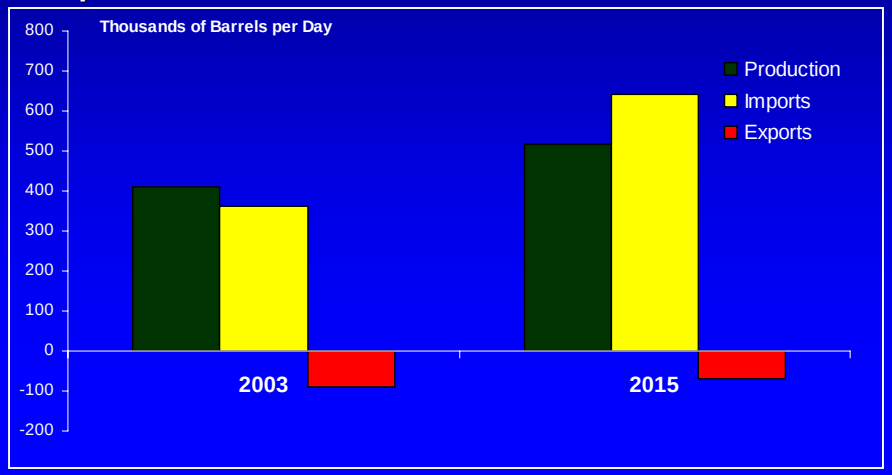

**Gasoline**



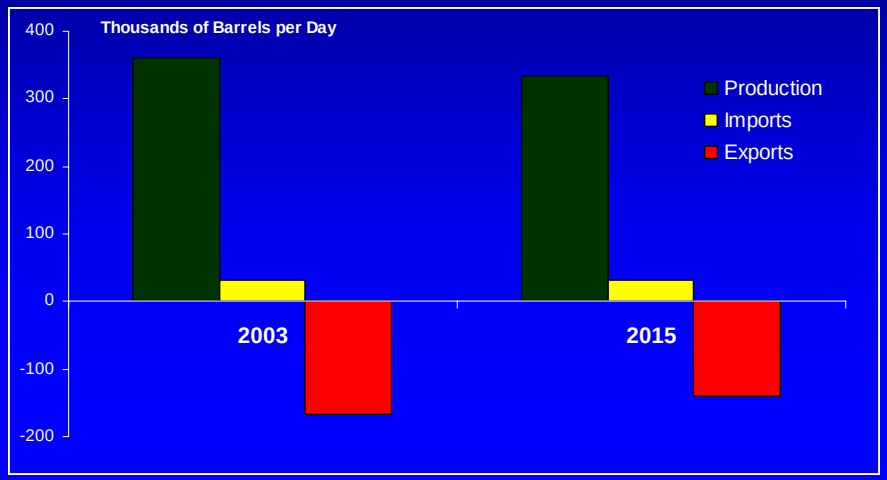

- **South Korea has experienced strong economic growth since the late 1990s.**
  - Future growth may be tempered by fundamental domestic financial issues. Some reforms have been implemented, however more are expected.
- **Gasoline consumption is anticipated to grow with rising national income and increased vehicle ownership.**
  - Korea produces all of its domestic requirements for gasoline, rather than relying on imports. It is likely to continue to be a net exporter, with most of its exports destined to local Asian markets.

# South Korea Products – Naphtha, Kero/Jet Fuel

**Naphtha**




**Kero/Jet Fuel**




- **South Korea currently imports comparable volumes of naphtha to what it produces domestically. Future demand is forecast to grow significantly with increased reliance on imports.**
  - Ethylene facilities are supplied by both light naphtha from local refineries as well as imports from the Middle East and other sources.
- **Kerosene utilization for lighting and cooking far exceeds the use of jet fuel in Korea. The market for kerosene is expected to soften as consumers begin switching to natural gas for heating due to a government mandate.**
  - Exports are expected to decrease with increasing domestic consumption.
  - LNG imports are forecast to increase, providing natural gas for domestic growth.



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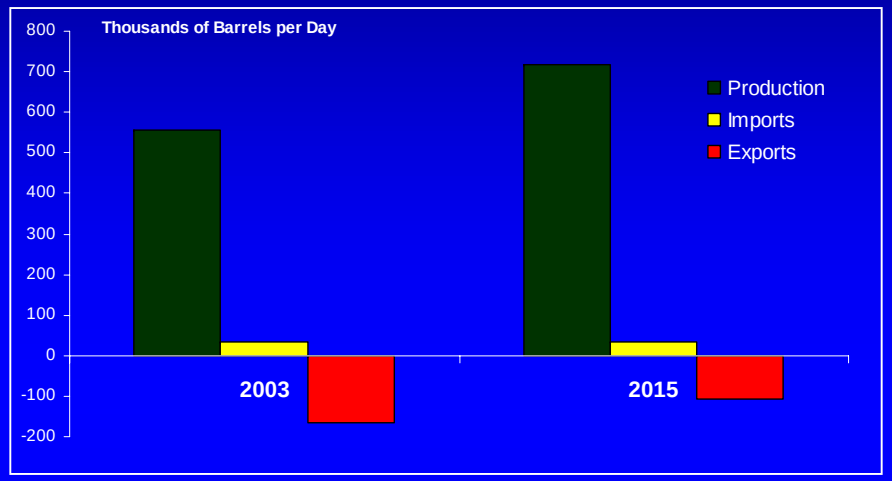
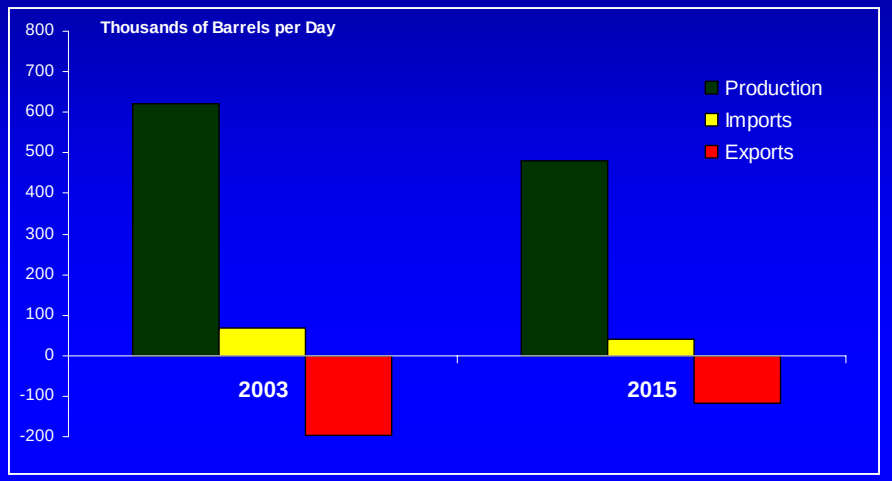
# South Korea Products – Distillate, Residual Fuel

**Distillate**




**Residual Fuel**




- **Demand for distillate product is expected to grow. Domestic production is expected to meet future requirements.**
  - 70% of all gasoil/diesel is consumed in the transportation sector with demand expected to grow.
  - New refinery capacity has created a sizeable surplus for export to other Asian countries, but exports should decline as demand grows.
- **Fuel oil demand has dropped significantly as LNG and imported bituminous coal have become the fuels of choice for power generation.**

# South Korea Crude Oil Demand

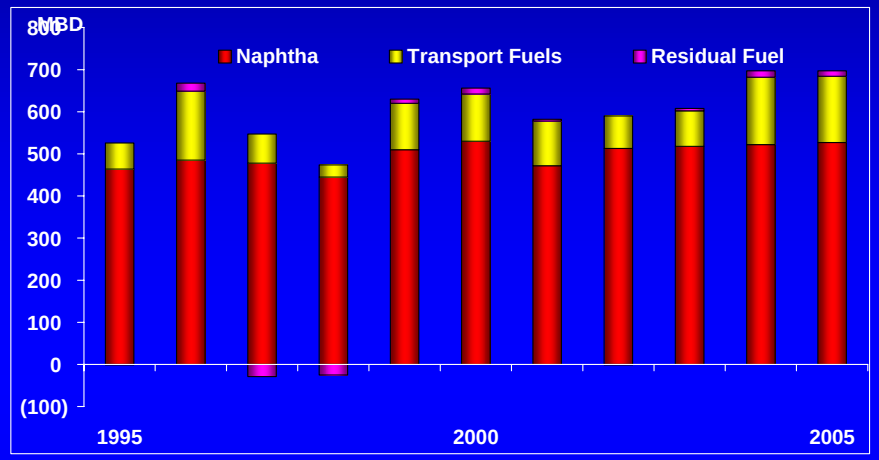
- **South Korea has no crude oil production.**
- **Korea imports crudes from a variety of sources.**
  - 5% of demand is met by African crudes.
  - 15% is Asia/Pacific sweet crudes.
  - 5% of the crude originates in Latin America.
  - Saudi Arabia accounts for about 40% of crude imports.
- **Crude oil runs are currently around 2.2 million B/D.**

# South Korea Potential Interest in Oil Sands

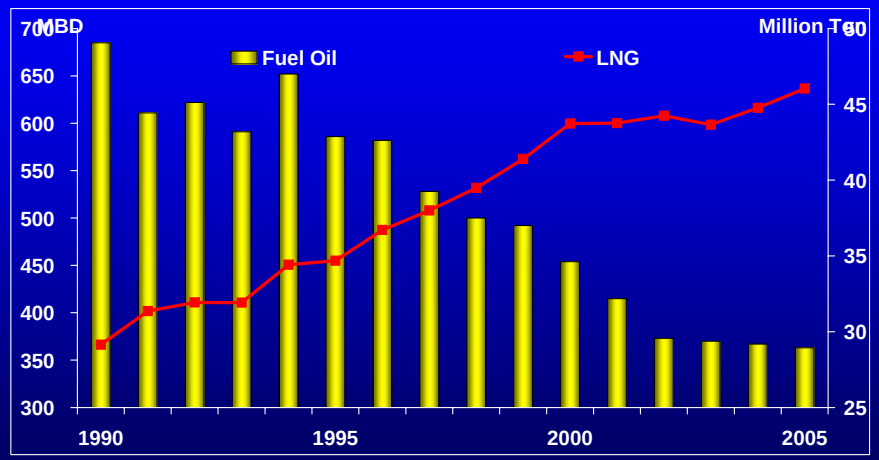
- **South Korean refineries have around 2.6 million B/D capacity in five large scale refining complexes.**
- **These refineries process primarily sour Middle East crudes. Around 20% is light sweet crude.**
- **South Korea should be able to process around 100,000 to 180,000 B/D of SCO, based mainly on replacing other sweet crude supplies.**
- **South Korea's refineries should be able to process some bitumen blends, but if they can handle the high sulfur bottoms is the main issue.**
  - Resid hydrotreating capabilities are likely limited to lower sulfur stocks.
  - Very little coking capability available to eliminate residual.
  - Already export high sulfur residual fuel oil.

# Japan Petroleum Products Supply and Demand

**Product Balance**




**Power and Industrial Demand**

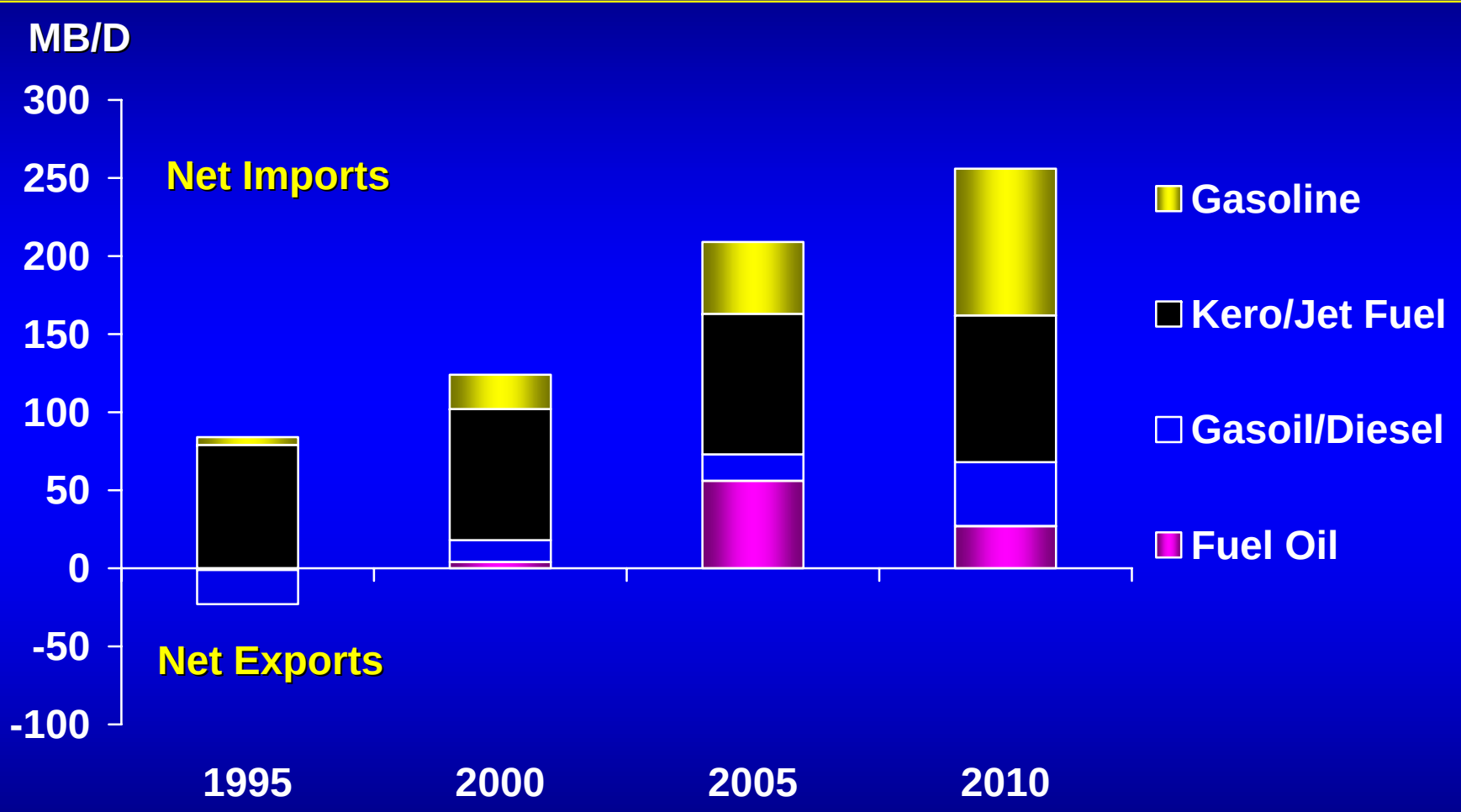



- **Japan has remained largely balanced in transportation fuels with some imports in small vessels from South Korea.**
- **Petrochemical naphtha is a key product and substantial imports are required, supplying half of demand.**
- **LNG is replacing residual fuel in power and industrial sectors.**
- **Residual demand has declined by half since 1990 but exports have been minimal as result of shifting to lighter crude slate.**
- **Ultra-low sulfur gasoline and diesel regulations are forthcoming.**
  - Little advantage in low sulfur crude.

# Japan Refining Capacity

| Refinery | Location | Crude Type | Crude | Vacuum | Visbreaking | Coking | FCC | Hydrocracking | Reforming | Hydrotreating | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | Resid | VGO | Distillate | Naphtha |
| **Cosmo** | | | | | | | | | | | | | |
| Cosmo Oil CL | Chiba | Light Sour | 228,000 | 57,000 | - | - | 33,300 | - | 32,850 | 64,800 | 31,500 | 120,600 | 34,200 |
| Cosmo Oil CL | Yokkaichi City | Light Sour | 147,250 | 70,300 | - | - | 25,200 | - | 17,550 | - | 43,200 | 67,500 | 17,550 |
| Cosmo Oil CL | Sakaide | Light Sour | 114,000 | 39,425 | - | - | 17,100 | - | 12,600 | 27,000 | 15,480 | 57,600 | 12,600 |
| Cosmo Oil CL | Sakai | Light Sour | 76,000 | 32,300 | - | - | 20,700 | - | 7,200 | - | 18,000 | 48,600 | 9,900 |
| **Esso** | | | | | | | | | | | | | |
| Tonen/General Sekiyu Seisei KK | Kawasaki | Light Sour | 318,250 | 116,850 | - | - | 82,800 | 22,500 | 47,000 | 22,500 | 77,000 | 149,000 | 59,000 |
| Tonen/General Sekiyu Seisei KK | Wakayama | Light Sour | 161,500 | 70,300 | - | - | 38,000 | - | 20,700 | - | 39,500 | 84,500 | 42,000 |
| Tonen/General Sekiyu Seisei KK | Sakai | Light Sour | 148,200 | 66,500 | - | - | 37,500 | - | 30,600 | - | 35,000 | 68,700 | 42,500 |
| **Idemitsu** | | | | | | | | | | | | | |
| Idemitsu Kosan CL | Ichihara, Chiba | Light Sour | 209,000 | 62,700 | - | - | 42,750 | 10,440 | 15,300 | 36,000 | 44,550 | 105,300 | 22,500 |
| Idemitsu Kosan CL | Chita, Aichi | Light Sour | 152,000 | - | - | - | 45,000 | - | 16,200 | 49,500 | - | 71,100 | 23,400 |
| Idemitsu Kosan CL | Tomakomai | Light Sour | 133,000 | 22,800 | - | - | 27,000 | 14,850 | 16,200 | 34,200 | - | 49,500 | 24,300 |
| Idemitsu Kosan CL | Tokuyama | Light Sour | 114,000 | 52,250 | - | - | 24,700 | - | 18,000 | - | 40,500 | 49,500 | 18,000 |
| **Japan Energy** | | | | | | | | | | | | | |
| Japan Energy | Mizushima | Light Sour | 190,190 | 103,550 | - | 23,400 | 43,200 | 27,900 | 39,600 | 58,900 | 68,850 | 98,010 | 39,150 |
| Fuji Oil CL | Sodegaura | Light Sour | 182,400 | 52,250 | 21,600 | - | 16,200 | - | 26,910 | - | 52,300 | 77,450 | 38,700 |
| Kashima Oil CL | Kashima | Light Sour | 180,500 | 39,900 | - | - | 29,700 | - | 19,800 | 27,000 | 22,500 | 85,500 | 20,700 |
| **Mitsubishi** | | | | | | | | | | | | | |
| Nippon Mitsubishi Petroleum Refining Co. | Mizushima | Light Sour | 237,500 | 73,150 | - | - | 61,400 | 11,700 | 18,000 | 40,500 | 41,100 | 72,000 | 40,500 |
| Nippon Oil CL | Sendai | Light Sour | 137,750 | 30,000 | - | - | 38,700 | - | 16,200 | 46,800 | 31,100 | 18,500 | 12,000 |
| **Mobil** | | | | | | | | | | | | | |
| Kyokuto Petroleum Ltd. | Chiba | Light Sour | 166,250 | 78,850 | - | - | 34,000 | 34,650 | 24,300 | - | - | 78,500 | 27,500 |
| **Nippon** | | | | | | | | | | | | | |
| Nippon Mitsubishi Petroleum Refining Co. | Negishi | Light Sour | 323,000 | 123,500 | 18,000 | - | 71,000 | - | 45,000 | 33,000 | 85,400 | 137,000 | 69,500 |
| Nippon Mitsubishi Petroleum Refining Co. | Muroran | Light Sour | 171,000 | 61,750 | - | - | 27,000 | 40,500 | 32,400 | 16,000 | 45,000 | 59,000 | 59,000 |
| Kyushu Oil CL | Oita | Light Sour | 147,250 | 62,700 | - | - | 18,900 | 9,900 | 24,300 | - | 36,000 | 61,200 | 25,200 |
| Nippon Oil CL | Marifu, Yamaguchi | Light Sour | 120,650 | 60,800 | - | 17,100 | 26,600 | - | 21,600 | - | 48,000 | 36,000 | 32,000 |
| Nippon Oil CL | Osaka | Light Sour | 109,250 | 57,000 | - | - | 24,300 | - | 12,600 | - | 18,900 | 41,400 | 19,800 |
| **Showa Shell** | | | | | | | | | | | | | |
| Showa Yokkaichi Sekiyu CL | Yokkaichi | Light Sour | 199,500 | 99,750 | - | - | 54,900 | - | 63,720 | 40,500 | 36,900 | 74,800 | 61,500 |
| Toa Oil CL | Kawasaki | Light Sour | 175,750 | 83,600 | - | 24,000 | 31,050 | - | 44,008 | - | 55,800 | 84,350 | 54,500 |
| Seibu Oil CL | Yamaguchi | Light Sour | 114,000 | 41,800 | - | - | 25,000 | - | 20,430 | 50,000 | - | 66,000 | 26,000 |
| **Taiyo** | | | | | | | | | | | | | |
| Taiyo Oil CL | Ehime | Light Sour | 96,900 | 25,650 | - | - | - | 17,100 | 29,700 | - | - | 48,000 | 37,000 |
| **AVERAGE REFINERY CAPACITY** | | | 167,427 | 60,949 | 1,523 | 2,481 | 34,462 | 7,290 | 25,876 | 21,027 | 34,099 | 73,447 | 33,423 |
| **UNIT CAPACITY AS % OF CRUDE** | | | | 36.4% | 0.9% | 1.5% | 20.6% | 4.4% | 15.5% | 12.6% | 20.4% | 43.9% | 20.0% |

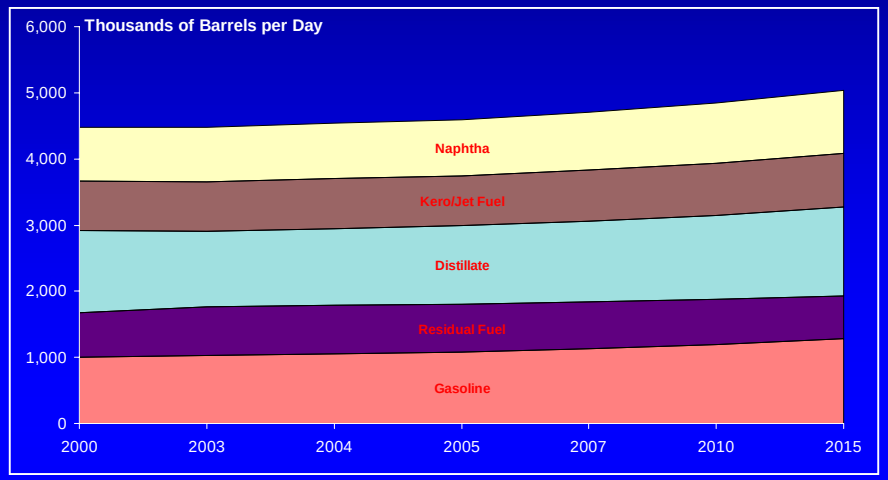
# Japan Products Imports and Exports



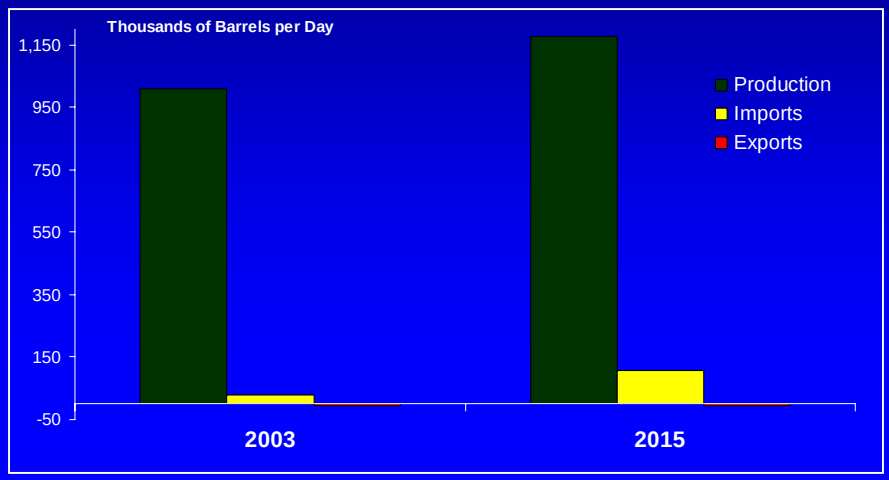

- Japan to gradually increase imports particularly gasoline.

