

Asia-Pacific Refined Products: Quality Challenges in the Global Demand Leader



By

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Basic Assumptions

- Continued, though slowing growth across Asia Pacific
- Push for better-quality products focusing on gasoline, ADO/gas oil
- Assumption of \$60/BBL through 2008; Slippage to \$55-60/BBL to 2010
- Accelerating gas development, supply
- Increasing crude imports
- GTL, bio-fuels, syncrude only post-2010

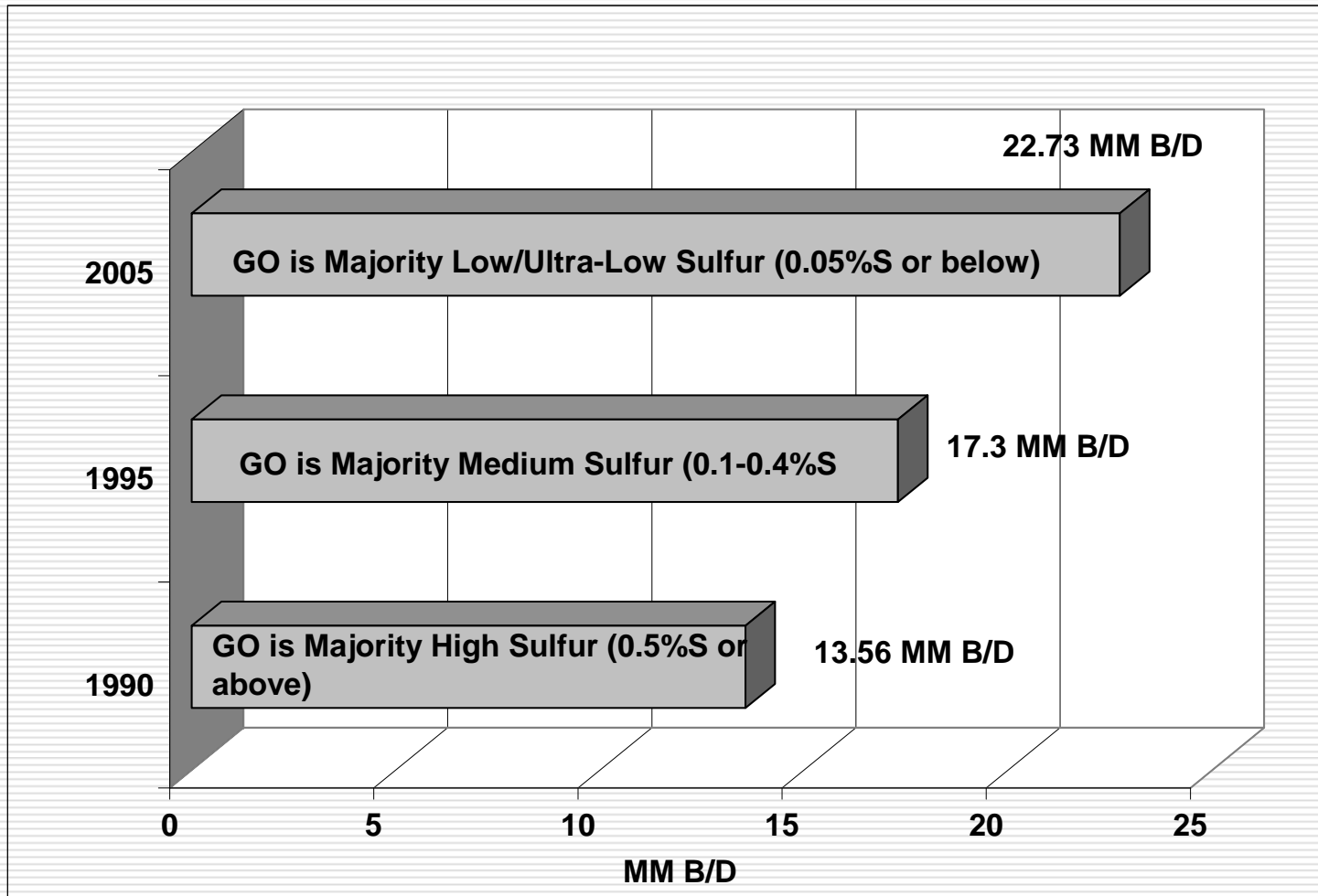
Asia-Pacific Demand Big & Getting Bigger ...