# Japan Product Demand - Gasoline

**Forecasted Net Demand All Products**



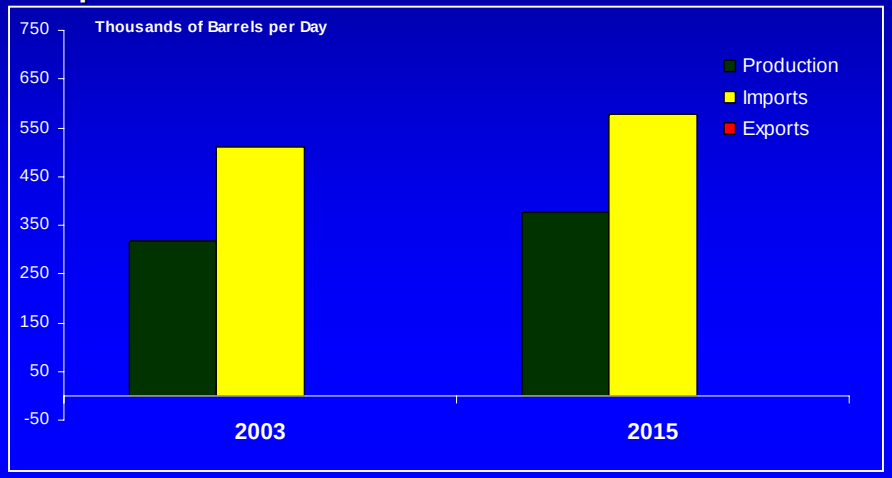

**Gasoline**



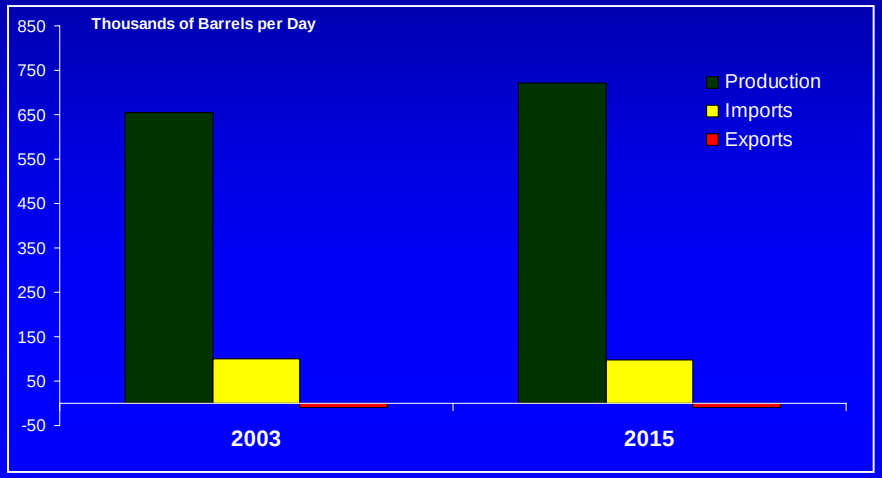

- **Primary energy demand in Japan has grown less than 1% annually since 1995.**
  - This is a result of limited production of domestic fossil energy and consequently; energy efficiency has been given a high priority.
  - The most commercially important sources of imported products are Korean refiners who have surplus capacity available at short-haul distances.
- **Gasoline demand is expected to increase, supporting slightly higher levels of imports.**
  - Demand growth has averaged about 2% annually over the past five years.
  - Gasoline imports consist of unfinished blendstock that is reprocessed or blended to meet Japanese specifications.

# Japan Products – Naphtha, Kero/Jet Fuel

**Naphtha**

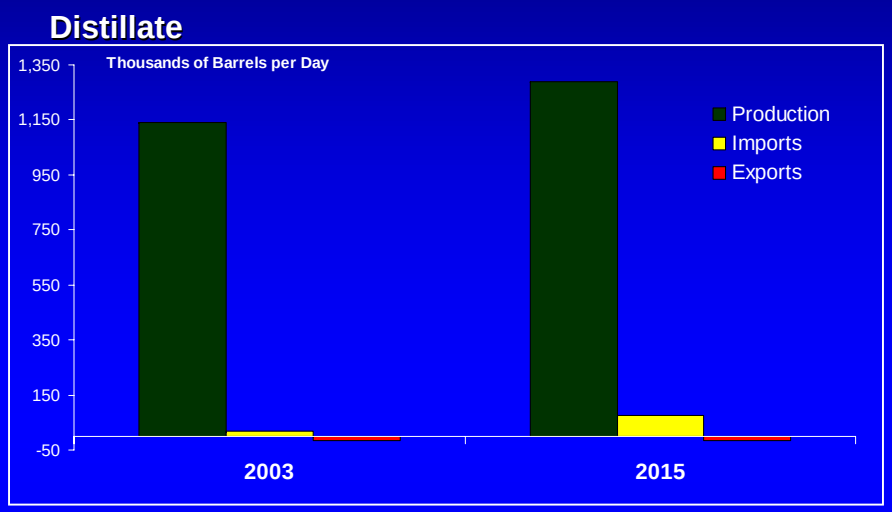


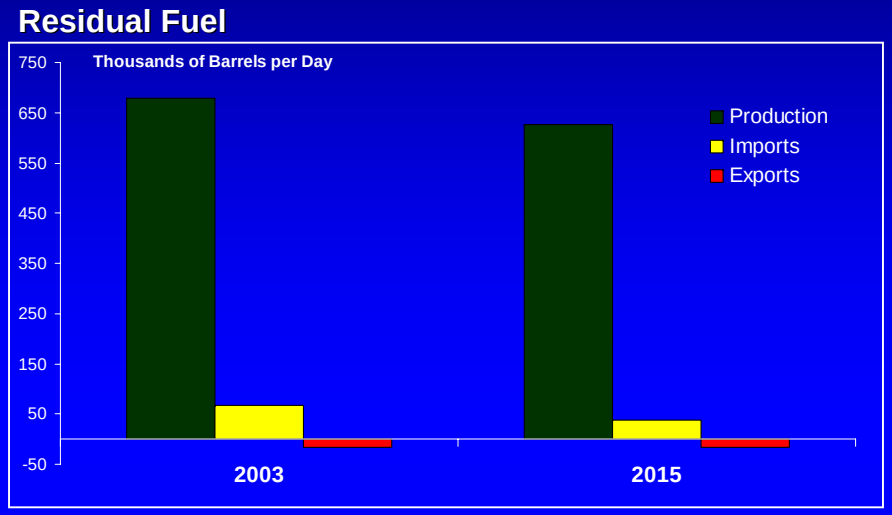

**Kero/Jet Fuel**




- **Naphtha demand is mainly satisfied through significant volumes of imports from the Middle East. This trend is expected to continue in future.**
  - Principal use for naphtha is for olefins manufacture of which over 95% of production is based on naphtha cracking.
- **Demand for jet fuel is forecast to increase moderately and in pace with air travel and economic growth.**

# Japan Products – Distillate, Residual Fuel

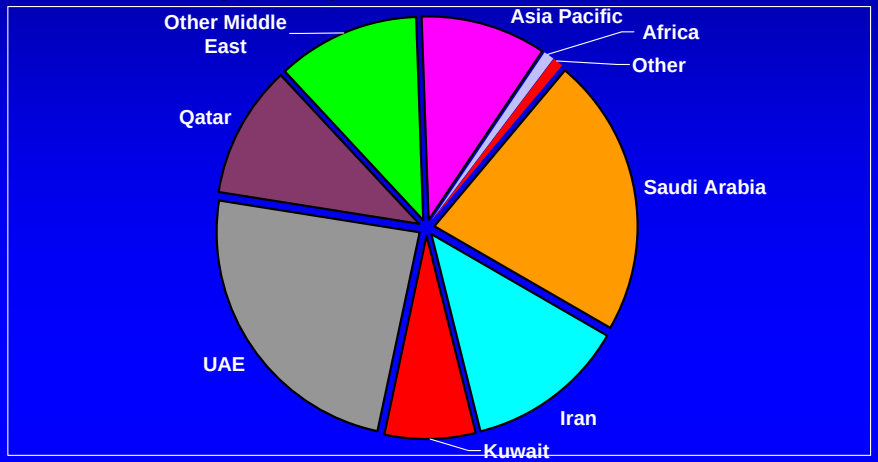


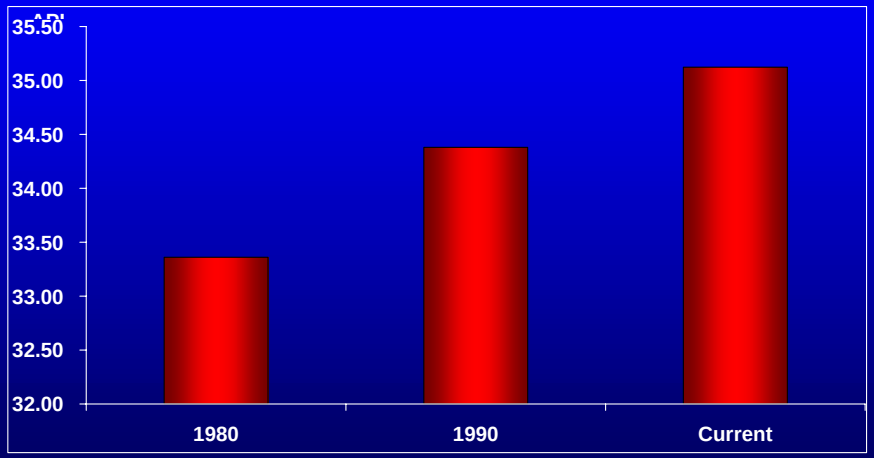

- **Distillate demand is forecast to experience moderate growth.**
  - Almost half of consumption is in the transportation sector.
- **Residual fuel oil demand is forecast to decrease slightly with very little make up from imports.**
  - The decline in fuel oil consumption is due primarily to substitution of nuclear power and natural gas in the power generation sector.

# Japan's Crude Oil Slate

Crude Imports by Source



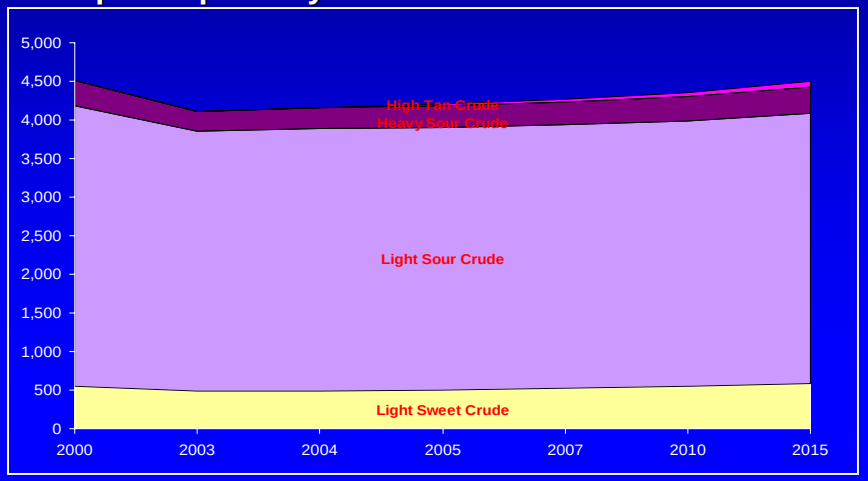

Average Crude API




- Japan has strong extremely reliance on Middle East crude imports.
- The country is less reliant on sweet crude and imports very little West African crude.
- One feature of the industry is its shift to a lighter and lighter crude slate over the past decades in lieu of conversion investment.
- With a few exceptions, Japan refineries are common in size and configuration.
  - 100 – 200 MB/D capacity
  - FCC and Resid HDS units
  - Very few coking units
  - Many are integrated with petrochemicals

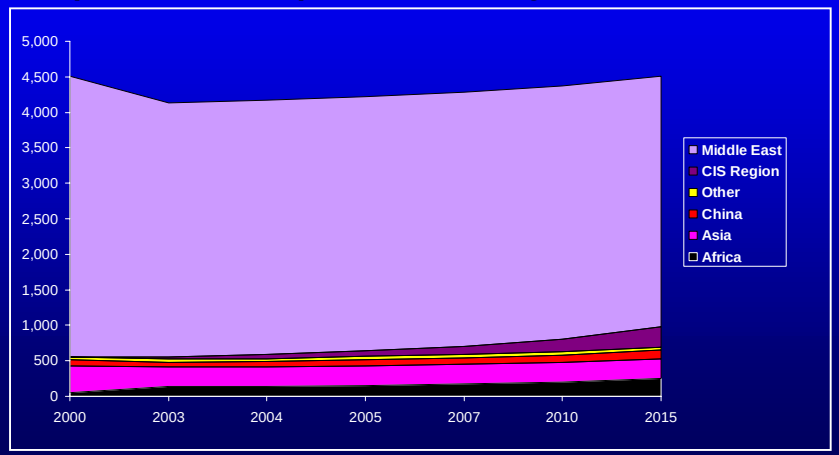
# Japan Crude Oil Demand

**Japan Imports by Crude Slate**




**Crude Imports - Other**

**Japan - Crude Import Forecast by Source**




- Crude imports are expected to grow 22.8% by 2015 relative to 2003.
- Light sweet crude supplied from Africa is forecast to increase by 150,000 B/D over the next ten years.
- The Middle East will provide the largest portion of import demand mainly through increased supply of light sour and heavy sour crudes.
- The Former Soviet Union (CIS Region) will provide approximately 300,000 B/D of the light sour crude imports by 2015.
- Japan's crude slate is primarily Middle East grades and shifting towards lighter, high value crudes.



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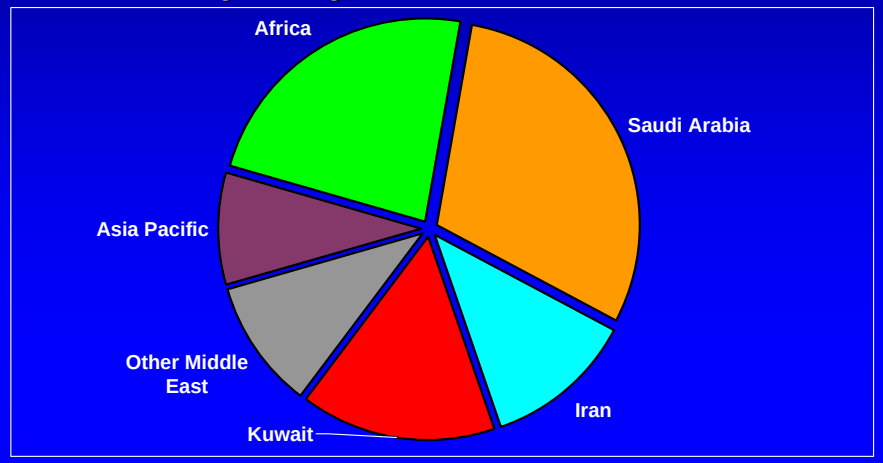
# Japan Potential Interest in Oil Sands

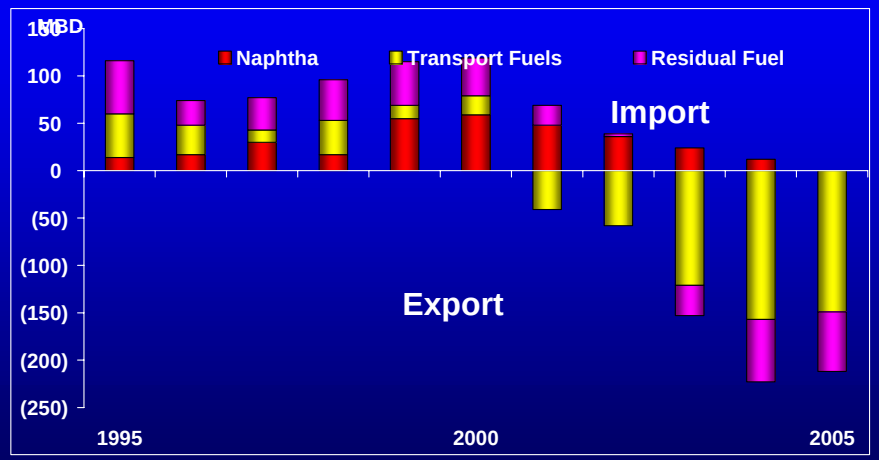
- **Japan refining industry consists of 30 refineries with 4.5 million B/D of capacity.**
- **Nearly 90% of Japanese refining capacity are Lt. Sour cracking refineries, although FCC capacity is only 20% of crude capacity.**
  - **Should be able to accommodate up to 500,000 B/D of SCO based on North American experience.**
  - **SCO would likely replace West African and other light sweet crudes.**
- **60% of total capacity are Lt. Sour cracking refineries with Resid Hydrotreating.**
  - Many of these hydrotreat long residue.
  - Should be able to accommodate some SynSynBit or SynBit Blends, but depends on capability to desulfurize such high sulfur residuals.
- **Refineries with Coking are 10% of capacity.**
  - Potentially these should be best candidates to process SynSynBit or SynBit Blends.

# Taiwan's Refining Industry

**Crude Imports by Source**




**Product Balance**

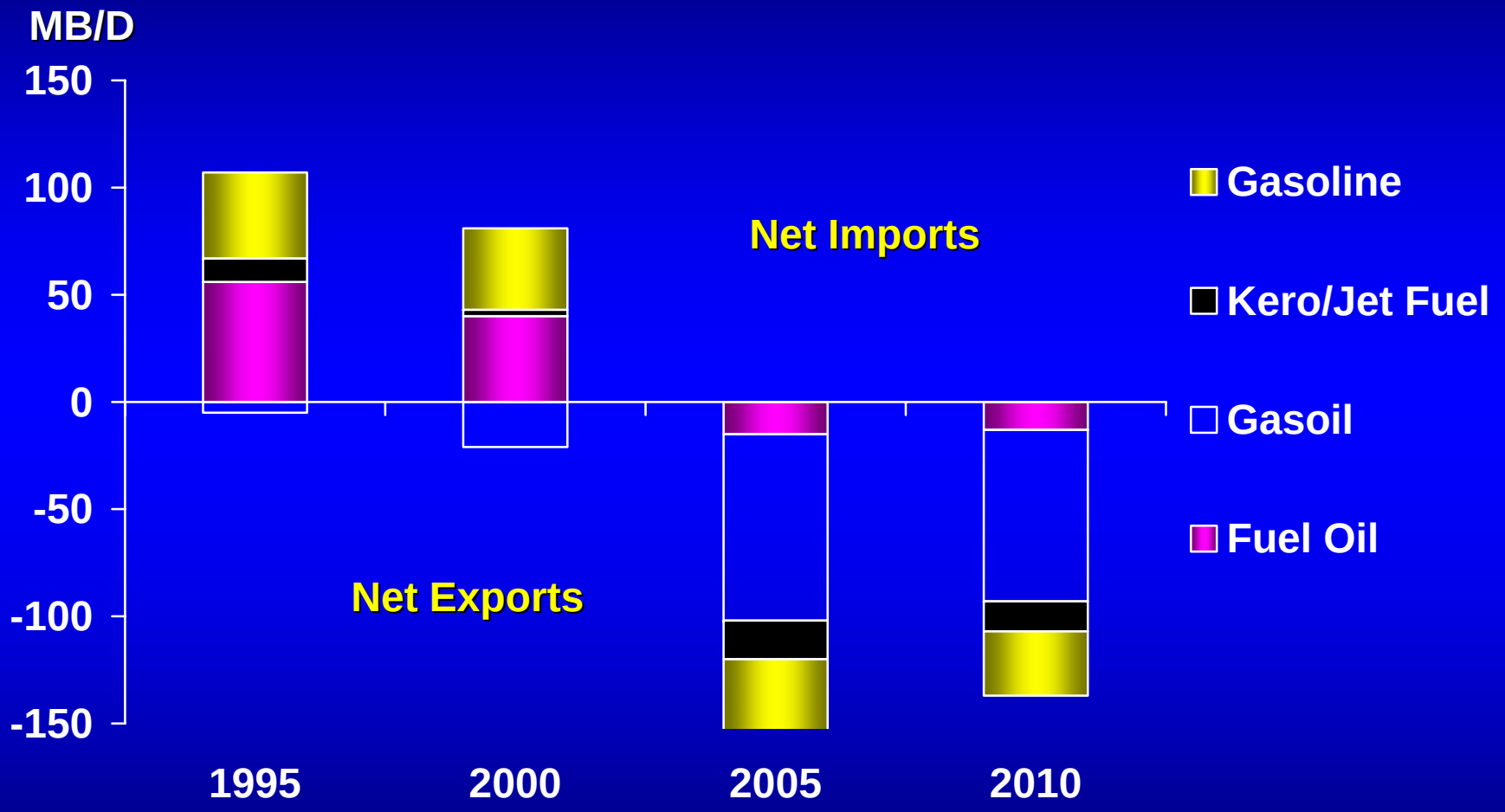



- **Taiwan is a large importer of West African crude.**
- **The Middle East portion of the crude slate is heavier than Japan's and quite sour.**
- **The country now has four refineries: 3 CPC refineries and Formosa Plastics.**
  - Formosa Plastics is a deep conversion 450,000 B/D complex with full RFCC and coking integrated with olefins and aromatics.
  - CPC refineries are much simpler with small conversion but are also integrated with Pchem.
  - Similar to Japan and South Korea, a feature of the Taiwan industry is significant resid HDS.
- **Taiwan is now a product exporting country joining South Korea and Singapore.**

# Taiwan Refining Capacity

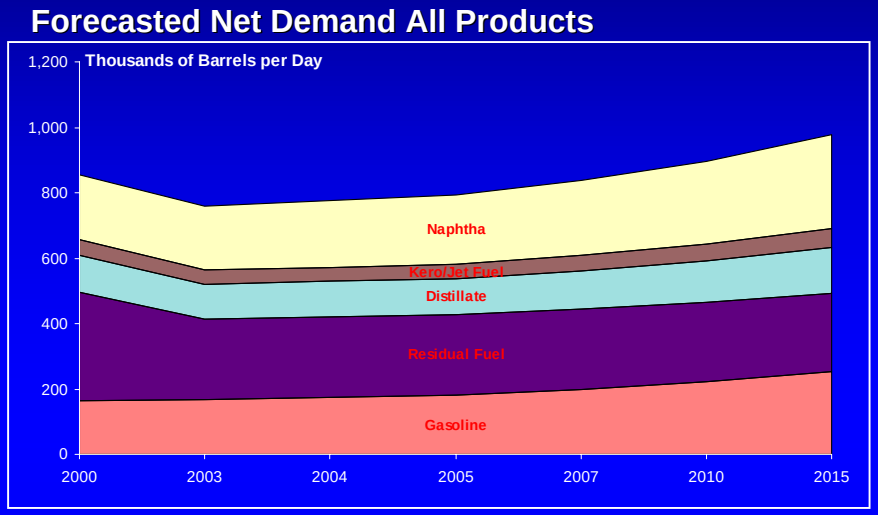
| Refinery | Location | Crude Type | Crude | Vacuum | Visbreaking | Coking | FCC | Hydrocracking | Reforming | Hydrotreating | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | Resid | VGO | Distillate | Naphtha |
| Chinese Petroleum Corp. | Kaohsiung | Light Sour | 570,000 | 75,500 | - | 15,000 | 50,000 | 18,080 | 70,000 | 90,000 | 32,000 | 13,560 | 115,000 |
| Formosa Petrochemical Co. | Mai-Liao | Light Sour | 450,000 | 80,000 | - | 36,000 | 146,000 | - | 35,000 | 140,000 | 52,000 | 63,000 | 35,000 |
| Chinese Petroleum Corp. | Taoyuan | Light Sour | 200,000 | 36,000 | - | - | 50,000 | - | 45,000 | - | 20,000 | 58,000 | 45,000 |
| **AVERAGE REFINERY CAPACITY** | | | 406,667 | 63,833 | - | 17,000 | 82,000 | 6,027 | 50,000 | 76,667 | 34,667 | 44,853 | 65,000 |
| **UNIT CAPACITY AS % OF CRUDE** | | | | 15.7% | 0.0% | 4.2% | 20.2% | 1.5% | 12.3% | 18.9% | 8.5% | 11.0% | 16.0% |

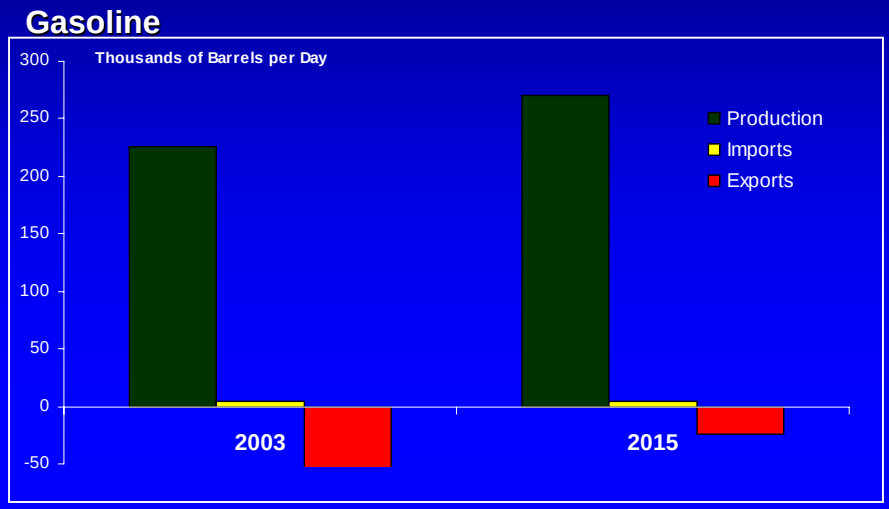
# Taiwan Exports and Imports




- Taiwan to remain an exporter.

# Taiwan Product Demand - Gasoline




- **Taiwan has had exceptional economic growth fueled primarily by exports of manufactured goods.**
  - Continued solid economic performance is projected.
  - Few indigenous energy resources are available rendering Taiwan dependent upon imported petroleum and other energy products.
- **Demand for gasoline is forecast to grow in step with economic development.**
  - Gasoline demand has averaged 8% growth annually since 1995.
  - Gasoline exports should decline over time.



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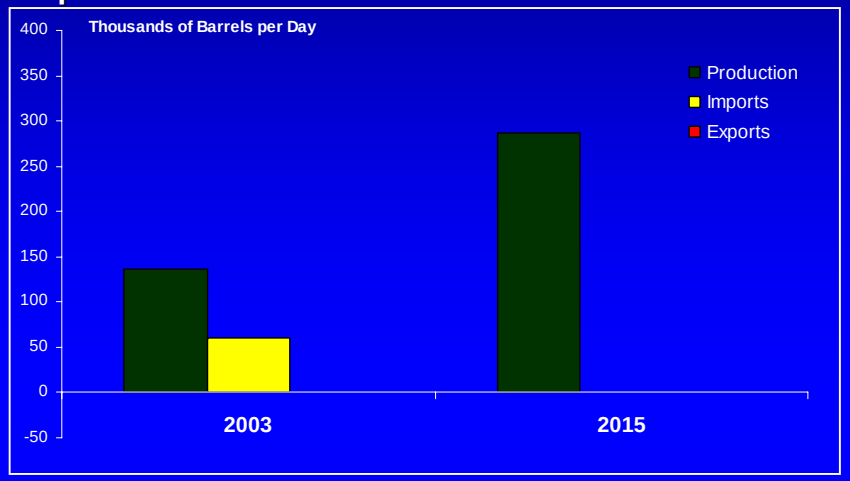
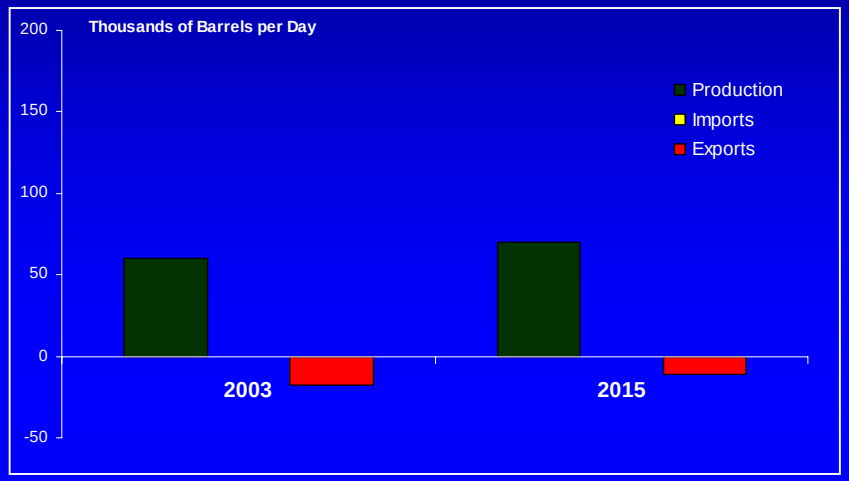
# Taiwan Products – Naphtha, Kero/Jet Fuel

**Naphtha**




**Kero/Jet Fuel**




- **Taiwan has a well developed petrochemical industry that has entered another phase of growth. Several new naphtha crackers have started up in recent years. Naphtha demand is forecast to grow significantly as a result of expansions of existing plants and plans for new greenfield plants.**
  - Future imports of Naphtha are not expected as demand is expected to be satisfied domestically.
- **Jet fuel currently accounts for the majority of total kerosene/ jet fuel demand.**



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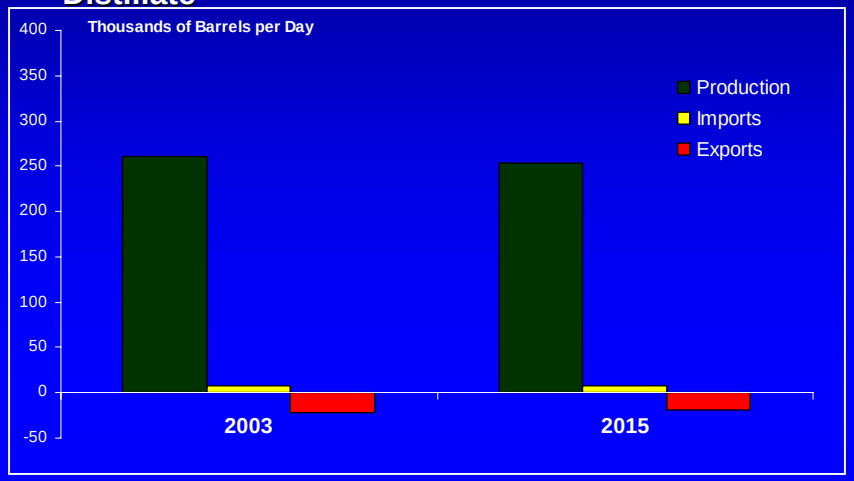
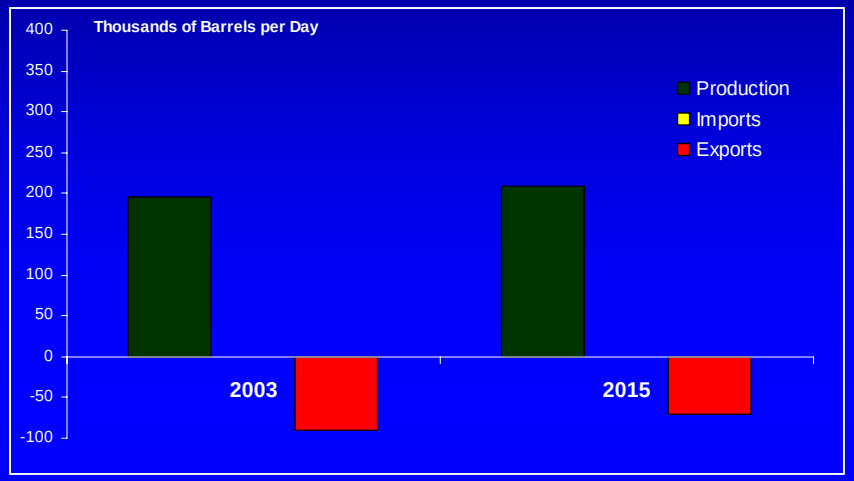
# Taiwan Products – Distillate, Residual Fuel

**Distillate**




**Residual Fuel**




- **Distillate demand is expected to be minimal.**
  - Distillate exports have increased since the completion of the Formosa Petrochemical refinery expansion.
- **Fuel oil demand is primarily for power generation, but is expected to decline as LNG imports increase. Taiwan Power Company has planned to replace some fuel oil with coal for power generation.**
  - Environmental concern has prompted a shift to natural gas.

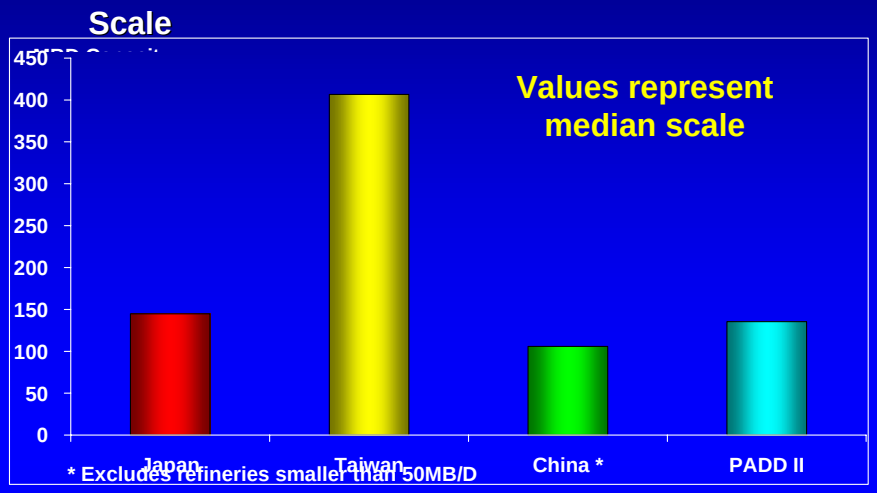
# Taiwan Crude Oil Demand

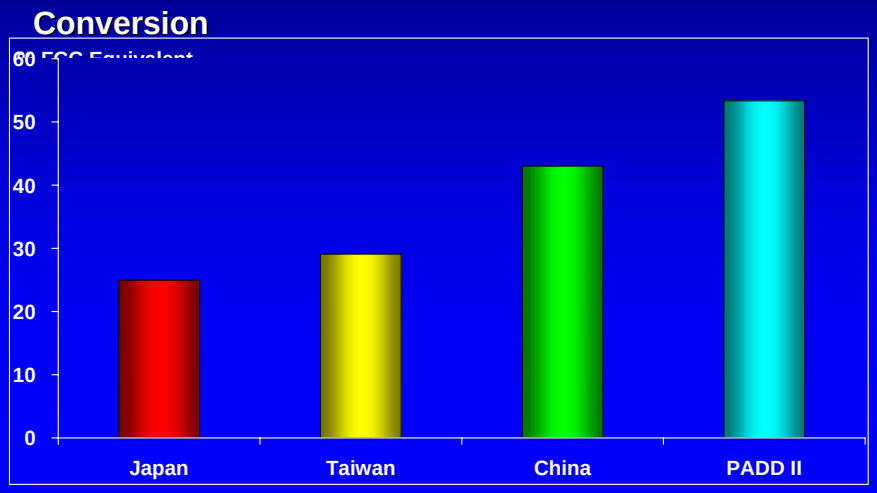
- Crude production in Taiwan consists of a small amount of condensate. Therefore, all crude demand is imported.
- Taiwan is a large importer of West African crude.
- The Middle East portion of the crude slate is heavier than Japan's and quite sour.
- Current refinery crude capacity is around 1.2 million B/D.

# Taiwan Potential Interest in Oil Sands

- Taiwan's refineries have around 1.2 million B/D capacity, located in 3 refining centres.
- They are designed for light sour crude, but contain some coking, catalytic cracking, and resid hydrotreating.
- Taiwan exports high sulfur residual fuel, but imports low sulfur residual fuel.
- Taiwan should have potential to process 100,000 to 150,000 B/D of SCO, mainly replacing West African crudes.
- The resid hydrotreating capability may be limited in how much bitumen residue can be processed. This may limit the interest in running bitumen blends.

# Asia Refineries Compared to PADD II




- Asia target market refineries have less conversion but comparable scale to PADD II.



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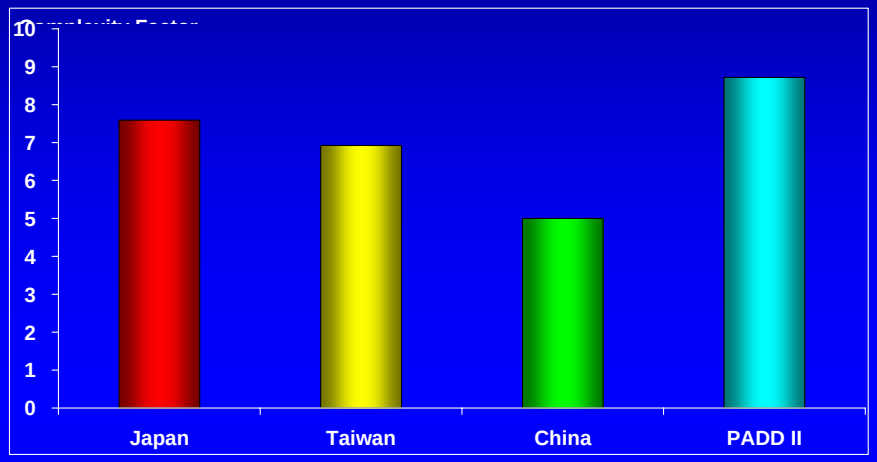
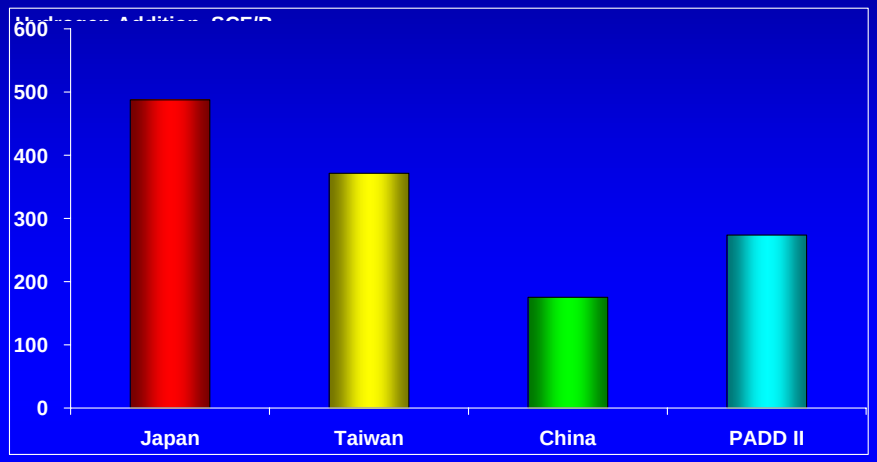
# Asia Refineries Compared to PADD II (continued)

**Complexity**




**Product Upgrading**




- Asian refineries have similar complexity to PADD II, and add more hydrogen per barrel processed than in PADD II.

# Potential Opportunity for Canadian Oil Sands

**Asian netbacks are comparable to netbacks from Chicago**

- Bitumen blends experiencing significant discounts in US markets
- SCO facing US market resistance

**Secure Crude Supplies**

- No exploration necessary
- Politically stable
- Major Investments Planned


- **Optimize potential of Alberta oil sands products**
- **Diversify exports, create new markets**

**Growing dependence on Middle East Crude imports**

- Middle East crudes comprised 53% of total crude imports in 2003 and are forecast to increase to 68% by 2015



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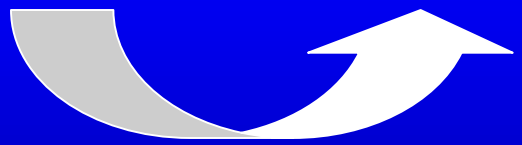
# Supply/Demand Analysis Major Markets
## Non-Middle East

MAJOR GROWING MARKETS
**Imports**

| 2003 | | 2015 |
|---|---|---|
| 1,990 | China | 4,345 |
| 1,716 | India | 2,483 |
| 9,646 | USA | 13,177 |
| 13,352 | | 20,005 |



6,653

Countries Competing for supplies

COUNTRIES WITH SIGNIFICANT SUPPLY POTENTIAL
**Exports**

| 2003 | | 2015 |
|---|---|---|
| 1,512 | Canada | 2,674 |
| 1,594 | Venezuela | 2,498 |
| 5,697 | Africa | 7,713 |
| 4,593 | Russia | 7,501 |
| 13,396 | | 20,386 |

6,990

Countries competing for markets

# Non-Middle East Strategic Suppliers to China

## RUSSIA

- Continental proximity
- Trading partners in other resources
- Government seeking to diversify exports

---

- Major infrastructure investment required, i.e. pipelines
- Major supplier and partner to Japan → increased competition

## CANADA

- Imports by tanker can access coastal areas where growth largest
- Transportation route avoids Malacca Strait → Pacific route
- Government seeking to diversify exports
- Flexible crude quality to fit specific needs

---

- Strong US ties underlined in NAFTA → May cause security concerns to other nations

## VENEZUELA

- Imports by tanker can access coastal areas where growth largest
- Common goals in preserving national interest in energy supply/demand
- National oil companies dictated by country governments can be a common framework for relationship/trade
- Government seeking to diversify exports
- Flexible crude quality to fit specific needs

---

- Transportation costly, Panama Canal inadequate for big tankers
- Requires additional partner to add technical knowledge and know how

## Africa

- Politically controversial assets available for acquisition → less competition, discounted valuations

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- Political risk
- Transportation route through the Malacca Strait

# IV. PRICING AND VALUATIONS

- VALUATION APPROACH
- PRODUCT PRICING BASIS
- ASIAN REFINING VALUES
- EDMONTON NETBACKS
- REFINED PRODUCTS NETBACK TO ALBERTA

# Crude Oil Valuation Approach to Value Oil Sands Crudes

## IDENTIFY DELIVERED COST OF CRUDES

- Bonny Light from West Africa (light sweet benchmark)
- Dubai from Arab Gulf (light sour benchmark)
- Estimate costs for transportation, credit & insurance to:
  - Japan
  - South Korea
  - China
  - Taiwan

## IDENTIFY ASIAN REFINING VALUES

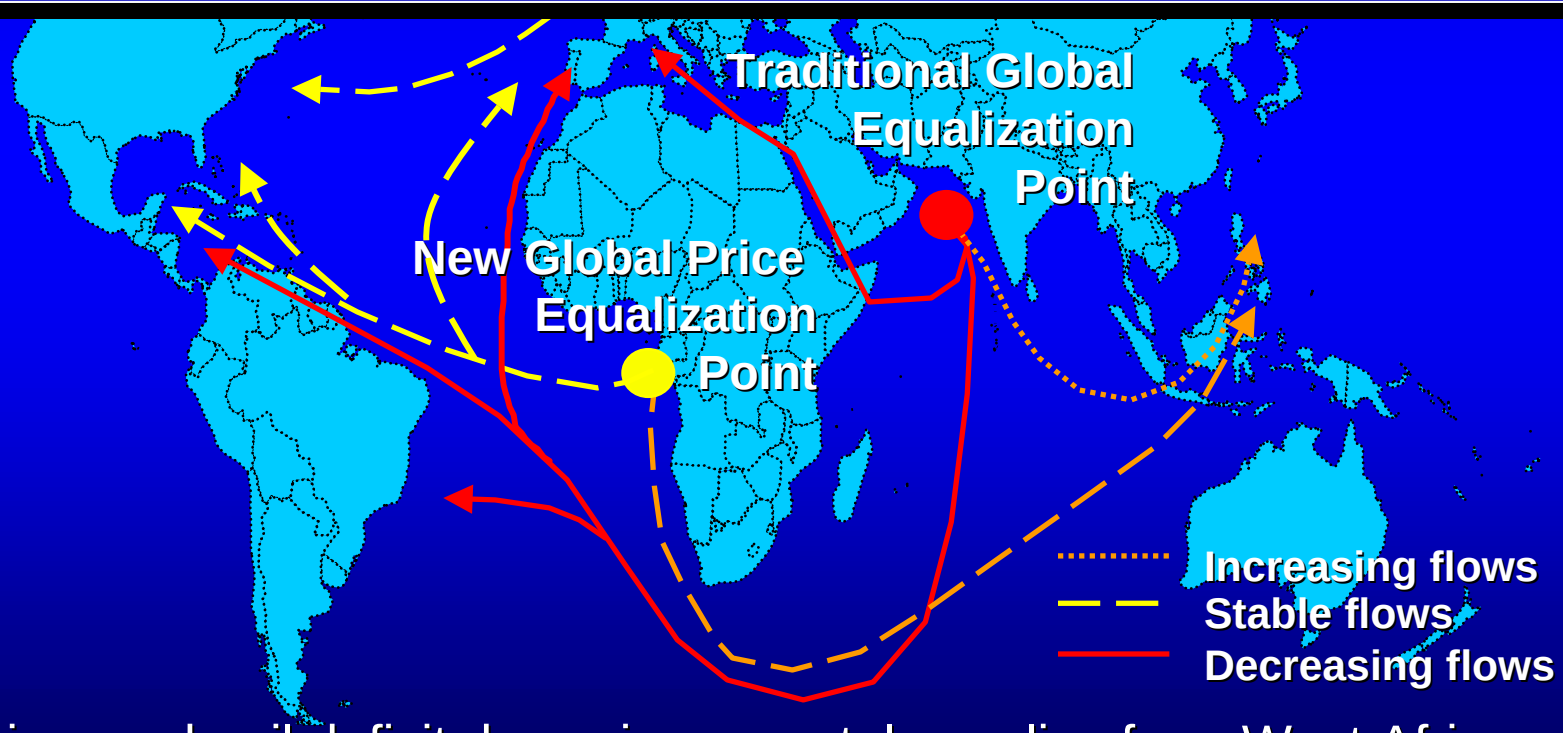
- Apply benchmark refinery models for marginal configurations:
  - Hydroskimming
  - FCC Cracking
- Calculate break-even values for each crude based on product prices and refinery variable costs:
  - SCO
  - SynBit/ SynSynBit
  - Dubai
  - Bonny Light

## DETERMINE CANADIAN BLEND NETBACKS

- Estimate Asian refining values for Canadian blends based on benchmark crude CIF prices and variable break-even differentials.
- Estimate Asian netbacks for Western Canada based on:
  - Waterborne transportation costs
  - Pipeline costs

# Asian Crude Oil Pricing

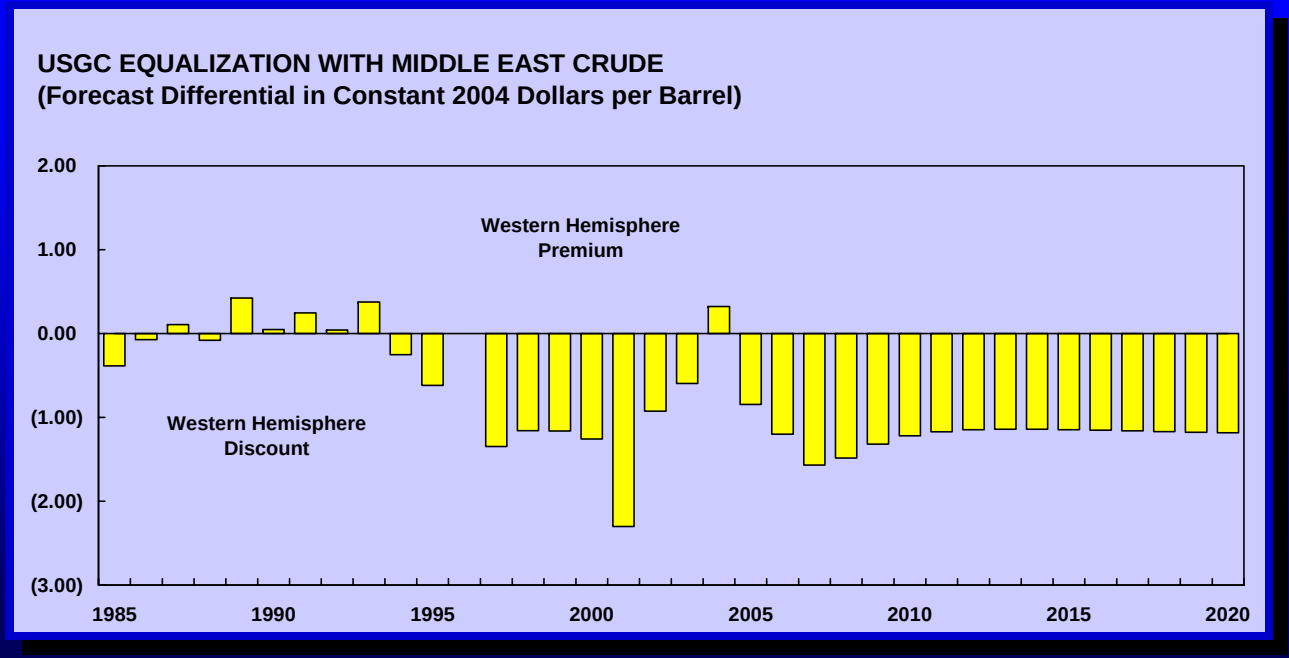
- Middle East deliveries to Europe and the Western hemisphere have increased the freight cost for incremental crude supplies to the Asia region.
- Incremental supplies are routinely drawn from West Africa, which has many Asian refiners to diversify their feedstock base with West African light sweet crude.
- Both Asia and the Western Hemisphere are priced in parity based on deliveries from West Africa.




➢ The Asian crude oil deficit draws incremental supplies from West Africa instead of the Middle East, which results in higher prices.