- Total demand will overtake North America by 2009
- Already biggest user gas oil; Will overtake EU in ADO by 2010
- Biggest user of paraffinic naphtha
- Fastest growing demand for jet/kerosine for aviation

... But Products also Must Get Better

- Sulfur drawdown mainly ADO, gasoline
- ADO focus sulfur, cetane and coming PAH cap
- Mogas focus octane, sulfur, aromatics/ benzene and coming strict olefins cap

Asia-Pacific Products Demand Rises as Gas Oil Sulfur Caps Tighten



Quality's Changing Mideast Relations

- Asia Pacific traditionally dependent on Mideast Gulf product imports
- Mideast Gulf must upgrade products to retain Asia-Pacific markets
- Quality forces Indian export drive to Mideast Gulf and distant markets

Quality Gap Changing

- Asia Pacific closing gap with Eurospec
- Top Asia-Pacific specs often ahead of US standards
- Gap between OECD Asia Pacific and Developing Asia narrowing

ADO Comparison – 2005/2010

	Eurospec	Japan	USA (EPA Only)
2005			
Sulfur (max %wt.)	0.005	0.005	0.05
Cetane Index/Number	--/51	--/50	40/--
Aromatics PAH Only/Total Aromatics (%wt.)	11/--	11/--	--/35
2010			
Sulfur (max %wt.)	0.001	0.001	0.0015
Cetane Index/Number	--/51	--/52	40/--
Aromatics PAH Only/Total Aromatics (%wt.)	11*	4	35

Note: *European Commission has suggested lowering PAH to 9% by 2009, but this is still under discussion.

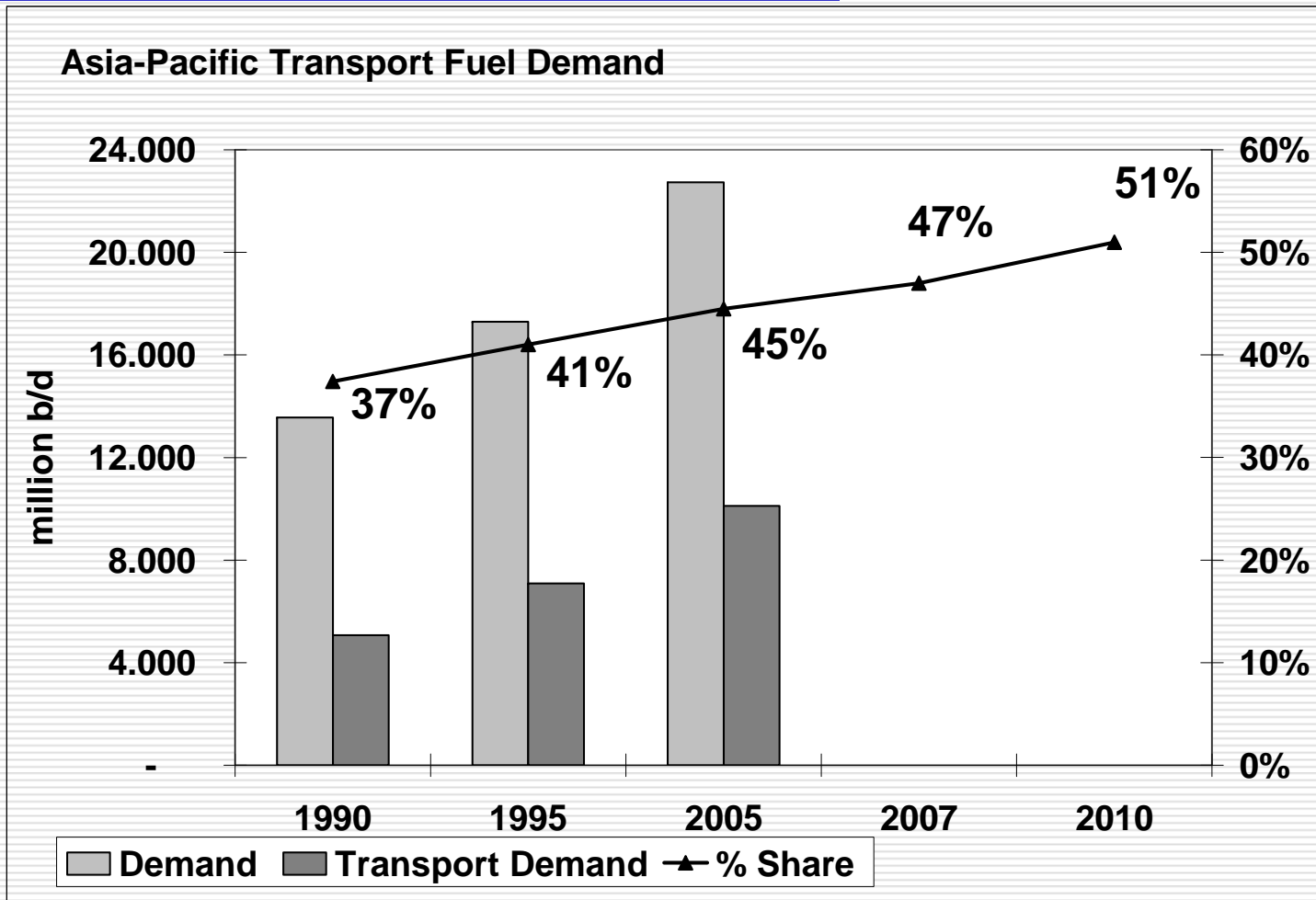
Asia Pacific Quality Pressures are Different