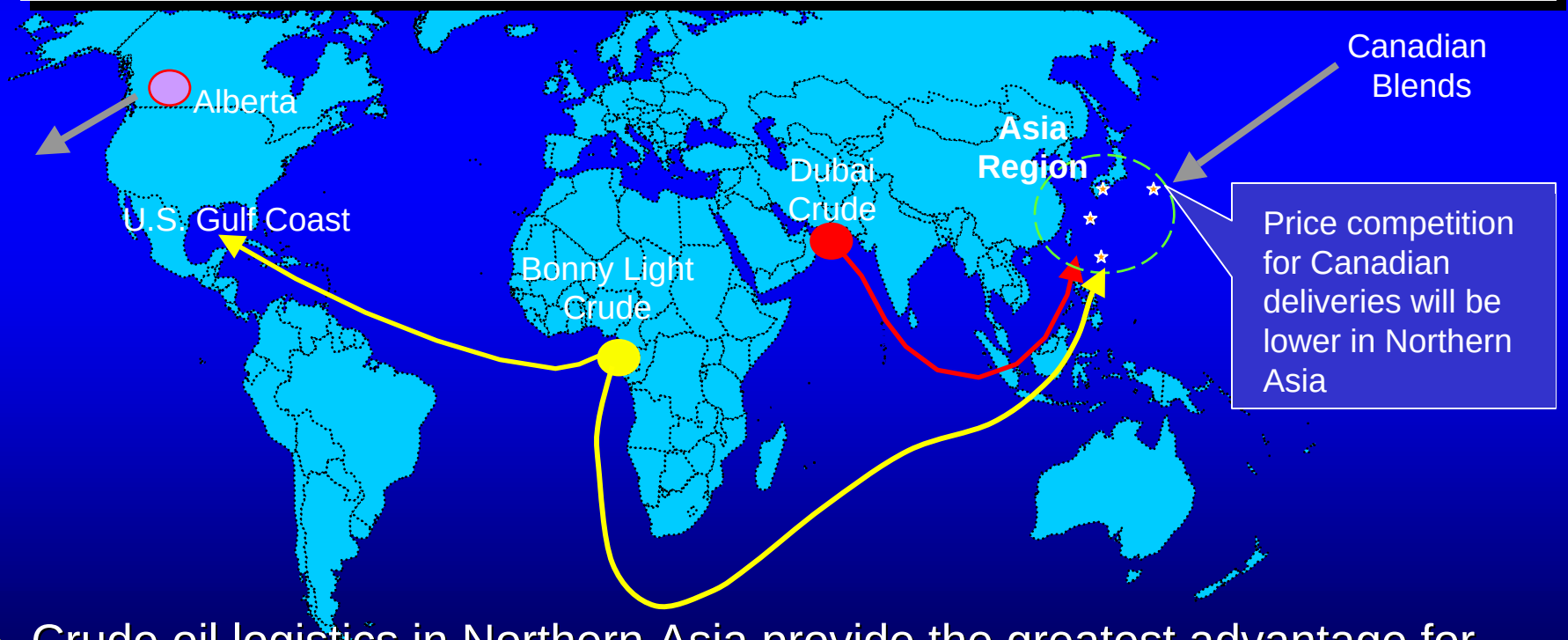
# Far East Crude Oil Price Premium

- Middle East producers typically receive a higher netback for sales to Asia than for sales to the West.
- The Far East premium (or Western Hemisphere discount) is defined by the amount Dubai is "out of the market" compared to competitive Atlantic Basin crude oils.
- The strong Atlantic Basin crude oil market in 2004 provided a temporary reversal of the Far East premium.
- In our forecast the Far East Premium is expected to continue at around $1.20 per barrel.



# Crude Oil Delivery to Asia

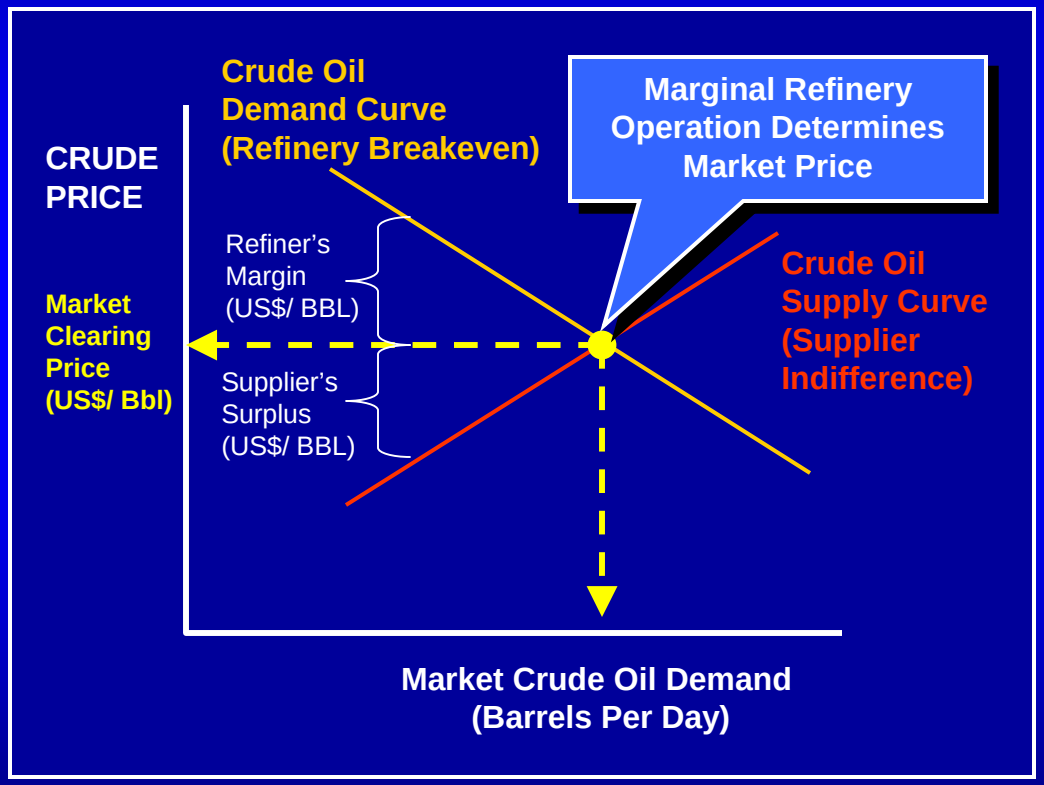
- Asian deliveries of Bonny Light are assumed to be priced in parity with deliveries to the U.S. Gulf Coast.
- Dubai FOB prices are forecast based on Asian refining value parity with Bonny Light.
- Delivery costs for Dubai and Bonny Light are highest in Northern Asia. For this reason, Japan and South Korea are likely to provide the greatest logistical advantage for Canadian supplies.




➢ Crude oil logistics in Northern Asia provide the greatest advantage for Canadian deliveries.

# Crude Oil Valuation Methodology – Fundamental Principles

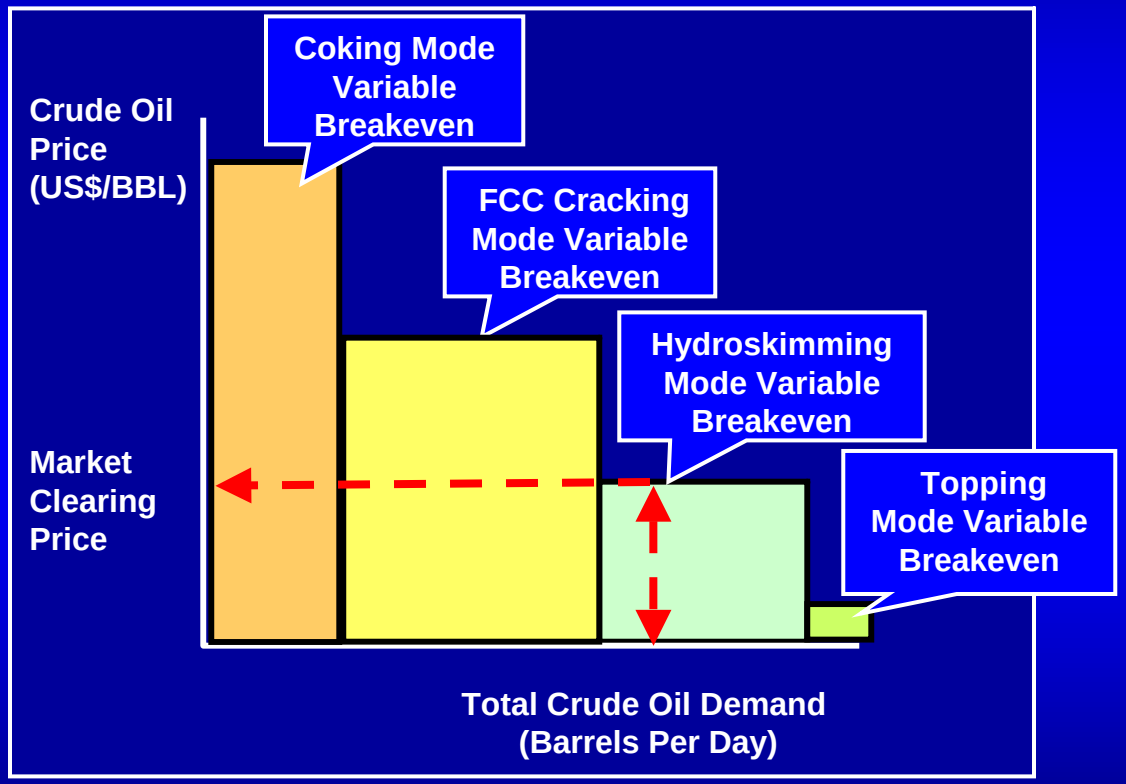
***CLASSIC SUPPLY-DEMAND FRAMEWORK***




- In theory, crude oil demand elasticity is described by the breakeven economics of the various refinery operations within a market.
- The marginal refinery operating mode is used to evaluate the relative refining value of each crude oil.
- In a competitive market, the crude oil price differentials are expected to be in parity with their refining value differentials based on the marginal mode.

# Crude Oil Valuation Methodology Application

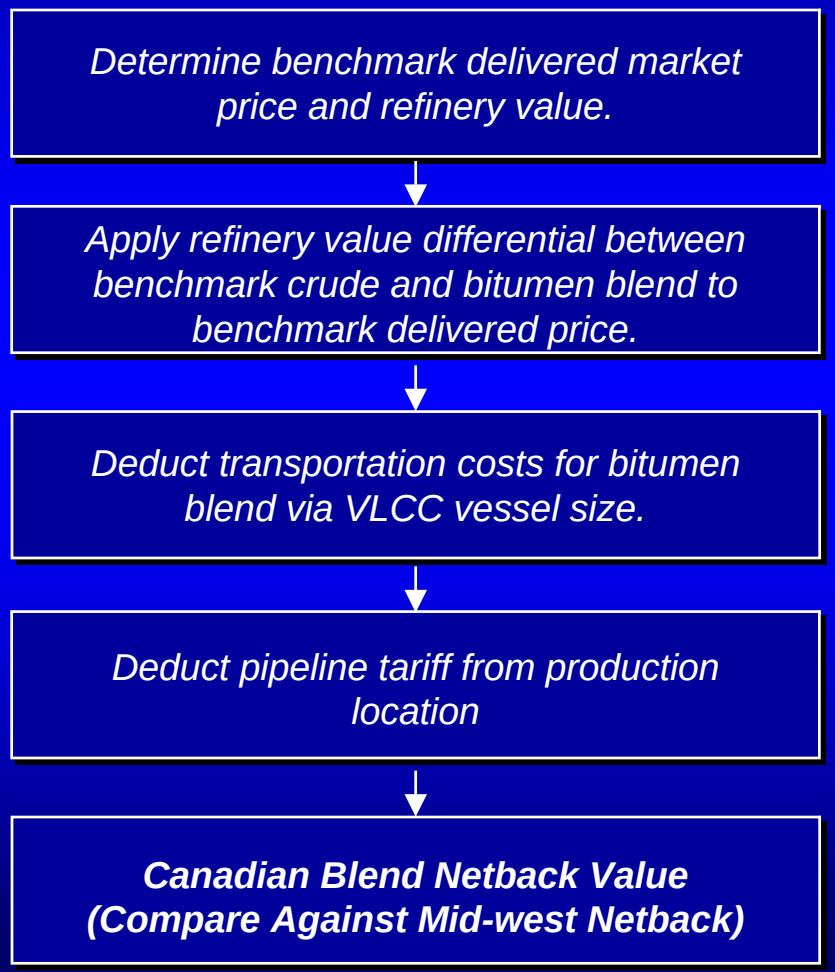
***APPLIED SUPPLY-DEMAND FRAMEWORK***




- Purvin & Gertz routinely evaluates the marginal refinery mode for each region based on refinery utilization and profitability.
- While refinery complexity and configurations vary widely, each refinery may include several operating modes, depending on the degree of utilization.
- Hydroskimming is the marginal refinery mode in the Asian region.
- Longer term, as investment in conversion capacity continues, hydroskimming operations may eventually become rationalized in favor of FCC cracking operations.

# Canadian Crude Valuations in Asia - Calculation Outline for SynBit

- ***The steps in Purvin & Gertz' netback pricing methodology are shown below.***




**ASIAN Dubai Example**

**Dubai CIF, Japan / Taiwan / S. Korea / China**

**=** **Dubai, CIF + (Canadian Blend Refining Value – Dubai Refining Value)**

**-** **SynBit Ocean Freight (Kitimat to Asia)**

**-** **SynBit Pipeline Tariff (Edmonton to Kitimat)**

**=** **SynBit Netback Price (FOB Edmonton)**



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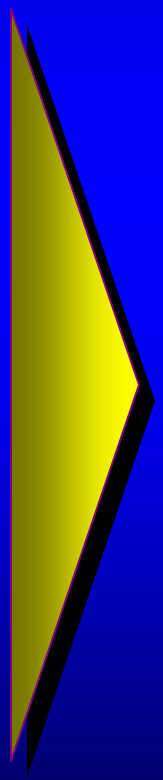
# Valuation Assumptions - Main Product Specifications

- ***Most Asian markets will eventually adopt European Union 2005 specifications by 2015.***
- ***Sulfur and benzene reductions are the most significant changes and will drive modest increases in variable cost.***

**2005 ASIAN SPECIFICATIONS**

Gasoline
- Sulfur < 500 ppm
- Benzene < 2%

Diesel
- Sulfur < 0.2% wt
- Cetane 45



**2015 ASIAN SPECIFICATIONS**

Gasoline
- Sulfur < 50 ppm
- Benzene < 1%

Diesel
- Sulfur < 500 ppm
- Cetane 45

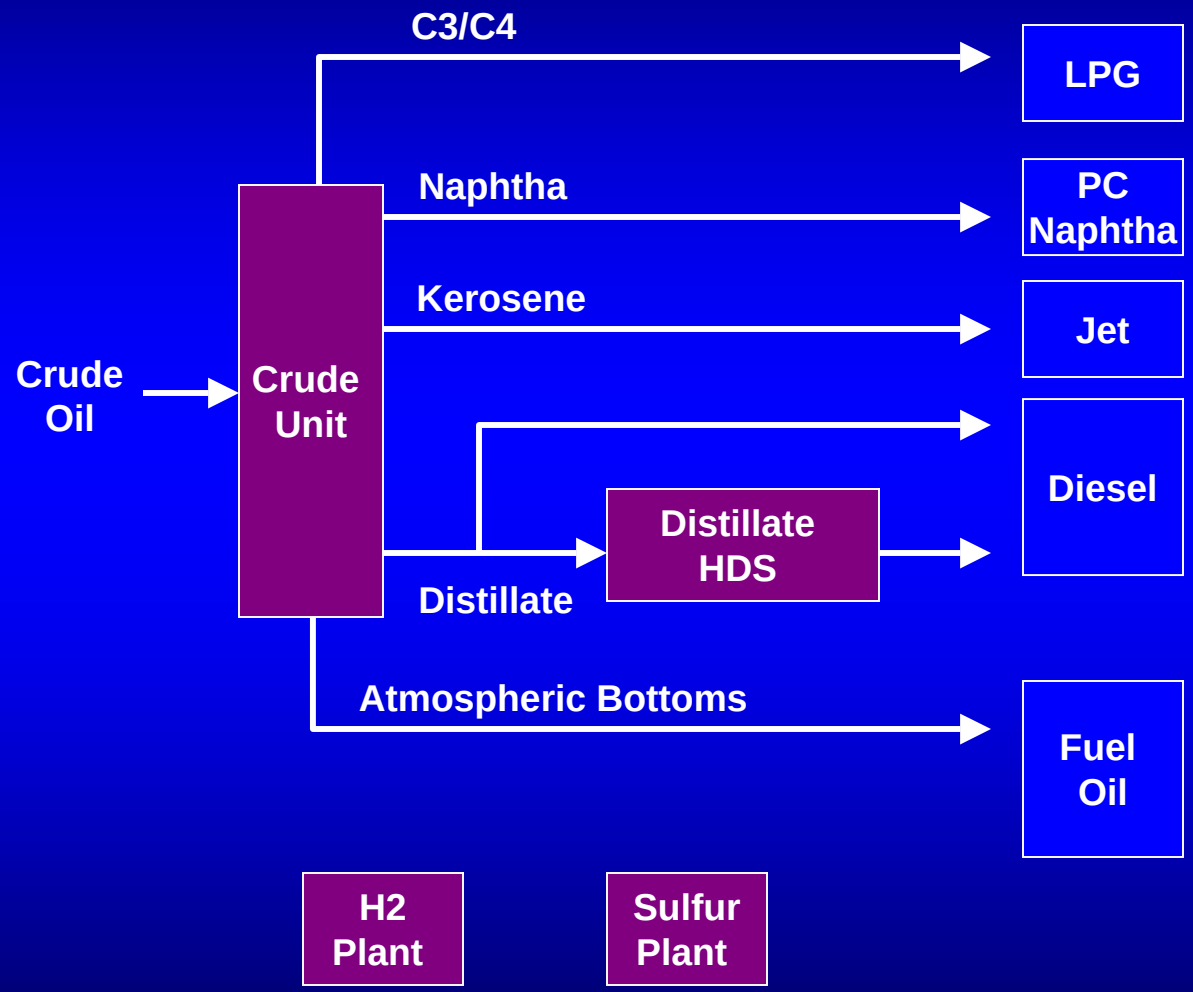
# Valuation Assumptions - Crude Quality Assumptions

- A SynSynBit blend of 64% SCO and 36% Bitumen provides close to the same vacuum resid content as Arab Light. This should provide a broad market base, since many expansion projects are designed for Arab Light (Arab Light characterized as Dubai).
- SynBit is a blend of 48% SCO and 52% Bitumen. It has a similar vacuum resid content to Arab Light or Dubai.

| | Bonny Light | Dubai | Sweet SCO | SynSynBit | SynBit | Athabasca Bitumen |
|---|---|---|---|---|---|---|
| API | 34.6 | 30.6 | 34.8 | 24.2 | 19.9 | 8.3 |
| Sulfur | 0.2 | 2.0 | 0.1 | 1.8 | 2.5 | 4.8 |
| LPG | 2.0 | 2.4 | 2.8 | 1.8 | 1.3 | 0.0 |
| Naphtha | 26.7 | 24.8 | 17.7 | 11.9 | 9.3 | 1.5 |
| Jet | 13.7 | 9.8 | 12.0 | 8.3 | 6.7 | 1.7 |
| Diesel | 26.4 | 20.5 | 33.8 | 26.6 | 23.4 | 13.9 |
| VGO | 24.3 | 25.7 | 33.4 | 32.9 | 32.6 | 31.9 |
| Resid | 6.8 | 16.7 | 0.0 | 18.3 | 26.4 | 50.8 |

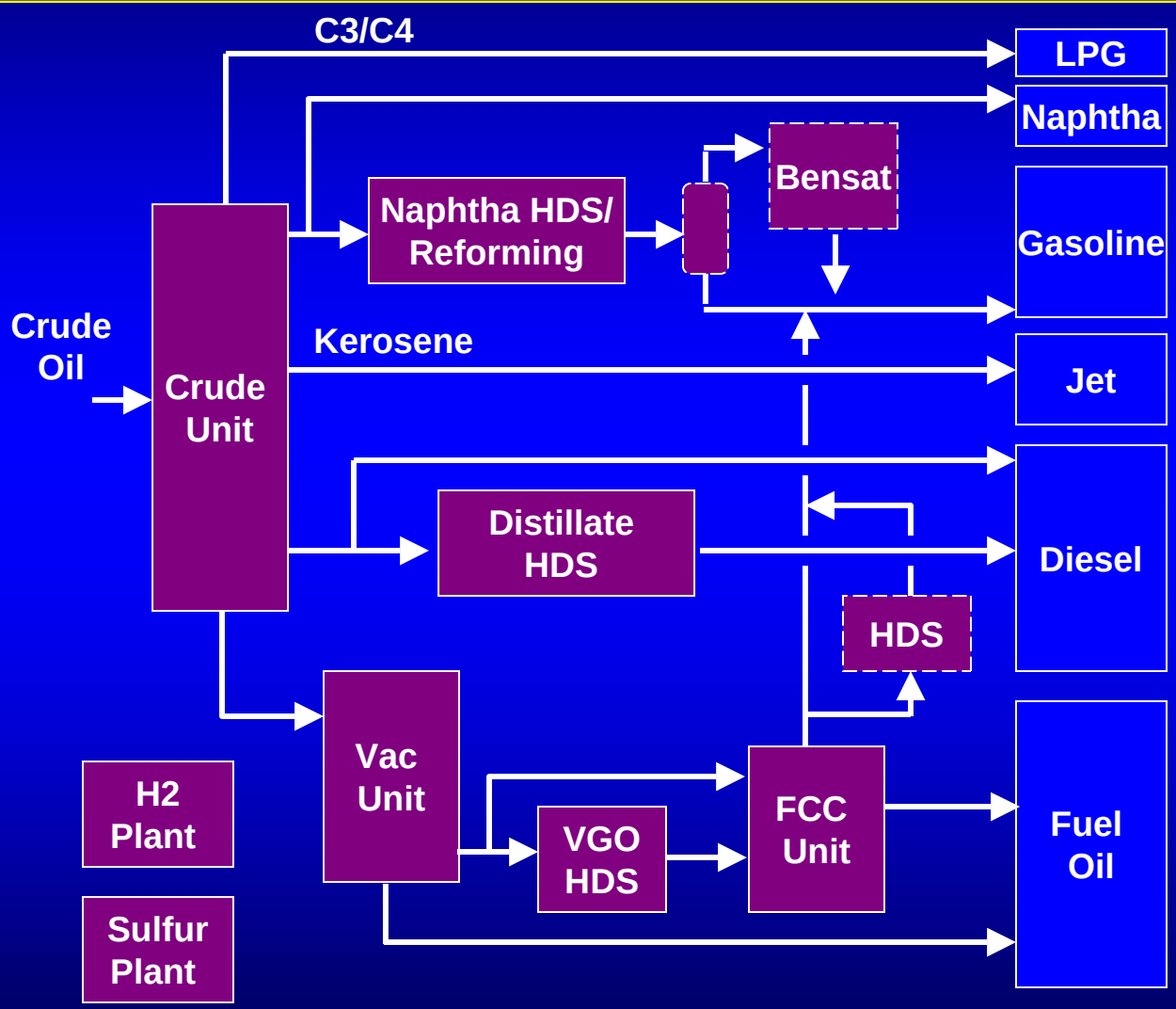
*Note: Resid content based on cutpoint of 1000 deg F.*

# Yardstick Hydroskimming Refinery Configuration




- Hydroskimming remains the marginal refining mode in Asia.
- Fuel oil production includes both vacuum resid and vacuum gas oil (VGO).
- Petrochemical naphtha is produced from incremental hydroskimming operations.

# Yardstick Cracking Refinery Configuration




- VGO is converted to gasoline and low quality distillates.
- Incremental VGO hydrotreating is required for sour crudes.
- By 2015, investment for benzene control and FCC gasoline sulfur control will be required.

# Hydroskimming Versus Cracking Yields

- **Incremental cracking yields favor gasoline production over naphtha and reduce low value fuel oil production through VGO conversion.**

**BONNY LIGHT YIELDS**

| | Hydroskimming | Cracking | Delta |
|---|---|---|---|
| LPG | 1.7 | 5.7 | 4.0 |
| Naphtha | 19.8 | 10.0 | -9.8 |
| Gasoline | 0.0 | 24.0 | 24.0 |
| Jet | 8.5 | 8.5 | 0.0 |
| Diesel | 38.5 | 40.7 | 2.2 |
| Fuel Oil | 31.1 | 11.4 | -19.7 |
| Total | 99.6 | 100.4 | 0.8 |

**DUBAI YIELDS**

| | Hydroskimming | Cracking | Delta |
|---|---|---|---|
| LPG | 2.1 | 6.2 | 4.1 |
| Naphtha | 17.9 | 11.0 | -6.9 |
| Gasoline | 0.0 | 21.7 | 21.7 |
| Jet | 16.6 | 16.6 | 0.0 |
| Diesel (1) | 20.5 | 18.7 | -1.8 |
| Fuel Oil | 42.4 | 26.2 | -16.2 |
| Total | 99.6 | 100.4 | 0.9 |

***Basis: 100 MB/D Of Crude; 2005 Specifications***

*Note (1): Net diesel yield after cutter purchases, if any.*

# Asian Hydroskimming Yield Comparison

- The low viscosity of bitumen residue increases its fuel oil yield in the hydroskimming mode.
- Regional fuel oil prices should weigh heavily on the projected value of various bitumen blends because of the high fuel oil yields from bitumen blends.

**COMPARATIVE HYDROSKIMMING YIELDS**

| | Bonny Light | Dubai | SCO | SynSynBit | SynBit |
|---|---|---|---|---|---|
| LPG | 0.3 | 0.6 | 0.0 | 0.0 | 1.2 |
| Naphtha | 21.2 | 19.5 | 14.3 | 9.4 | 6.0 |
| Gasoline | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Jet | 8.5 | 16.6 | 18.0 | 12.4 | 10.0 |
| 0.2% Diesel | 23.5 | 20.5 | 0.0 | 26.6 | 23.4 |
| 0.05% Diesel | 15.0 | 0.0 | 33.8 | 0.0 | 0.0 |
| Cutter | 0.0 | 0.0 | 0.0 | -8.6 | -13.4 |
| Fuel Oil | 31.1 | 42.4 | 33.4 | 59.8 | 72.4 |
| Total | 99.6 | 99.6 | 99.5 | 99.6 | 99.7 |
| Fuel, FOE/Bbl | 0.02 | 0.03 | 0.02 | 0.03 | 0.03 |
| Water, Mgal/Bbl | 0.04 | 0.04 | 0.04 | 0.04 | 0.04 |
| Catalyst & Chem, $/Bbl | 0.02 | 0.03 | 0.02 | 0.02 | 0.02 |
| Electricty, KW-Hr/Bbl | 1.35 | 1.92 | 1.37 | 1.50 | 1.59 |

# Asian Cracking Yield Comparison

- SCO is highly differentiated in the cracking mode due to its low fuel oil yield and high distillate yield.
- Canadian bitumen blends generally produce more gasoline and fuel oil in the cracking mode due to their VGO content and resid viscosity.

**COMPARATIVE CRACKING YIELDS**

| | Bonny Light | Dubai | SCO | SynSynBit | SynBit |
|---|---|---|---|---|---|
| LPG | 5.7 | 6.2 | 7.3 | 5.9 | 5.3 |
| Naphtha | 10.0 | 11.0 | 3.3 | 2.2 | 2.3 |
| Gasoline | 24.0 | 21.7 | 32.4 | 28.0 | 26.5 |
| Jet | 8.5 | 16.6 | 14.0 | 9.3 | 6.7 |
| 0.2% Diesel | 27.6 | 20.5 | 8.7 | 26.6 | 23.4 |
| 0.05% Diesel | 13.1 | 0.0 | 32.9 | 0.0 | 0.0 |
| Cutter | 0.0 | -1.8 | 0.0 | -4.7 | -10.9 |
| Fuel Oil | 11.4 | 26.2 | 1.6 | 32.9 | 47.1 |
| Total | 100.4 | 100.4 | 100.1 | 100.2 | 100.4 |
| Fuel, FOE/Bbl | 0.01 | 0.03 | 0.00 | 0.02 | 0.03 |
| Water, Mgal/Bbl | 0.05 | 0.06 | 0.05 | 0.05 | 0.06 |
| Catalyst & Chem, $/Bbl | 0.08 | 0.12 | 0.10 | 0.12 | 0.13 |
| Electricty, KW-Hr/Bbl | 4.60 | 5.84 | 5.92 | 6.20 | 6.44 |

# Sulfur, Cetane & TAN Value Adjustments

## FUEL OIL SULFUR PENALTY

- Bitumen residue has a sulfur content of 6.4%.
- Incremental fuel oil from SynBit or SynSynBit exceeds the high sulfur fuel oil specification of 3.5% sulfur.
- A value penalty (or credit) is applied based on the price spread between low sulfur and high sulfur fuel oil and the variance from standard fuel oil specifications.
- The sulfur penalty in the SynBit cracking case is roughly $0.40 per barrel.
- In comparison, SCO and Bonny Light cases received a value credit.

## DIESEL CETANE PENALTY

- Bitumen blends have relatively poor diesel cetane.
- A penalty is applied to raw distillates with a cetane index below 45.
- Cetane value penalties are assumed to be $0.15 per cetane-barrel based on the expected cost of cetane improver additives.
- Relative to Dubai, Canadian bitumen blends received a value penalty of approximately $0.20 per barrel in most cases.

## CRUDE OIL TAN DISCOUNT

- Bitumen has a TAN of approximately 4 mgKOH/g.
- Metallurgy improvements or additives for corrosion inhibitor are usually required for processing crudes with TAN > 0.5.
- Dilution of Bitumen reduces the TAN penalty associated with bitumen blends, but the estimated penalty is still significant.
- Approx. SynBit TAN penalty = $0.68/Bbl (TAN = 2).
- Approx. SynSynBit Penalty = $0.47/Bbl. (TAN = 1.4)
- No penalty was assigned to Sweet SCO.

# Naphtha Pricing Basis


- Japan and Singapore Establishes the basis for naphtha pricing.
- Incremental naphtha supplies are received from Singapore and the Arab Gulf.
- The cost of delivered supplies from Singapore is used to develop pricing in each importing country.
- Japan is the largest and most significant naphtha importer.
- South Korean naphtha imports are assumed to be equivalent to Japan CIF.
- Chinese naphtha pricing provides for a 6% import duty, which is assumed to decline to 3% by 2015.
- Naphtha freight costs are estimated based on 50 KDWT vessels from Singapore with allowances for insurance and losses.

# Gasoline Pricing Basis


- Vietnam is the main destination for incremental gasoline exports.
- Marginal gasoline supplies from North Asia must be shipped as far as South China and Vietnam, where they compete must with supplies from Singapore.
- While Shanghai routinely receives imported supplies from Singapore, it also ships gasoline to South China due to tariff advantages.
- Deliveries to Chinese locations are assumed to require an import duty of 6%, which declines to 3% by 2015.
- Pricing in Shanghai and Japan are expected to reflect delivered costs from Singapore.
- Pricing in South Korea and Taiwan should reflect netbacks from Saigon.
- South Korean export costs based on 50 KDWT vessel. All other gasoline freight costs based on 30 KDWT vessels.

# Jet Fuel and Diesel Pricing


- South China establishes jet and diesel pricing.
- Guangzhou projected to remain a significant distillate import location
- Yosu, Singapore and Taiwan marginally export to Guangzhou.
- Some supplies are also shipped from Shanghai due to import duty shelters.
- Chinese locations are assumed to require an import duty of 9% for jet fuel and 6% for diesel. Chinese import duties are expected to decline by 50% in 2015.
- Pricing in South Korea and Taiwan are expected to reflect South China netbacks.
- Pricing in Shanghai and Japan are expected to reflect delivered costs from Singapore.
- All distillate freight costs based on 50 KDWT vessels.

# Fuel Oil Pricing Basis


- South China is the destination for Asian refinery fuel oil surplus.
- Japan and Shanghai pricing is expected to reflect delivered costs from Singapore
- Taiwan and South Korean pricing is expected to reflect netbacks from South China, where supplies must compete with deliveries from Singapore.
- Import duty shelters allow supplies from Shanghai to compete in South China.
- Chinese import duties are assumed to be 6% until 2015. In 2015, Chinese import duties are assumed to decline by 50%.
- All fuel oil freight costs are based on LR-1 vessels.

# Petroleum Product Pricing Basis for Asia

| | Singapore | Japan | South Korea | Shanghai China | Taiwan |
|---|---|---|---|---|---|
| LPG | Export | Arab Gulf Imports | Arab Gulf Imports | Arab Gulf Imports + Tariff | Arab Gulf Imports |
| Naphtha | Export | Singapore Import | Japan CIF | Singapore Import + Tariff | Singapore Import |
| Gasoline | Export | Singapore Import | Vietnam Export | Singapore Import + Tariff | Vietnam Export |
| Jet | Export | Singapore Import | S. China Export - Tariff | Singapore Import + Tariff | S. China Export - Tariff |
| Diesel | Export | Singapore Import | S. China Export - Tariff | Singapore Import + Tariff | S. China Export - Tariff |
| Fuel Oil | Export | S. China Export - Tariff | S. China Export - Tariff | Singapore Import + Tariff | S. China Export - Tariff |

- **Pricing in each location is based on trade analysis.**
- **Singapore is a major export center and provides the basis for product pricing for most of the Asian region.**
- **Product prices in China and Japan will reflect the cost of delivered imports.**
- **Prices in South Korea and Taiwan favor naphtha production.**

# Regional Product Prices Relative to Singapore

***2010 Regional Price Versus Singapore, 2004$/Bbl***

| | Japan | South Korea | Shanghai China | Taiwan |
|---|---|---|---|---|
| LPG | 3.1 | 2.5 | 3.2 | 2.5 |
| Naphtha | 1.6 | 1.6 | 2.9 | 0.9 |
| Gasoline | 1.4 | -0.4 | 3.5 | -0.2 |
| Jet | 1.5 | 0.1 | 4.4 | 0.3 |
| Diesel | 1.6 | 0.1 | 3.4 | 0.4 |
| Fuel Oil | -0.2 | 0.1 | 2.3 | 0.2 |

- **Product pricing in China and Japan will be strongest due to broad product deficits.**
- **Prices in both Japan and China reflect import parity across most products.**
- **Extra incentive is provided for jet production in China due to a slightly higher import tariff of 9%.**
- **Relative to other markets, prices in South Korea and Taiwan favor naphtha production.**

# Japan Market Pricing

## PRODUCT PRICING

| | 2000 | 2005 | 2010 | 2015 |
|---|---|---|---|---|
| LPG | 30.16 | 34.33 | 27.50 | 30.62 |
| Naphtha | 30.24 | 43.42 | 34.18 | 38.78 |
| 90 RON Gasoline | 32.01 | 48.03 | 37.43 | 42.52 |
| Jet | 36.27 | 50.05 | 40.09 | 45.50 |
| 0.2% Sulfur Diesel | 34.99 | 49.47 | 39.69 | 45.07 |
| 0.05% Sulfur Diesel | 35.25 | 50.31 | 40.14 | 45.58 |
| Cutter | 33.73 | 48.18 | 38.26 | 43.49 |
| 3.5% 380 cst Fuel Oil | 23.69 | 27.38 | 22.36 | 25.83 |
| Sulfur, $/LT | 4.11 | 4.77 | 5.29 | 5.84 |
| Utilities | | | | |
| Fuel, $/FOE | 23.90 | 27.64 | 22.54 | 26.01 |
| Water, $/Mgal | 0.50 | 0.51 | 0.57 | 0.63 |
| Catalyst & Chemicals, $ | 1.00 | 1.03 | 1.14 | 1.25 |
| Electricity, $/Kw-Hr | 0.08 | 0.09 | 0.09 | 0.10 |
| Net Dubai HSK Realization | 28.42 | 37.75 | 30.30 | 34.57 |
| Net Dubai Cracking Realization | 29.68 | 40.70 | 32.33 | 36.78 |
| Net Bonny Light HSK Realization | 30.12 | 41.21 | 33.21 | 37.79 |
| Net Bonny Light CRK Realization | 31.75 | 44.77 | 35.53 | 40.35 |

## DELIVERED CRUDE COSTS

| | 2000 | 2005 | 2010 | 2015 |
|---|---|---|---|---|
| **Dubai, FOB** | **26.24** | **34.82** | **27.76** | **31.81** |
| Fateh To Yokohama WS100, $/MT | 10.11 | 12.57 | 12.57 | 12.57 |
| VLCC Spot Rate, %WS | 115.41 | 131.96 | 84.80 | 89.27 |
| Freight Cost, $/MT | 11.67 | 16.59 | 10.66 | 11.22 |
| Freight Cost, $/Bbl | 1.60 | 2.28 | 1.46 | 1.54 |
| Losses & Insurance | 0.14 | 0.19 | 0.15 | 0.17 |
| Credit Float, $/Bbl | (0.02) | (0.01) | (0.01) | (0.01) |
| Port Fees | 0.03 | 0.03 | 0.03 | 0.04 |
| Total Transportation | 1.76 | 2.48 | 1.63 | 1.73 |
| **Dubai, CIF $/Bbl** | **28.00** | **37.30** | **29.39** | **33.54** |
| **Bonny Light, FOB** | **28.51** | **38.60** | **30.34** | **34.77** |
| Bonny To Yokohama WS100, $/MT | 16.59 | 20.65 | 20.65 | 20.65 |
| VLCC Spot Rate, %WS | 115.41 | 131.96 | 84.80 | 89.27 |
| Freight Cost, $/MT | 19.15 | 27.25 | 17.51 | 18.43 |
| Freight Cost, $/Bbl | 2.58 | 3.67 | 2.36 | 2.48 |
| Losses & Insurance, $/Bbl | 0.16 | 0.21 | 0.16 | 0.19 |
| Credit Float, $/Bbl | 0.11 | 0.09 | 0.08 | 0.10 |
| Port Fees, $/Bbl | 0.03 | 0.03 | 0.03 | 0.04 |
| Total Transportation, $/Bbl | 2.88 | 4.00 | 2.64 | 2.80 |
| **Bonny Light, CIF $/Bbl** | **31.39** | **42.60** | **32.99** | **37.57** |

# Shanghai China Market Pricing

## PRODUCT PRICING

| | 2000 | 2005 | 2010 | 2015 |
|---|---|---|---|---|
| LPG | 31.06 | 34.82 | 27.68 | 30.39 |
| Naphtha | 31.50 | 45.22 | 35.57 | 39.26 |
| 90 RON Gasoline | 33.85 | 51.04 | 39.77 | 43.90 |
| Jet | 39.14 | 54.14 | 43.37 | 47.21 |
| 0.2% Sulfur Diesel | 36.69 | 52.05 | 41.75 | 46.07 |
| 0.05% Sulfur Diesel | 36.95 | 52.89 | 42.21 | 46.58 |
| Cutter | 35.43 | 50.76 | 40.32 | 44.50 |
| 3.5% 380 cst Fuel Oil | 26.81 | 31.15 | 25.16 | 28.10 |
| Sulfur, $/LT | 4.11 | 4.77 | 5.29 | 5.84 |
| Utilities | | | | |
| Fuel, $/FOE | 23.90 | 27.64 | 22.54 | 26.01 |
| Water, $/Mgal | 0.50 | 0.51 | 0.57 | 0.63 |
| Catalyst & Chemicals, $ | 1.00 | 1.03 | 1.14 | 1.25 |
| Electricity, $/Kw-Hr | 0.08 | 0.09 | 0.09 | 0.10 |
| Net Dubai HSK Realization | 30.82 | 40.91 | 32.73 | 36.11 |
| Net Dubai Cracking Realization | 31.89 | 43.73 | 34.67 | 38.19 |
| Net Bonny Light HSK Realization | 32.26 | 44.11 | 35.45 | 39.13 |
| Net Bonny Light CRK Realization | 33.66 | 47.52 | 37.68 | 41.53 |

## DELIVERED CRUDE COSTS

| | 2000 | 2005 | 2010 | 2015 |
|---|---|---|---|---|
| **Dubai, FOB** | **26.24** | **34.82** | **27.76** | **31.81** |
| Fateh To Shanghai WS100, $/MT | 8.44 | 10.49 | 10.49 | 10.49 |
| VLCC Spot Rate, %WS | 115.41 | 131.96 | 84.80 | 89.27 |
| Freight Cost, $/MT | 9.74 | 13.84 | 8.89 | 9.36 |
| Freight Cost, $/Bbl | 1.34 | 1.90 | 1.22 | 1.29 |
| Losses & Insurance | 0.14 | 0.18 | 0.14 | 0.17 |
| Credit Float, $/Bbl | (0.10) | (0.08) | (0.07) | (0.08) |
| Port Fees | 0.03 | 0.03 | 0.03 | 0.04 |
| Total Transportation | 1.41 | 2.04 | 1.33 | 1.40 |
| **Dubai, CIF $/Bbl** | **27.65** | **36.85** | **29.09** | **33.21** |
| **Bonny Light, FOB** | **28.51** | **38.60** | **30.34** | **34.77** |
| Bonny To Shanghai WS100, $/MT | 14.69 | 18.38 | 18.38 | 18.38 |
| VLCC Spot Rate, %WS | 115.41 | 131.96 | 84.80 | 89.27 |
| Freight Cost, $/MT | 16.96 | 24.25 | 15.59 | 16.41 |
| Freight Cost, $/Bbl | 2.29 | 3.27 | 2.10 | 2.21 |
| Losses & Insurance, $/Bbl | 0.15 | 0.21 | 0.16 | 0.18 |
| Credit Float, $/Bbl | (0.06) | (0.05) | (0.04) | (0.05) |
| Port Fees, $/Bbl | 0.03 | 0.03 | 0.03 | 0.04 |
| Total Transportation, $/Bbl | 2.41 | 3.46 | 2.25 | 2.38 |
| **Bonny Light, CIF $/Bbl** | **30.92** | **42.06** | **32.60** | **37.15** |

# South Korea Market Pricing

## PRODUCT PRICING

| | 2000 | 2005 | 2010 | 2015 |
|---|---|---|---|---|
| LPG | 30.25 | 34.48 | 26.86 | 29.92 |
| Naphtha | 30.24 | 43.42 | 34.18 | 38.78 |
| 90 RON Gasoline | 29.74 | 45.38 | 35.34 | 40.27 |
| Jet | 34.52 | 48.06 | 38.51 | 43.80 |
| 0.2% Sulfur Diesel | 32.72 | 47.15 | 37.50 | 42.68 |
| 0.05% Sulfur Diesel | 33.36 | 48.18 | 38.46 | 43.76 |
| Cutter | 31.46 | 45.86 | 36.07 | 41.10 |
| 3.5% 380 cst Fuel Oil | 24.02 | 27.83 | 22.67 | 26.15 |
| Sulfur, $/LT | 4.11 | 4.77 | 5.29 | 5.84 |
| Utilities | | | | |
| Fuel, $/FOE | 23.90 | 27.64 | 22.54 | 26.01 |
| Water, $/Mgal | 0.50 | 0.51 | 0.57 | 0.63 |
| Catalyst & Chemicals, $ | 1.00 | 1.03 | 1.14 | 1.25 |
| Electricity, $/Kw-Hr | 0.08 | 0.09 | 0.09 | 0.10 |
| Net Dubai HSK Realization | 27.80 | 37.13 | 29.72 | 33.93 |
| Net Dubai Cracking Realization | 28.56 | 39.48 | 31.25 | 35.61 |
| Net Bonny Light HSK Realization | 29.25 | 40.32 | 32.40 | 36.91 |
| Net Bonny Light CRK Realization | 30.23 | 43.10 | 34.07 | 38.77 |

## DELIVERED CRUDE COSTS

| | 2000 | 2005 | 2010 | 2015 |
|---|---|---|---|---|
| **Dubai, FOB** | **26.24** | **34.82** | **27.76** | **31.81** |
| Fateh To Ulsan WS100, $/MT | 8.88 | 11.04 | 11.04 | 11.04 |
| VLCC Spot Rate, %WS | 115.41 | 131.96 | 84.80 | 89.27 |
| Freight Cost, $/MT | 10.25 | 14.57 | 9.36 | 9.86 |
| Freight Cost, $/Bbl | 1.41 | 2.00 | 1.29 | 1.35 |
| Losses & Insurance | 0.14 | 0.18 | 0.15 | 0.17 |
| Credit Float, $/Bbl | (0.03) | (0.02) | (0.02) | (0.02) |
| Port Fees | 0.03 | 0.03 | 0.03 | 0.04 |
| Total Transportation | 1.55 | 2.19 | 1.45 | 1.53 |
| **Dubai, CIF $/Bbl** | **27.79** | **37.01** | **29.21** | **33.34** |
| **Bonny Light, FOB** | **28.51** | **38.60** | **30.34** | **34.77** |
| Bonny To Ulsan WS100, $/MT | 15.26 | 19.10 | 19.10 | 19.10 |
| VLCC Spot Rate, %WS | 115.41 | 131.96 | 84.80 | 89.27 |
| Freight Cost, $/MT | 17.62 | 25.20 | 16.19 | 17.05 |
| Freight Cost, $/Bbl | 2.37 | 3.40 | 2.18 | 2.30 |
| Losses & Insurance, $/Bbl | 0.15 | 0.21 | 0.16 | 0.19 |
| Credit Float, $/Bbl | (0.01) | (0.01) | (0.01) | (0.01) |
| Port Fees, $/Bbl | 0.03 | 0.03 | 0.03 | 0.04 |
| Total Transportation, $/Bbl | 2.55 | 3.63 | 2.37 | 2.51 |
| **Bonny Light, CIF $/Bbl** | **31.06** | **42.23** | **32.72** | **37.28** |

# Taiwan Market Pricing

## PRODUCT PRICING

| | 2000 | 2005 | 2010 | 2015 |
|---|---|---|---|---|
| LPG | 29.57 | 33.79 | 26.86 | 29.92 |
| Naphtha | 29.43 | 42.31 | 33.28 | 37.81 |
| 90 RON Gasoline | 30.05 | 45.61 | 35.52 | 40.47 |
| Jet | 34.80 | 48.33 | 38.73 | 44.05 |
| 0.2% Sulfur Diesel | 33.46 | 47.67 | 38.27 | 43.54 |
| 0.05% Sulfur Diesel | 33.72 | 48.51 | 38.72 | 44.05 |
| Cutter | 32.20 | 46.38 | 35.88 | 40.90 |
| 3.5% 380 cst Fuel Oil | 24.18 | 28.04 | 22.74 | 26.21 |
| Sulfur, $/LT | 4.11 | 4.77 | 5.29 | 5.84 |
| Utilities | | | | |
| Fuel, $/FOE | 23.90 | 27.64 | 22.54 | 26.01 |
| Water, $/Mgal | 0.50 | 0.51 | 0.57 | 0.63 |
| Catalyst & Chemicals, $ | 1.00 | 1.03 | 1.14 | 1.25 |
| Electricity, $/Kw-Hr | 0.08 | 0.09 | 0.09 | 0.10 |
| Net Dubai HSK Realization | 27.91 | 37.15 | 29.77 | 33.98 |
| Net Dubai Cracking Realization | 28.73 | 39.57 | 31.41 | 35.78 |
| Net Bonny Light HSK Realization | 29.38 | 40.34 | 32.47 | 36.99 |
| Net Bonny Light CRK Realization | 30.47 | 43.24 | 34.29 | 39.02 |

## DELIVERED CRUDE COSTS

| | 2000 | 2005 | 2010 | 2015 |
|---|---|---|---|---|
| **Dubai, FOB** | **26.24** | **34.82** | **27.76** | **31.81** |
| Fateh To Kaoshung WS100, $/MT | 7.99 | 9.93 | 9.93 | 9.93 |
| VLCC Spot Rate, %WS | 115.41 | 131.96 | 84.80 | 89.27 |
| Freight Cost, $/MT | 9.22 | 13.11 | 8.43 | 8.87 |
| Freight Cost, $/Bbl | 1.27 | 1.80 | 1.16 | 1.22 |
| Losses & Insurance | 0.14 | 0.18 | 0.14 | 0.17 |
| Credit Float, $/Bbl | (0.05) | (0.04) | (0.04) | (0.05) |
| Port Fees | 0.03 | 0.03 | 0.03 | 0.04 |
| Total Transportation | 1.38 | 1.97 | 1.30 | 1.38 |
| **Dubai, CIF $/Bbl** | **27.62** | **36.79** | **29.06** | **33.18** |
| **Bonny Light, FOB** | **28.51** | **38.60** | **30.34** | **34.77** |
| Bonny To Kaoshung WS100, $/MT | 14.12 | 17.66 | 17.66 | 17.66 |
| VLCC Spot Rate, %WS | 115.41 | 131.96 | 84.80 | 89.27 |
| Freight Cost, $/MT | 16.30 | 23.31 | 14.98 | 15.77 |
| Freight Cost, $/Bbl | 2.20 | 3.14 | 2.02 | 2.13 |
| Losses & Insurance, $/Bbl | 0.15 | 0.21 | 0.16 | 0.18 |
| Credit Float, $/Bbl | (0.01) | (0.01) | (0.01) | (0.01) |
| Port Fees, $/Bbl | 0.03 | 0.03 | 0.03 | 0.04 |
| Total Transportation, $/Bbl | 2.37 | 3.37 | 2.21 | 2.34 |
| **Bonny Light, CIF $/Bbl** | **30.88** | **41.97** | **32.55** | **37.10** |

# Asian Refining Values

- SCO
- SynSynBit
- SynBit
- Notes
  - 2004 and 2005 price differentials are viewed as an anomaly due to strong Atlantic Basin prices for crude oil and record light/heavy price differentials.
  - Longer term, restoration of Far East premium and somewhat narrower light/heavy price differentials expected.

# Crude Oil Price Outlook

- **Crude oil prices and light heavy differentials are expected to return to sustainable levels based on industry fundamentals.**

## BENCHMARK CRUDE OIL PRICE FORECAST (1)

*U.S. $/Bbl*

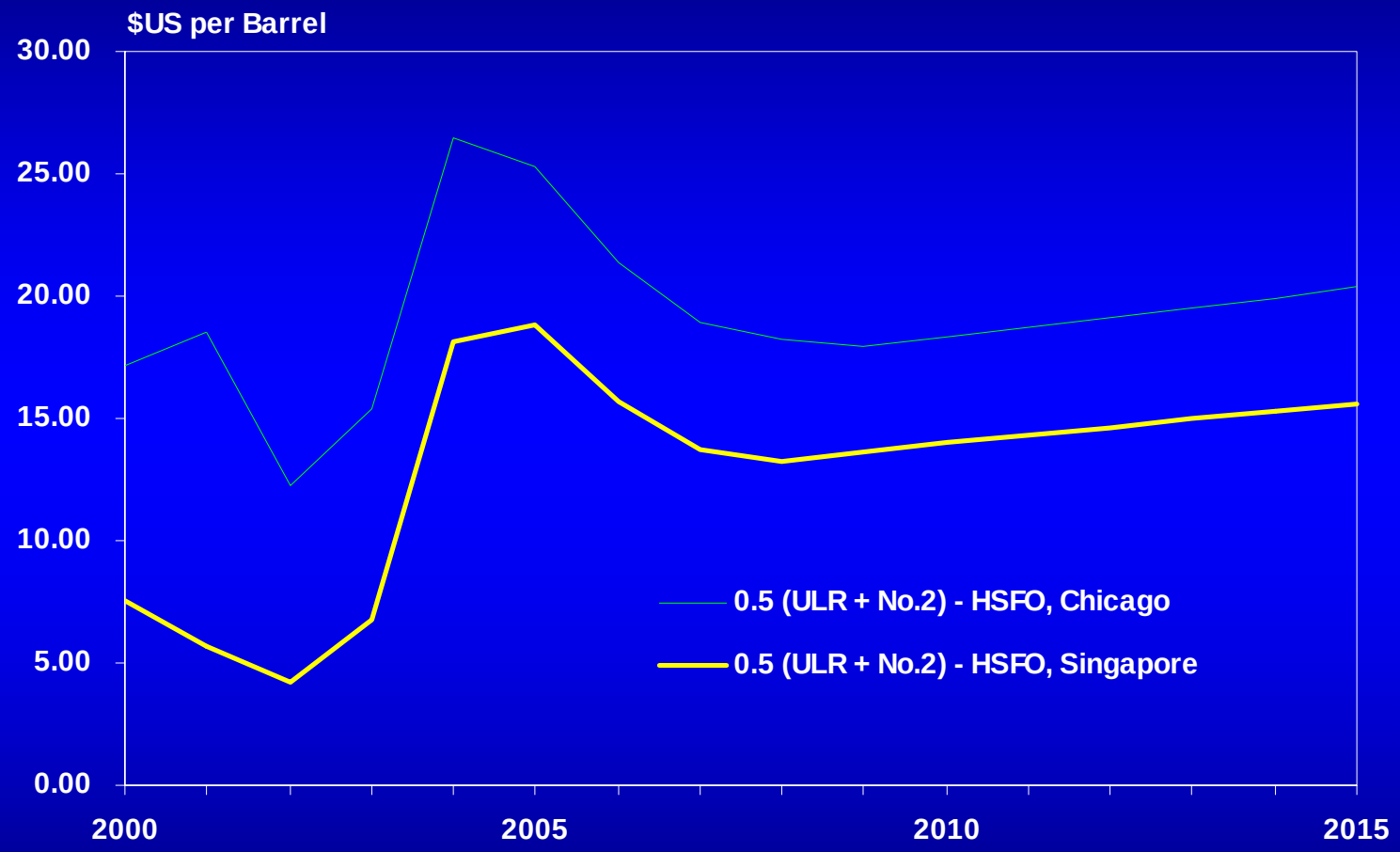
| | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2010 | 2015 |
|---|---|---|---|---|---|---|---|---|
| Tapis, FOB | 29.85 | 25.32 | 25.72 | 30.06 | 41.19 | 42.06 | 32.50 | 37.06 |
| Brent, FOB | 28.50 | 24.44 | 25.02 | 28.83 | 38.27 | 38.50 | 29.89 | 34.23 |
| WTI, Spot Cushing | 30.37 | 25.93 | 26.16 | 31.06 | 41.49 | 41.32 | 32.24 | 36.84 |
| Bonny Light FOB | 28.51 | 24.52 | 25.14 | 28.77 | 38.30 | 38.60 | 30.34 | 34.77 |
| Bonny Light, CIF Japan | 31.39 | 26.56 | 26.70 | 31.60 | 42.90 | 42.60 | 32.99 | 37.57 |
| Bonny Light, CIF South Korea | 31.06 | 26.34 | 26.55 | 31.36 | 42.50 | 42.23 | 32.72 | 37.28 |
| Bonny Light, CIF Shanghai | 30.92 | 26.25 | 26.48 | 31.25 | 42.32 | 42.06 | 32.60 | 37.15 |
| Bonny Light, CIF Taiwan | 30.88 | 26.21 | 26.46 | 31.18 | 42.20 | 41.97 | 32.55 | 37.10 |
| Dubai, FOB | 26.24 | 22.80 | 23.85 | 26.76 | 33.69 | 34.82 | 27.76 | 31.81 |
| Dubai, CIF Japan | 28.00 | 24.07 | 24.83 | 28.53 | 36.55 | 37.30 | 29.39 | 33.54 |
| Dubai, CIF South Korea | 27.79 | 23.93 | 24.73 | 28.33 | 36.22 | 37.01 | 29.21 | 33.34 |
| Dubai, CIF Shanghai | 27.65 | 23.83 | 24.66 | 28.23 | 36.06 | 36.85 | 29.09 | 33.21 |
| Dubai, CIF Taiwan | 27.62 | 23.81 | 24.64 | 28.18 | 35.97 | 36.79 | 29.06 | 33.18 |

Note: (1) Purvin & Gertz January 2005 Crude Oil Price Forecast.

# Longer Term Price Outlook for Light/Heavy Differentials Relative to 2004-2005

- Forecast prices reflect shift from 2004 and 2005, considered unusual relative to history and the longer term outlook.
- Very wide light/heavy price differentials occurred in 2004 and 2005. Future differentials expected to be higher than 1995 – 2003 period, but narrower than occurred in 2004 and 2005.
- Asian differentials did not widen as much in 2004 as in the US, but will likely remain wider than historical because HSFO growth will be less than other products.
- Far East crude price premium did not occur in 2004, driven by strong Atlantic basin demand for crude oil. This premium is expected to return as the Far East continues to experience strong demand growth.
- Tanker rates jumped in 2004, aggravating prices of HSFO in the US versus Asia and contributing to wider light/heavy price differentials. New tanker capacity coming on stream in next several years should bring tanker rates down somewhat closer to historical levels.

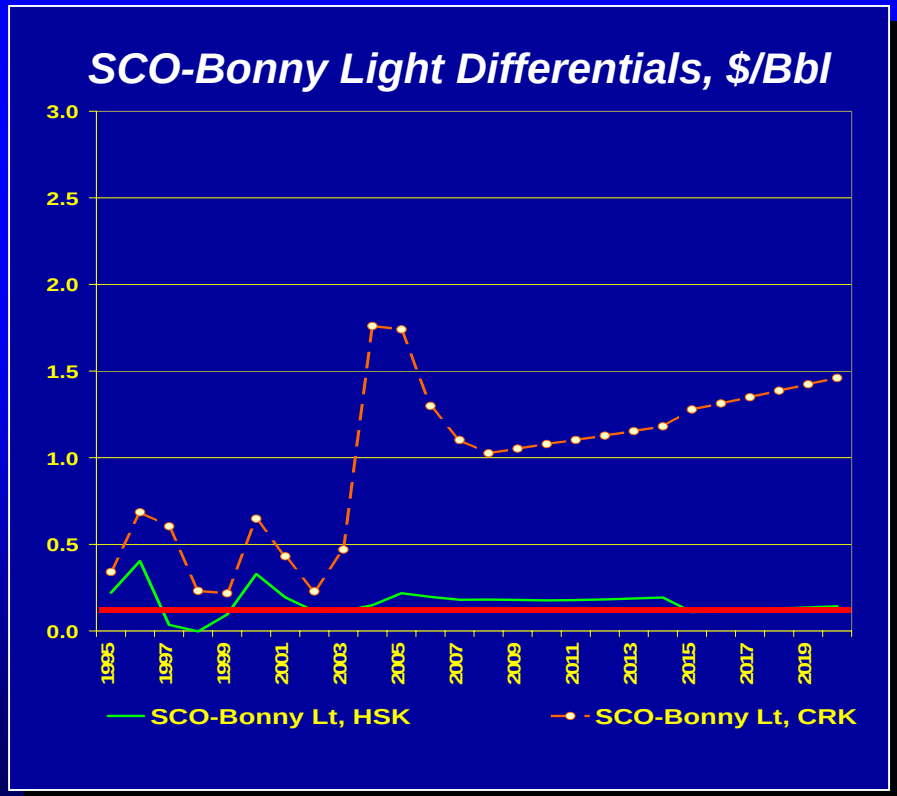
# Product Heavy/Light Spread




- Both markets are expected to have wider light/heavy price differentials in the future than experienced prior to 2004.

# SCO Refining Values: Shanghai China

- Refinery cracking operations forecast to favor SCO over Bonny Light due to the low vacuum residue.
- SCO is further differentiated by FCC cracking economics due to its relatively high VGO content.

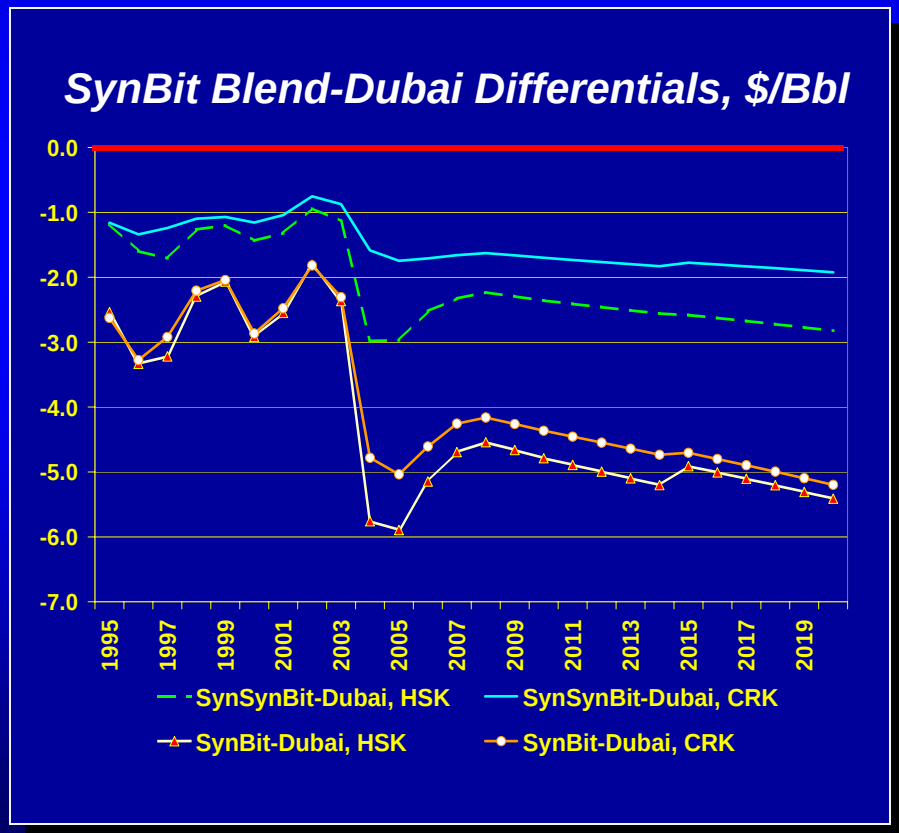



**SCO SHANGHAI REFINING VALUE**

| | 2000 | 2005 | 2010 | 2015 |
|---|---|---|---|---|
| Bonny Light, CIF | 30.92 | 42.06 | 32.60 | 37.15 |
| Bonny Light HSK Realization | 32.25 | 43.96 | 35.34 | 39.03 |
| SCO HSK Realization | 32.58 | 44.18 | 35.51 | 39.14 |
| HSK Refining Value Differential | (0.33) | (0.22) | (0.18) | (0.11) |
| Bonny Light CRK Realization | 33.66 | 47.52 | 37.68 | 41.23 |
| SCO CRK Realization | 34.31 | 49.26 | 38.75 | 42.51 |
| CRK Refining Value Differential | (0.65) | (1.74) | (1.08) | (1.28) |
| SCO HSK Value, CIF | 31.25 | 42.28 | 32.77 | 37.26 |
| SCO CRK Value, CIF | 31.57 | 43.80 | 33.68 | 38.43 |

# Bitumen Blend Refining Values: Shanghai China

- Chinese import tariffs will widen the light-heavy differential slightly.
- Import tariffs are assumed to decline by 50% in 2015.

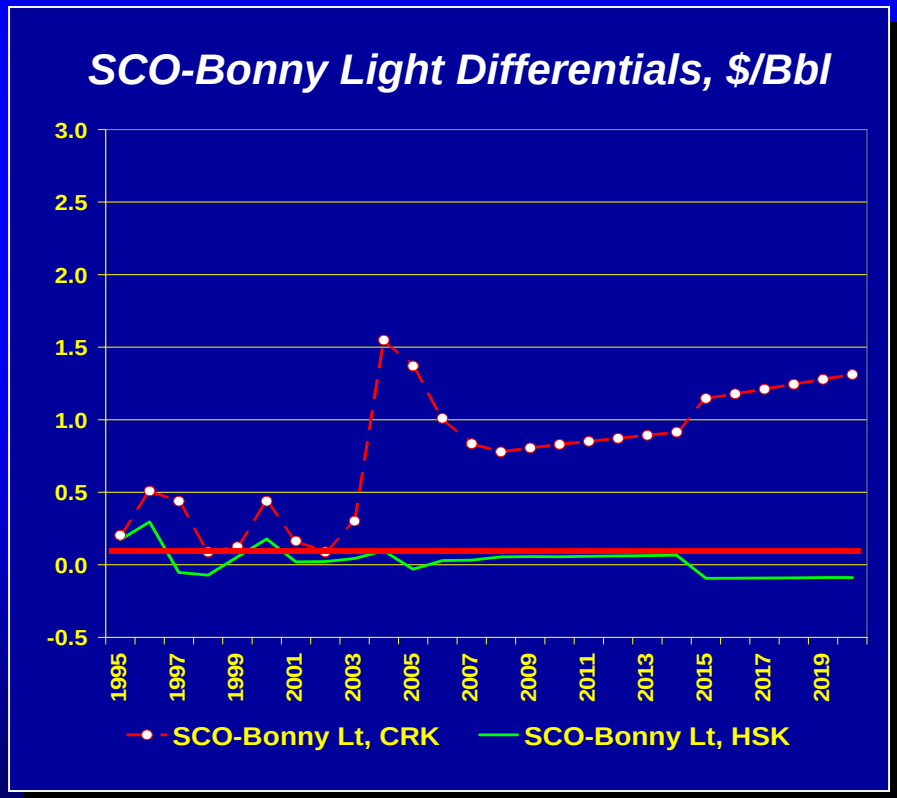



**BITUMEN BLEND SHANGHAI REFINING VALUE**

| | 2000 | 2005 | 2010 | 2015 |
|---|---|---|---|---|
| Dubai, CIF | 27.65 | 36.85 | 29.09 | 33.21 |
| Dubai HSK Realization | 30.81 | 40.74 | 32.61 | 35.81 |
| SynSynBit HSK Realization | 29.79 | 38.20 | 30.72 | 33.75 |
| SynSynBit TAN Penalty | (0.42) | (0.43) | (0.47) | (0.52) |
| HSK Refining Value Differential | 1.44 | 2.97 | 2.36 | 2.58 |
| Dubai CRK Realization | 31.89 | 43.73 | 34.67 | 38.03 |
| SynSynBit CRK Realization | 31.15 | 42.41 | 33.44 | 36.77 |
| SynSynBit TAN Penalty | (0.42) | (0.43) | (0.47) | (0.52) |
| CRK Refining Value Differential | 1.16 | 1.75 | 1.70 | 1.77 |
| **SynSynBit HSK Value, CIF** | **26.21** | **33.88** | **26.73** | **30.63** |
| **SynSynBit CRK Value, CIF** | **26.49** | **35.11** | **27.39** | **31.44** |
| Dubai HSK Realization | 30.81 | 40.74 | 32.61 | 35.81 |
| SynBit HSK Realization | 28.50 | 35.46 | 28.50 | 31.65 |
| SynBit TAN Penalty | (0.60) | (0.62) | (0.68) | (0.75) |
| HSK Refining Value Differential | 2.92 | 5.89 | 4.79 | 4.91 |
| Dubai CRK Realization | 31.89 | 43.73 | 34.67 | 38.03 |
| SynBit CRK Realization | 29.62 | 39.31 | 30.99 | 34.07 |
| SynBit TAN Penalty | (0.60) | (0.62) | (0.68) | (0.75) |
| CRK Refining Value Differential | 2.87 | 5.04 | 4.36 | 4.70 |
| **SynBit HSK Value, CIF** | **24.73** | **30.96** | **24.30** | **28.30** |
| **SynBit CRK Value, CIF** | **24.78** | **31.82** | **24.72** | **28.51** |

# SCO Refining Values: South Korea

- The relative value of SCO is expected to increase as low sulfur diesel specifications are implemented (in 2015 below).
- The robust outlook for light-heavy differentials will favor lighter crudes.

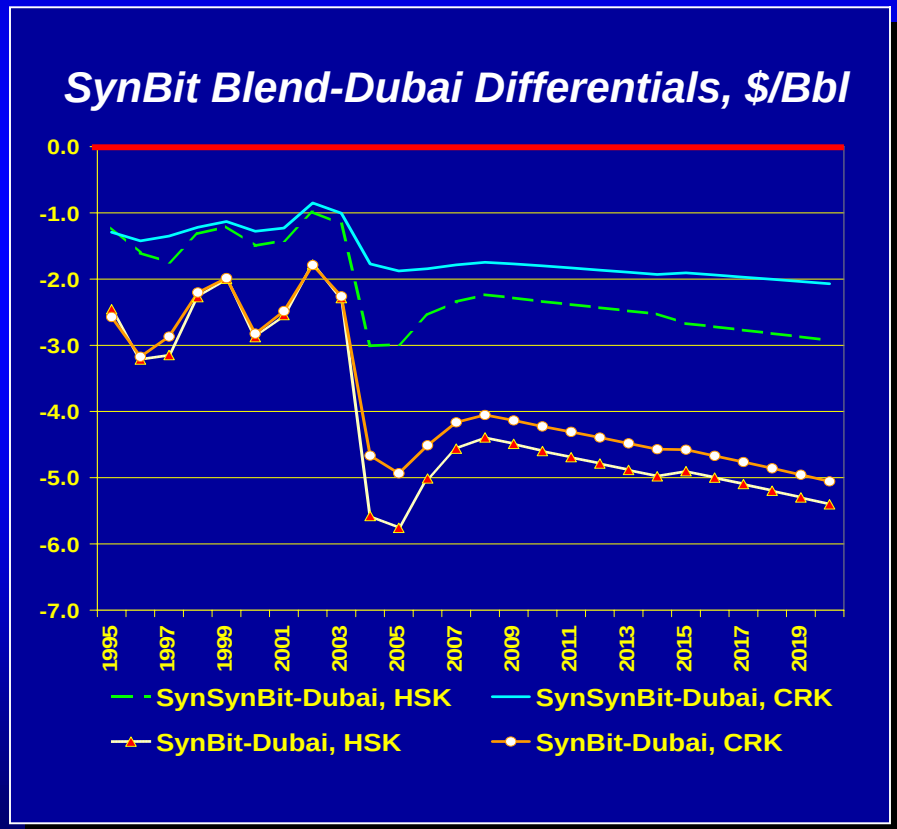



**SCO SOUTH KOREA REFINING VALUE**

| | 2000 | 2005 | 2010 | 2015 |
|---|---|---|---|---|
| Bonny Light, CIF | 31.06 | 42.23 | 32.72 | 37.28 |
| Bonny Light HSK Realization | 29.25 | 40.19 | 32.30 | 36.95 |
| SCO HSK Realization | 29.43 | 40.16 | 32.35 | 36.85 |
| HSK Refining Value Differential | (0.18) | 0.03 | (0.06) | 0.09 |
| Bonny Light CRK Realization | 30.23 | 43.10 | 34.07 | 38.54 |
| SCO CRK Realization | 30.66 | 44.47 | 34.90 | 39.69 |
| CRK Refining Value Differential | (0.44) | (1.37) | (0.83) | (1.15) |
| SCO HSK Value, CIF | 31.24 | 42.20 | 32.77 | 37.18 |
| SCO CRK Value, CIF | 31.50 | 43.60 | 33.55 | 38.42 |

# Bitumen Blend Refining Values: South Korea

- **Refining value differentials in South Korea are very similar to Shanghai China.**

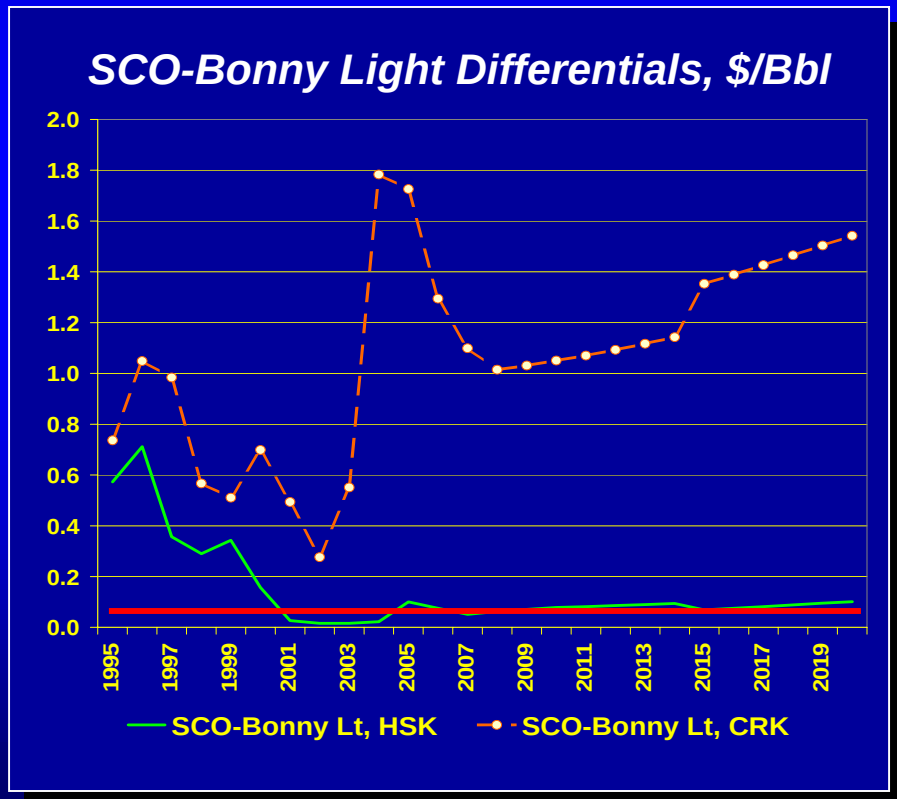



**BITUMEN BLEND SOUTH KOREA REFINING VALUE**

| | 2000 | 2005 | 2010 | 2015 |
|---|---|---|---|---|
| Dubai, CIF | 27.79 | 37.01 | 29.21 | 33.34 |
| Dubai HSK Realization | 27.80 | 36.99 | 29.61 | 33.81 |
| SynSynBit HSK Realization | 26.72 | 34.43 | 27.74 | 31.66 |
| SynSynBit TAN Penalty | (0.42) | (0.43) | (0.47) | (0.52) |
| HSK Refining Value Differential | 1.50 | 2.99 | 2.34 | 2.67 |
| Dubai CRK Realization | 28.56 | 39.48 | 31.25 | 35.63 |
| SynSynBit CRK Realization | 27.70 | 38.03 | 29.92 | 34.24 |
| SynSynBit TAN Penalty | (0.42) | (0.43) | (0.47) | (0.52) |
| CRK Refining Value Differential | 1.28 | 1.88 | 1.80 | 1.91 |
| **SynSynBit HSK Value, CIF** | **26.29** | **34.02** | **26.87** | **30.67** |
| **SynSynBit CRK Value, CIF** | **26.51** | **35.14** | **27.40** | **31.44** |
| Dubai HSK Realization | 27.80 | 36.99 | 29.61 | 33.81 |
| SynBit HSK Realization | 25.53 | 31.85 | 25.69 | 29.66 |
| SynBit TAN Penalty | (0.60) | (0.62) | (0.68) | (0.75) |
| HSK Refining Value Differential | 2.88 | 5.76 | 4.60 | 4.90 |
| Dubai CRK Realization | 28.56 | 39.48 | 31.25 | 35.63 |
| SynBit CRK Realization | 26.34 | 35.17 | 27.71 | 31.80 |
| SynBit TAN Penalty | (0.60) | (0.62) | (0.68) | (0.75) |
| CRK Refining Value Differential | 2.82 | 4.93 | 4.22 | 4.58 |
| **SynBit HSK Value, CIF** | **24.91** | **31.25** | **24.61** | **28.44** |
| **SynBit CRK Value, CIF** | **24.96** | **32.08** | **24.98** | **28.77** |

# SCO Refining Values: Japan

- While product pricing is Japan is relatively strong, the differential between light and heavy products is similar to other Asian countries.

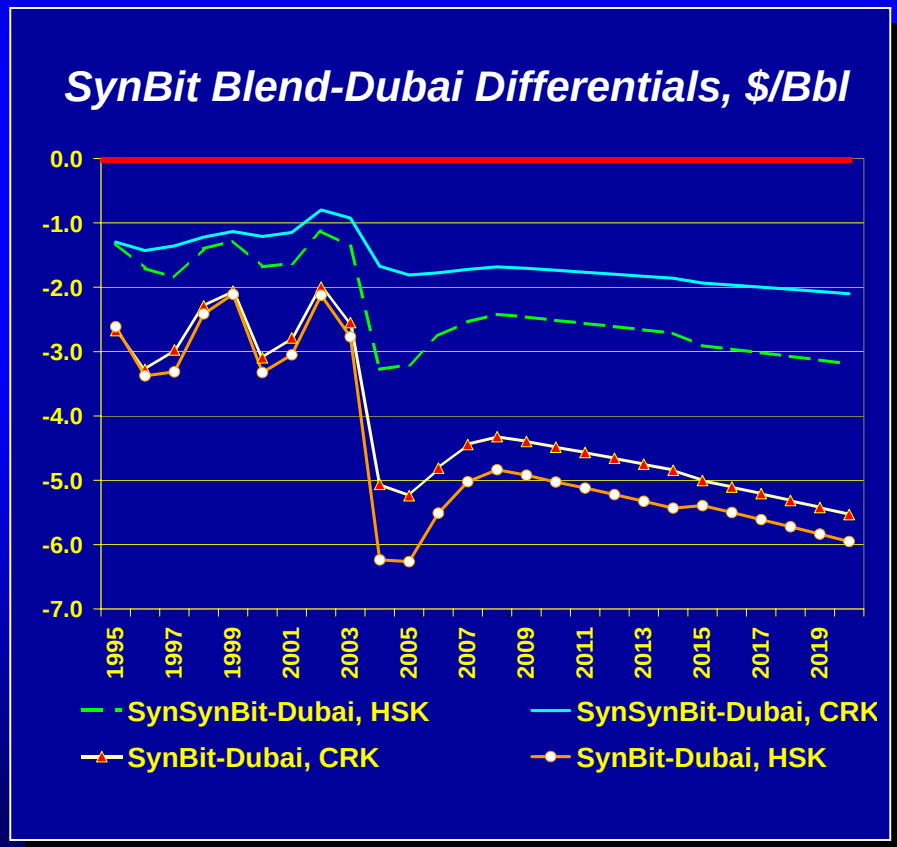



**SCO JAPAN REFINING VALUE**

| | 2000 | 2005 | 2010 | 2015 |
|---|---|---|---|---|
| Bonny Light, CIF | 31.39 | 42.60 | 32.99 | 37.57 |
| Bonny Light HSK Realization | 30.12 | 41.21 | 33.21 | 37.82 |
| SCO HSK Realization | 30.27 | 41.32 | 33.29 | 37.89 |
| HSK Refining Value Differential | (0.16) | (0.10) | (0.08) | (0.07) |
| Bonny Light CRK Realization | 31.75 | 44.77 | 35.53 | 40.04 |
| SCO CRK Realization | 32.45 | 46.49 | 36.58 | 41.39 |
| CRK Refining Value Differential | (0.70) | (1.73) | (1.05) | (1.35) |
| SCO HSK Value, CIF | 31.54 | 42.70 | 33.06 | 37.64 |
| SCO CRK Value, CIF | 32.09 | 44.33 | 34.04 | 38.92 |

# Bitumen Blend Refining Values: Japan

- **While product pricing is Japan is relatively strong, the differential between light and heavy products is similar to other Asian countries.**




**BITUMEN BLEND JAPAN REFINING VALUE**

| | 2000 | 2005 | 2010 | 2015 |
|---|---|---|---|---|
| Dubai, CIF | 28.00 | 37.30 | 29.39 | 33.54 |
| Dubai HSK Realization | 28.42 | 37.60 | 30.20 | 34.36 |
| SynSynBit HSK Realization | 27.15 | 34.82 | 28.16 | 31.97 |
| SynSynBit TAN Penalty | (0.42) | (0.43) | (0.47) | (0.52) |
| HSK Refining Value Differential | 1.68 | 3.21 | 2.51 | 2.91 |
| Dubai CRK Realization | 29.68 | 40.70 | 32.33 | 36.70 |
| SynSynBit CRK Realization | 28.89 | 39.31 | 31.07 | 35.29 |
| SynSynBit TAN Penalty | (0.42) | (0.43) | (0.47) | (0.52) |
| CRK Refining Value Differential | 1.21 | 1.81 | 1.74 | 1.93 |
| **SynSynBit HSK Value, CIF** | **26.31** | **34.09** | **26.88** | **30.63** |
| **SynSynBit CRK Value, CIF** | **26.79** | **35.49** | **27.66** | **31.61** |
| Dubai HSK Realization | 28.42 | 37.60 | 30.20 | 34.36 |
| SynBit HSK Realization | 25.69 | 31.95 | 25.85 | 29.71 |
| SynBit TAN Penalty | (0.60) | (0.62) | (0.68) | (0.75) |
| HSK Refining Value Differential | 3.33 | 6.27 | 5.03 | 5.39 |
| Dubai CRK Realization | 29.68 | 40.70 | 32.33 | 36.70 |
| SynBit CRK Realization | 27.19 | 36.07 | 28.53 | 32.45 |
| SynBit TAN Penalty | (0.60) | (0.62) | (0.68) | (0.75) |
| CRK Refining Value Differential | 3.10 | 5.24 | 4.49 | 5.00 |
| **SynBit HSK Value, CIF** | **24.67** | **31.03** | **24.36** | **28.15** |
| **SynBit CRK Value, CIF** | **24.90** | **32.06** | **24.91** | **28.54** |



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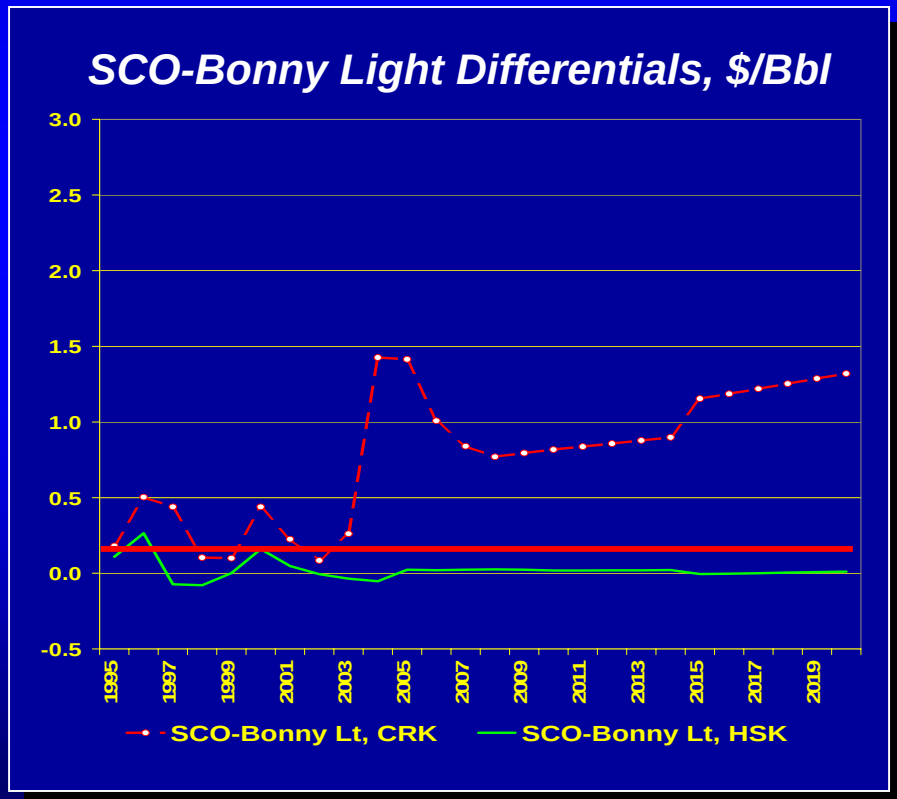
# SCO Refining Values: Taiwan

- Export pricing in Taiwan reduces the premium of SCO over Bonny Light.

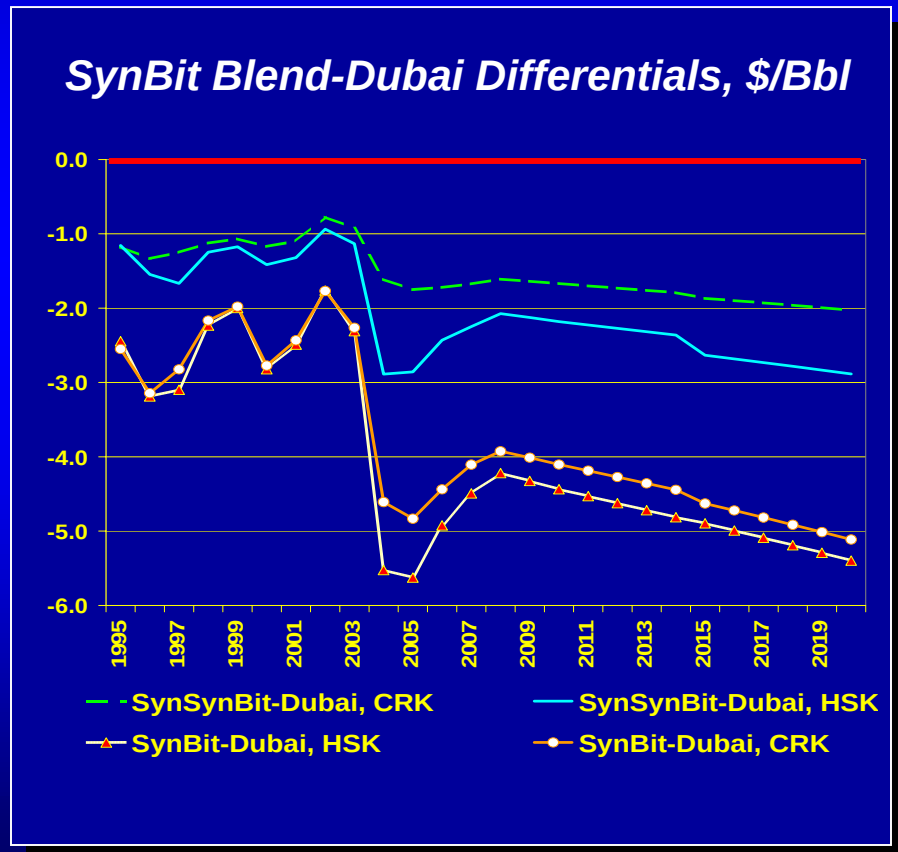



**SCO TAIWAN REFINING VALUE**

| | 2000 | 2005 | 2010 | 2015 |
|---|---|---|---|---|
| Bonny Light, CIF | 30.88 | 41.97 | 32.55 | 37.10 |
| Bonny Light HSK Realization | 29.38 | 40.22 | 32.38 | 36.91 |
| SCO HSK Realization | 29.54 | 40.24 | 32.40 | 36.90 |
| HSK Refining Value Differential | (0.16) | (0.02) | (0.02) | 0.01 |
| Bonny Light CRK Realization | 30.47 | 43.24 | 34.29 | 38.68 |
| SCO CRK Realization | 30.91 | 44.65 | 35.11 | 39.84 |
| CRK Refining Value Differential | (0.44) | (1.41) | (0.82) | (1.15) |
| SCO HSK Value, CIF | 31.04 | 42.00 | 32.57 | 37.10 |
| SCO CRK Value, CIF | 31.32 | 43.39 | 33.37 | 38.26 |

# Bitumen Blend Refining Values: Taiwan

- **The relative value of Canadian bitumen blends will be adversely affected by fuel oil export pricing.**




**BITUMEN BLEND TAIWAN REFINING VALUE**

| | 2000 | 2005 | 2010 | 2015 |
|---|---|---|---|---|
| Dubai, CIF | 27.62 | 36.79 | 29.06 | 33.18 |
| Dubai HSK Realization | 27.91 | 37.02 | 29.67 | 33.76 |
| SynSynBit HSK Realization | 26.91 | 34.59 | 27.96 | 31.65 |
| SynSynBit TAN Penalty | (0.42) | (0.43) | (0.47) | (0.52) |
| HSK Refining Value Differential | 1.41 | 2.86 | 2.18 | 2.63 |
| Dubai CRK Realization | 28.73 | 39.57 | 31.41 | 35.67 |
| SynSynBit CRK Realization | 27.97 | 38.24 | 30.21 | 34.32 |
| SynSynBit TAN Penalty | (0.42) | (0.43) | (0.47) | (0.52) |
| CRK Refining Value Differential | 1.17 | 1.75 | 1.67 | 1.87 |
| **SynSynBit HSK Value, CIF** | **26.21** | **33.93** | **26.88** | **30.55** |
| **SynSynBit CRK Value, CIF** | **26.45** | **35.04** | **27.39** | **31.32** |
| Dubai HSK Realization | 27.91 | 37.02 | 29.67 | 33.76 |
| SynBit HSK Realization | 25.69 | 32.01 | 25.91 | 29.62 |
| SynBit TAN Penalty | (0.60) | (0.62) | (0.68) | (0.75) |
| HSK Refining Value Differential | 2.82 | 5.63 | 4.44 | 4.89 |
| Dubai CRK Realization | 28.73 | 39.57 | 31.41 | 35.67 |
| SynBit CRK Realization | 26.55 | 35.35 | 27.98 | 31.79 |
| SynBit TAN Penalty | (0.60) | (0.62) | (0.68) | (0.75) |
| CRK Refining Value Differential | 2.77 | 4.83 | 4.10 | 4.63 |
| **SynBit HSK Value, CIF** | **24.80** | **31.16** | **24.62** | **28.29** |
| **SynBit CRK Value, CIF** | **24.85** | **31.96** | **24.95** | **28.56** |

# Edmonton Netback Pricing Results

- **Netback Crude Prices**
  - **Asia**
  - **Chicago**
- **Netback Product Prices at Edmonton, Alberta**
  - **Based on proposed new pipeline from Edmonton to Kitimat, and VLCC shipments to Asia**
  - **Compared to existing Taresen crude oil line to Vancouver, and LR1 tanker shipments to Asia.**

# Asian Versus Chicago Market Product Pricing

*2010 Regional Price Versus Chicago, 2004$/Bbl*

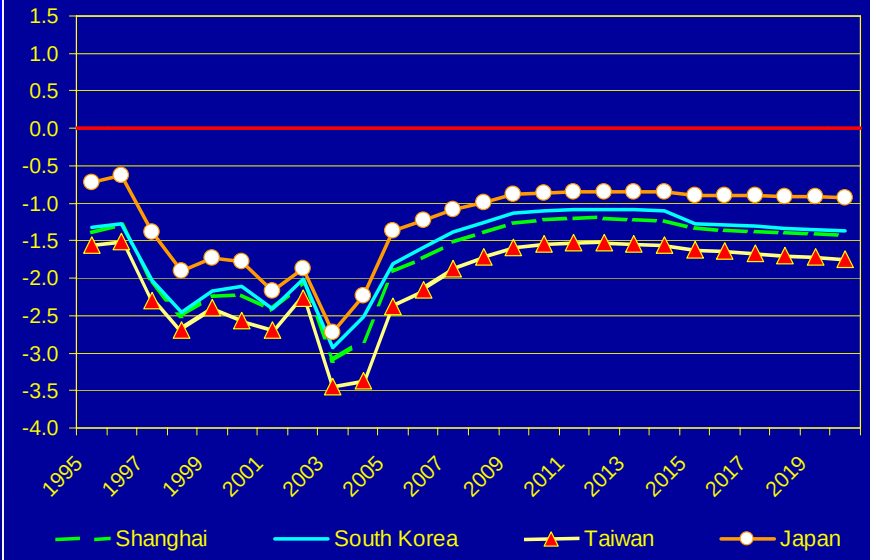
| | Japan | South Korea | Shanghai China | Taiwan |
|---|---|---|---|---|
| LPG | 0.7 | 0.1 | 0.8 | 0.1 |
| Gasoline | -0.7 | -2.5 | 1.4 | -2.4 |
| Jet | 1.9 | 0.5 | 4.8 | 0.7 |
| Diesel | 2.6 | 1.1 | 4.4 | 1.3 |
| Fuel Oil | 3.2 | 3.5 | 5.7 | 3.5 |

- Fuel oil prices are significantly higher in Asia, which provides greater support for refinery fuel oil production in Asia.
- North American pricing favors gasoline production, while Asian pricing favors jet and diesel production.
- Chicago pricing is largely reflective of refinery FCC cracking economics.

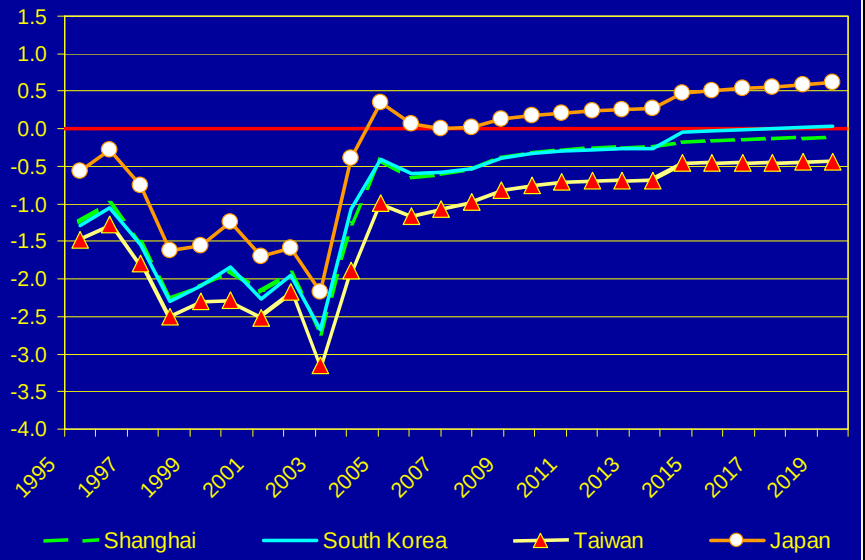
# SCO Asian Netbacks At Edmonton VLCC

- **Asian hydroskimming netbacks are projected to be slightly below Chicago netbacks at Edmonton.**

***Asian Hydroskimming Versus Chicago Netback, (U.S. $/Bbl)***




***Asian Cracking Versus Chicago Netback (U.S. $/Bbl)***



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# SCO Asian Netbacks At Edmonton: Detail

- **Cracking netbacks are roughly $1.20/Bbl higher than hydroskimming netbacks. This is due to the relatively high VGO content of SCO.**

***Asian Hydroskimming Netback (U.S. $/Bbl)***

| | 2000 | 2005 | 2010 | 2015 |
|---|---|---|---|---|
| SCO, Japan CIF | 31.54 | 42.61 | 32.99 | 37.55 |
| SCO, South Korea, CIF | 31.24 | 42.20 | 32.77 | 37.18 |
| SCO, Shanghai CIF | 31.25 | 42.28 | 32.77 | 37.26 |
| SCO, Taiwan CIF | 31.04 | 42.00 | 32.57 | 37.10 |
| Spot VLCC Rate, %WS | 136.11 | 162.95 | 100.98 | 104.72 |
| Total Waterborne Transportation Costs | | | | |
| Kitimat to Yokohama | 1.18 | 1.77 | 1.15 | 1.22 |
| Kitimat to South Korea | 1.20 | 1.80 | 1.18 | 1.25 |
| Kitimat to Shanghai | 1.33 | 1.98 | 1.29 | 1.37 |
| Kitimat to Kaoshung | 1.46 | 2.16 | 1.41 | 1.50 |
| Pipeline Costs - Enbridge Tariff | 1.85 | 1.85 | 1.92 | 2.07 |
| Edmonton Netbacks, VLCC/Enbridge | | | | |
| **From Japan** | **28.51** | **38.99** | **29.92** | **34.26** |
| **From South Korea** | **28.18** | **38.55** | **29.67** | **33.87** |
| **From Shanghai** | **28.07** | **38.45** | **29.56** | **33.82** |
| **From Taiwan** | **27.73** | **37.98** | **29.24** | **33.53** |
| From Chicago | 30.29 | 40.36 | 30.78 | 35.15 |
| Edmonton Netbacks, LR1/TMPL | | | | |
| From Japan | 28.19 | 38.71 | 29.84 | 34.20 |
| From South Korea | 27.84 | 38.25 | 29.58 | 33.80 |
| From Shanghai | 27.62 | 38.06 | 29.41 | 33.69 |
| From Taiwan | 27.17 | 37.50 | 29.01 | 33.33 |

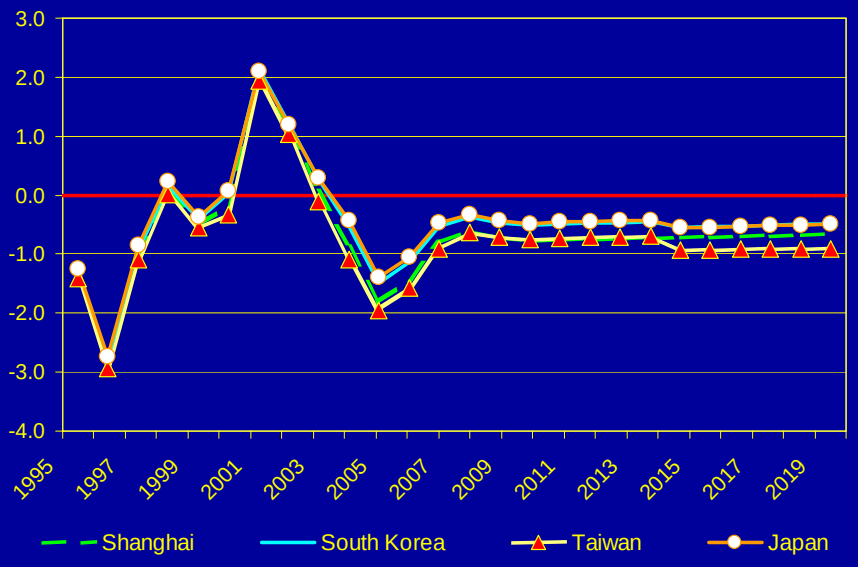
***Asian Cracking Netback (U.S. $/Bbl)***

| | 2000 | 2005 | 2010 | 2015 |
|---|---|---|---|---|
| SCO, Japan CIF | 32.09 | 44.33 | 34.04 | 38.92 |
| SCO, South Korea, CIF | 31.50 | 43.60 | 33.55 | 38.42 |
| SCO, Shanghai CIF | 31.57 | 43.80 | 33.68 | 38.43 |
| SCO, Taiwan CIF | 31.32 | 43.39 | 33.37 | 38.26 |
| Spot VLCC Rate, %WS | 136.11 | 162.95 | 100.98 | 104.72 |
| Total Waterborne Transportation Costs | | | | |
| Kitimat to Yokohama | 1.18 | 1.77 | 1.16 | 1.23 |
| Kitimat to South Korea | 1.21 | 1.80 | 1.18 | 1.25 |
| Kitimat to Shanghai | 1.32 | 2.00 | 1.29 | 1.37 |
| Kitimat to Kaoshung | 1.46 | 2.17 | 1.42 | 1.50 |
| Pipeline Costs - Enbridge Tariff | 1.85 | 1.85 | 1.92 | 2.07 |
| Edmonton Netbacks, VLCC/Enbridge | | | | |
| **From Japan** | **29.05** | **40.71** | **30.96** | **35.63** |
| **From South Korea** | **28.44** | **39.95** | **30.45** | **35.11** |
| **From Shanghai** | **28.40** | **39.95** | **30.46** | **34.99** |
| **From Taiwan** | **28.01** | **39.37** | **30.03** | **34.69** |
| From Chicago | 30.29 | 40.36 | 30.78 | 35.15 |
| Edmonton Netbacks, LR1/TMPL | | | | |
| From Japan | 28.74 | 40.42 | 30.88 | 35.57 |
| From South Korea | 28.10 | 39.64 | 30.36 | 35.04 |
| From Shanghai | 27.95 | 39.56 | 30.31 | 34.85 |
| From Taiwan | 27.45 | 38.89 | 29.81 | 34.48 |

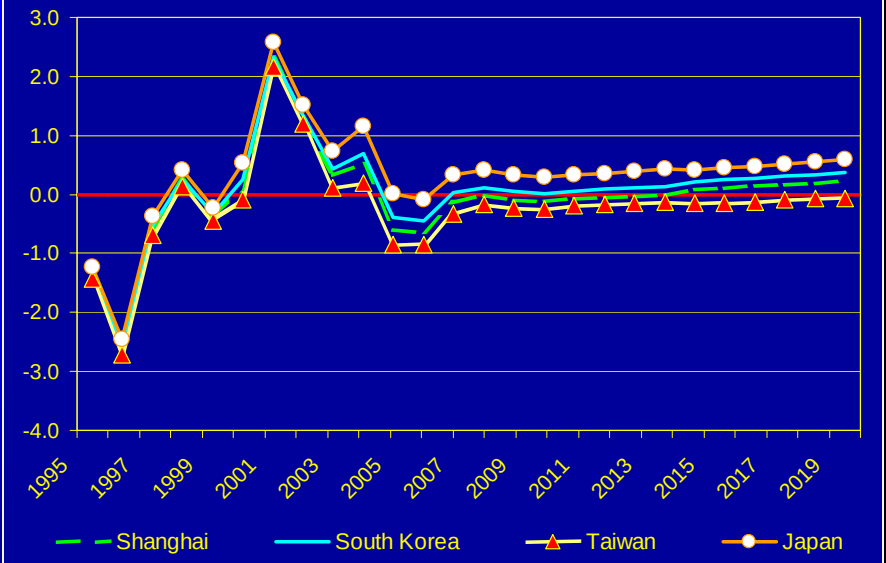
# SynSynBit Asian Netbacks At Edmonton

- Chicago netbacks are largely based on FCC cracking economics.
- Despite the relative strength of the Asian fuel oil market, Asian hydroskimming netbacks are projected to be slightly weaker than Chicago netbacks at Edmonton.

***Asian Hydroskimming Versus Chicago Netback, (U.S. $/Bbl)***




***Asian Cracking Versus Chicago Netback (U.S. $/Bbl)***



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# SynSynBit Asian Netbacks At Edmonton: Detail

- **Asian cracking netbacks are roughly $1/Bbl higher than hydroskimming.**

***Asian Hydroskimming Netback (U.S. $/Bbl)***

| | 2000 | 2005 | 2010 | 2015 |
|---|---|---|---|---|
| SynSynBit, Japan CIF | 26.31 | 34.09 | 26.88 | 30.63 |
| SynSynBit, South Korea, CIF | 26.29 | 34.02 | 26.87 | 30.67 |
| SynSynBit, Shanghai CIF | 26.21 | 33.88 | 26.73 | 30.63 |
| SynSynBit, Taiwan CIF | 26.21 | 33.93 | 26.88 | 30.55 |
| Spot VLCC Rate, %WS | 136.11 | 162.95 | 100.98 | 104.72 |
| Total Waterborne Transportation Costs | | | | |
| Kitimat to Yokohama | 1.21 | 1.80 | 1.18 | 1.25 |
| Kitimat to South Korea | 1.24 | 1.84 | 1.20 | 1.27 |
| Kitimat to Shanghai | 1.37 | 2.02 | 1.32 | 1.40 |
| Kitimat to Kaoshung | 1.50 | 2.21 | 1.44 | 1.53 |
| Pipeline Costs - Enbridge Tariff | 1.85 | 1.85 | 1.92 | 2.07 |
| Edmonton Netbacks, VLCC/Enbridge | | | | |
| **From Japan** | **23.25** | **30.44** | **23.78** | **27.32** |
| **From South Korea** | **23.20** | **30.34** | **23.75** | **27.33** |
| **From Shanghai** | **22.99** | **30.01** | **23.49** | **27.17** |
| **From Taiwan** | **22.85** | **29.87** | **23.51** | **26.95** |
| From Chicago | 23.18 | 31.83 | 24.26 | 27.88 |
| Edmonton Netbacks, LR1/TMPL | | | | |
| From Japan | 22.89 | 30.13 | 23.68 | 27.24 |
| From South Korea | 22.83 | 30.00 | 23.63 | 27.24 |
| From Shanghai | 22.50 | 29.59 | 23.31 | 27.01 |
| From Taiwan | 22.25 | 29.35 | 23.26 | 26.72 |

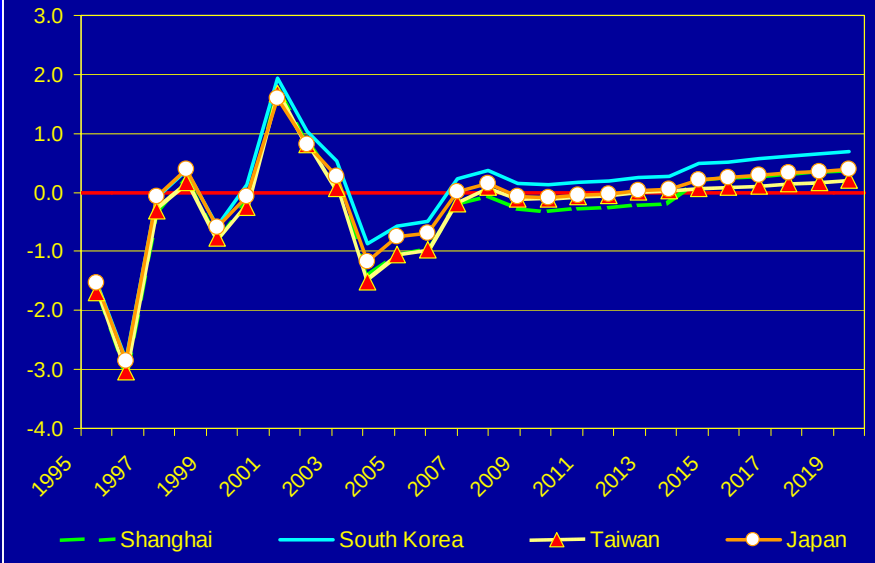
***Asian Cracking Netback (U.S. $/Bbl)***

| | 2000 | 2005 | 2010 | 2015 |
|---|---|---|---|---|
| SynSynBit, Japan CIF | 26.79 | 35.49 | 27.66 | 31.61 |
| SynSynBit, South Korea, CIF | 26.51 | 35.14 | 27.40 | 31.44 |
| SynSynBit, Shanghai CIF | 26.49 | 35.11 | 27.39 | 31.44 |
| SynSynBit, Taiwan CIF | 26.45 | 35.04 | 27.39 | 31.32 |
| Spot VLCC Rate, %WS | 136.11 | 162.95 | 100.98 | 104.72 |
| Total Waterborne Transportation Costs | | | | |
| Kitimat to Yokohama | 1.22 | 1.80 | 1.18 | 1.25 |
| Kitimat to South Korea | 1.24 | 1.84 | 1.20 | 1.27 |
| Kitimat to Shanghai | 1.37 | 2.02 | 1.32 | 1.40 |
| Kitimat to Kaoshung | 1.50 | 2.22 | 1.45 | 1.53 |
| Pipeline Costs - Enbridge Tariff | 1.85 | 1.85 | 1.92 | 2.07 |
| Edmonton Netbacks, VLCC/Enbridge | | | | |
| **From Japan** | **23.72** | **31.83** | **24.56** | **28.29** |
| **From South Korea** | **23.42** | **31.45** | **24.28** | **28.10** |
| **From Shanghai** | **23.27** | **31.24** | **24.15** | **27.97** |
| **From Taiwan** | **23.10** | **30.97** | **24.02** | **27.72** |
| From Chicago | 23.18 | 31.83 | 24.26 | 27.88 |
| Edmonton Netbacks, LR1/TMPL | | | | |
| From Japan | 23.36 | 31.52 | 24.45 | 28.21 |
| From South Korea | 23.05 | 31.11 | 24.17 | 28.00 |
| From Shanghai | 22.78 | 30.81 | 23.96 | 27.81 |
| From Taiwan | 22.49 | 30.46 | 23.77 | 27.48 |

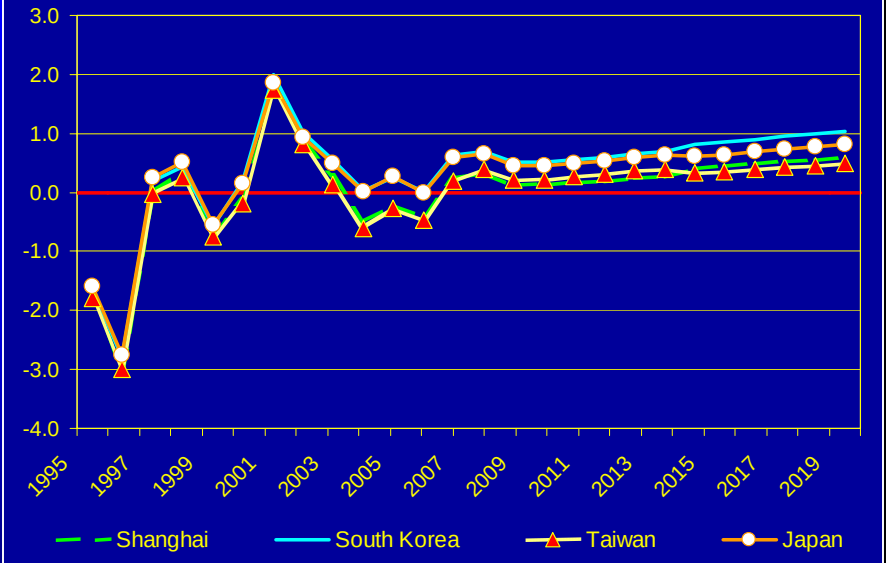
# SynBit Asian Netbacks At Edmonton

- **SynBit valuations are more dependent on fuel oil pricing, which is significantly higher in Asia.**

***Asian Hydroskimming Versus Chicago Netback, (U.S. $/Bbl)***




***Asian Cracking Versus Chicago Netback (U.S. $/Bbl)***






PURVIN & GERTZ INC.

# SynBit Asian Netbacks At Edmonton: Detail

- **Cracking mode valuations are roughly $0.50/Bbl higher.**
- **Demand for SynBit in Asia, however, is expected to be limited.**

***Asian Hydroskimming Netback (U.S. $/Bbl)***

| | 2000 | 2005 | 2010 | 2015 |
|---|---|---|---|---|
| SynBit, Japan CIF | 24.67 | 31.03 | 24.36 | 28.15 |
| SynBit, South Korea, CIF | 24.91 | 31.25 | 24.61 | 28.44 |
| SynBit, Shanghai CIF | 24.73 | 30.96 | 24.30 | 28.30 |
| SynBit, Taiwan CIF | 24.80 | 31.16 | 24.62 | 28.29 |
| Spot VLCC Rate, %WS | 136.11 | 162.95 | 100.98 | 104.72 |
| Total Waterborne Transportation Costs | | | | |
| Kitimat to Yokohama | 1.28 | 1.89 | 1.23 | 1.31 |
| Kitimat to South Korea | 1.30 | 1.93 | 1.26 | 1.33 |
| Kitimat to Shanghai | 1.44 | 2.12 | 1.38 | 1.47 |
| Kitimat to Kaoshung | 1.58 | 2.32 | 1.52 | 1.60 |
| Pipeline Costs - Enbridge Tarif | 1.85 | 1.85 | 1.92 | 2.07 |
| Edmonton Netbacks, VLCC/Enbridge | | | | |
| **From Japan** | **21.54** | **27.29** | **21.21** | **24.77** |
| **From South Korea** | **21.76** | **27.48** | **21.43** | **25.04** |
| **From Shanghai** | **21.44** | **26.99** | **20.99** | **24.77** |
| **From Taiwan** | **21.37** | **26.99** | **21.18** | **24.62** |
| **From Chicago** | **21.62** | **28.04** | **21.30** | **24.55** |
| Edmonton Netbacks, LR1/TMPL | | | | |
| From Japan | 21.12 | 26.93 | 21.07 | 24.66 |
| From South Korea | 21.32 | 27.09 | 21.28 | 24.91 |
| From Shanghai | 20.88 | 26.51 | 20.77 | 24.56 |
| From Taiwan | 20.68 | 26.41 | 20.89 | 24.34 |

***Asian Cracking Netback (U.S. $/Bbl)***

| | 2000 | 2005 | 2010 | 2015 |
|---|---|---|---|---|
| SynBit, Japan CIF | 24.90 | 32.06 | 24.91 | 28.54 |
| SynBit, South Korea, CIF | 24.96 | 32.08 | 24.98 | 28.77 |
| SynBit, Shanghai CIF | 24.78 | 31.82 | 24.72 | 28.51 |
| SynBit, Taiwan CIF | 24.85 | 31.96 | 24.95 | 28.56 |
| Spot VLCC Rate, %WS | 136.11 | 162.95 | 100.98 | 104.72 |
| Total Waterborne Transportation Costs | | | | |
| Kitimat to Yokohama | 1.28 | 1.89 | 1.23 | 1.31 |
| Kitimat to South Korea | 1.30 | 1.93 | 1.26 | 1.33 |
| Kitimat to Shanghai | 1.43 | 2.14 | 1.38 | 1.47 |
| Kitimat to Kaoshung | 1.58 | 2.33 | 1.52 | 1.61 |
| Pipeline Costs - Enbridge Tariff | 1.85 | 1.85 | 1.92 | 2.07 |
| Edmonton Netbacks, VLCC/Enbridge | | | | |
| **From Japan** | **21.77** | **28.32** | **21.75** | **25.16** |
| **From South Korea** | **21.81** | **28.30** | **21.80** | **25.37** |
| **From Shanghai** | **21.50** | **27.82** | **21.42** | **24.97** |
| **From Taiwan** | **21.42** | **27.78** | **21.51** | **24.88** |
| From Chicago | 21.62 | 28.04 | 21.30 | 24.55 |
| Edmonton Netbacks, LR1/TMPL | | | | |
| From Japan | 21.35 | 27.95 | 21.61 | 25.04 |
| From South Korea | 21.37 | 27.91 | 21.65 | 25.23 |
| From Shanghai | 20.94 | 27.34 | 21.20 | 24.77 |
| From Taiwan | 20.73 | 27.20 | 21.22 | 24.60 |

# NETBACK VALUES OF OIL SANDS CRUDES DELIVERED TO JAPAN - 2010

**(U.S. Dollars Per Barrel)**

| | Bonny Light | Dubai | Arab Ext Lt | Arab Heavy | Sweet SCO | SynSynBit | SynBit |
|---|---|---|---|---|---|---|---|
| API | 34.6 | 30.6 | 36.6 | 27.3 | 34.8 | 24.2 | 19.9 |
| Sulfur Content (Wt. %) | 0.2 | 2.0 | 1.35 | 3.06 | 0.1 | 1.8 | 2.5 |
| Product Yields (Vol %)**(1)** | | | | | | | |
| LPG | 1.7 | 2.1 | 1.4 | 2.4 | 2.5 | 1.6 | 1.2 |
| Naphtha | 19.8 | 17.9 | 20.6 | 14.9 | 11.8 | 7.8 | 6.0 |
| Jet/Kerosene | 8.5 | 16.6 | 22.9 | 13.3 | 18.0 | 12.4 | 10.0 |
| Diesel | 38.5 | 20.5 | 21.9 | 17.5 | 33.8 | 26.6 | 23.4 |
| Fuel Oil | 31.1 | 42.4 | 32.9 | 51.2 | 33.4 | 51.2 | 59.0 |
| Price/Value in Japan **(2)** | 32.99 | 29.39 | 32.84 | 26.49 | 32.99 | 26.88 | 24.36 |
| Tanker Freight, Kitimat to Japan (VLCC) | | | | | 1.15 | 1.18 | 1.23 |
| Pipeline Tariff, Edmonton to Kitimat | | | | | 1.92 | 1.92 | 1.92 |
| **Netback Price in Edmonton** | | | | | **29.92** | **23.78** | **21.21** |

NOTE: (1) Hydroskimming yields based on Purvin & Gertz' refining model.
(2) Based on Purvin & Gertz' January 2005 product price forecast, and crude prices for Bonny Light, Dubai, Arab Extra Light, and Arab Heavy into Japan.

# Potential for Discounts in Traditional U.S. Markets

- **Canadian oil sands crudes (SCO, SynBit, and SynSynBit) will face further market hurdles in traditional U.S. markets as supplies increase.**
  - SynBit and other bitumen blends are already experiencing significant discounts.
  - SynSynBit is a new crude, and it may face discounts from the forecast used in order to get established in the market.
  - SCO is expected to face more market resistance as supplies increase.
  - New markets will be further away, and will provide lower netbacks.
- **New investments in U.S. refineries could help them process more oil sands crudes. Likely, discounts will be required to support such investments.**
- **Expected pricing of SynBit shows that prevailing discounts should allow SynBit to achieve a higher value in Asian markets.**
- **If discounts on SCO and SynSynBit begin to occur in a significant way, then Asian markets may be preferred for all oil sands crudes.**
- **Diversification of markets into Asia is recommended so that oil sands crudes do not become discounted further.**

# Potential for Refined Product Imports into Asia

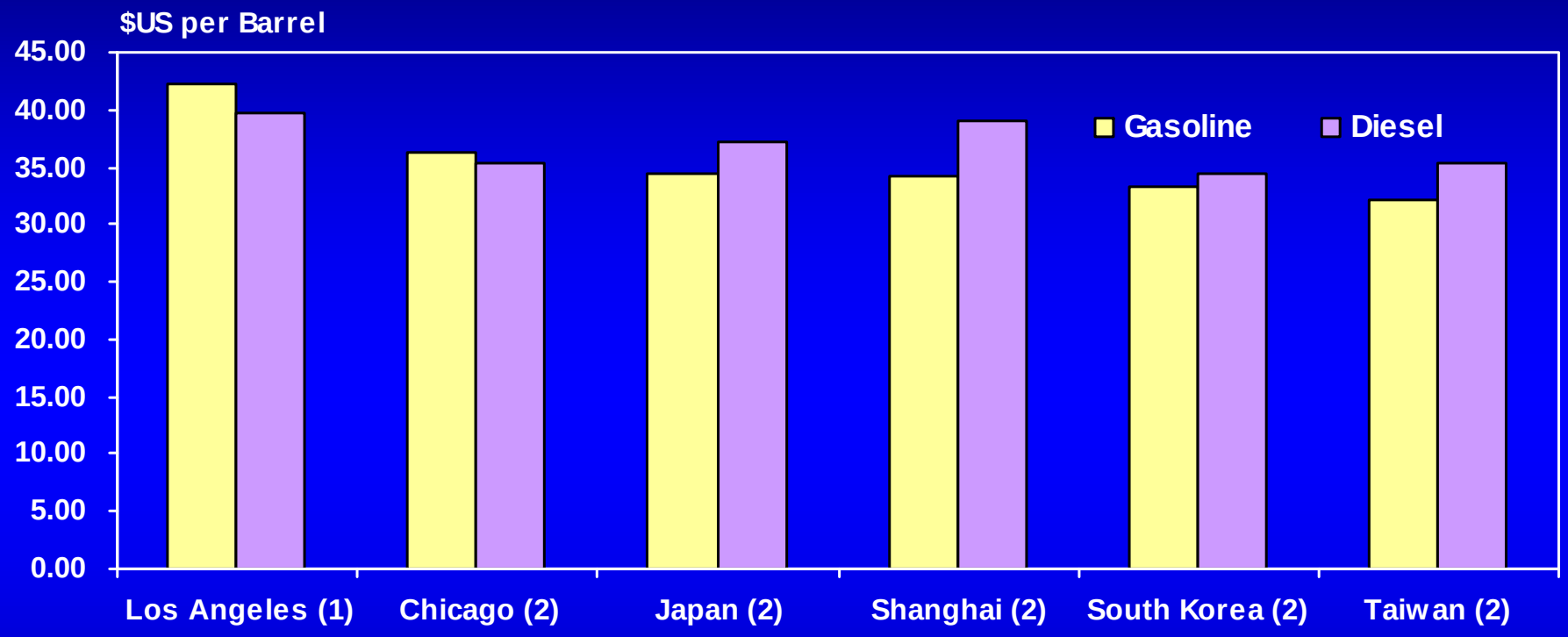
- These Asian countries produce most of their domestic requirements for refined products. They use small volumes of imports, and sometimes exports, for balancing purposes. Distillate imports will be higher than gasoline.
- China is not expected to be a major importer of products, but this assumes that it constructs the equivalent of six 200,000 B/D refineries by 2015.
- China expected to increase its distillate imports by over 300,000 B/D by 2015.
- Japan is expected to increase imports of gasoline.
- If China is not able to build all the refining capacity that it needs, product imports could be much higher.

# Export of Refined Products from Alberta

- We examined the potential of producing refined products in Alberta in a new bitumen based refinery and delivering petroleum products (gasoline and diesel fuel) to Chicago and Los Angeles (1). The resulting netback prices were updated consistent with Purvin & Gertz' January 2005 pricing outlook.
- Imported product prices in Japan, China, Taiwan and South Korea were netted back to Alberta based on utilizing LR-1 tankers.
- Gasoline and diesel qualities were assumed to be the same for Chicago and Asia, all low sulfur. California products are of higher quality to meet CARB specifications.

(1) Purvin & Gertz, "Phase II - Refined Products and Petrochemicals from Bitumen", December 17, 2004, prepared for the Government of Alberta and an Industry Group.

# Petroleum Product Prices Netback to Edmonton - 2010




1) CARB Specifications. Gasoline is CARBOB (prepared for ethanol blending).
2) Low Sulfur Specifications

- This analysis assumes refined products are produced in Alberta and exported.
- Diesel prices from Japan, China, and Taiwan are higher than netbacks from Chicago.
- Gasoline prices from Asia slightly lower than U.S. netbacks.

# Export of Refined Products from Alberta

- If bitumen is upgraded all the way to gasoline or diesel fuel, netbacks from Asia to Alberta would provide higher returns than if upgraded to SCO[(1)].
- The resulting netback prices from Asia were compared to exporting products to Chicago and Los Angeles [(1)].
- Diesel fuel netbacks are higher from Asia than from U.S. Midwest.
- Diesel demand growth in Asia will continue to outpace gasoline. Further, diesel production from the oil sands is easier to produce than gasoline.
- Asia market could grow to accept refined products from Alberta, but there may be merit in sharing output with California market in order to achieve an orderly market development.

(1) Purvin & Gertz, "Phase II - Refined Products and Petrochemicals from Bitumen", December 17, 2004, prepared for the Government of Alberta and an Industry Group.

# Canadian Oil Sands – Potential to Supply Asia

- The Canadian oil sands could become a significant supplier of crudes to the Asian market. They would likely be sweet SCO and bitumen blends.
- SCO/bitumen blends could be suitable substitutes for Middle East sour crude supplies. The Asian countries studied are seeking to reduce their dependence on Middle East crude.
- SCO may have the highest value to cracking refineries in Japan.
- Bitumen blends high TAN values may limit the amount of bitumen blend that Asia refineries can process.
- High sulfur content of residual fuel may limit the market acceptability of bitumen blends.
- Refined products produced from an export refinery based on oil sands could find outlets in Asia ; distillate to China, gasoline to Japan.
- Potential to serve Asian markets is subject to achieving a satisfactory price for these products relative to traditional North American markets.

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