- Structural import dependence LPG, naphtha & fuel oil
- ADO, not gasoline region
- Petrochemicals based on naphtha
- Significant non-transport kerosine
- Large fuel oil use; Biggest bunker market

Asia-Pacific Quality Trends are Global

- Though non-transport use high; Yet transport to top 50%
- Natural gas under-used; Yet structural acceleration of development
- Dual-purpose fuels main growth transport, product quality

Overall Demand Keeps on Growing, but Transport Fuels Become Majority Only by 2010



Five Trends Shaping Asia-Pacific Products

- High crude prices are products driven
- Transport fuels increasingly growth focus
- Refinery investment on quality over quantity
- Quality will dictate prices within single product
- Blending will accelerate; Singapore's salvation

Incremental Singapore Tank Storage (In MM BBLs)

Operator	Capacity	Start-Up	Comments
Horizon/ENOC	0.69	3Q-2007	Terminal started operations at end-2006 with 5.28 MM BBLs in storage capacity; Dirty and clean blending.
Helios/Chemoil	2.83	4Q-2007	For petrochemicals and clean oil products
Universal Terminal	14.47	4Q-2007	Both dirty and clean and will have extensive fuel oil blending and some crude break bulk.
Tankstore/Kuo	1.51	4Q-2007	Expansion of existing terminal, mostly clean.
Vopak	1.36	1Q-2008	Expansion of existing terminal, mostly clean.
Horizon/ENOC	1.57	3Q-2008	Third stage of recently commissioned tank farm.
Total	22.43		

Focus by Product: LPG

- Specifications
 - International specification
 - Asia Pacific uses mainly Saudi spec
 - Differences with US spec minor

- Quality – Current & Future
 - No change expected
 - No difference between refinery and field

➤ Sectoral Use

- Mainly residential/commercial
- Minor petrochemical, mainly Japan
- Minor, though growing transport
- Transport can expand on incentives (Australia)

➤ Future Trends

- Appearance of piped gas reduces demand
- High infrastructure costs encourage local consumption
- Asia-Pacific imports remain structural
- Takes money to make money in LPG

Focus by Product: Gasoline

- Specifications
 - Octane, sulfur, aromatics/benzene, FBP, oxygenates
 - Strict olefins cap beginning
 - MTBE allowed
 - RVP, FBP important in some markets
- Quality Changes
 - Increased octane
 - Decreased sulfur, aromatics/benzene, lower FBP
 - No MTBE ban this decade
 - Minimal ethanol; ETBE in Japan

➤ Sectoral Use

- All transport
- Overwhelmingly road fuel; Small volume aviation

➤ Future Trends

- Growth slows in high oil price environment
- Overcoming prejudice *Rich Man's Fuel*
- Will ADO retain tax/tariff advantage?
- Potential for flip-flop, *dieselization* in Japan

Focus by Product: Naphtha

➤ Specifications

- All naphtha contains N+A and paraffins
- PNA dictates sector use
- Sulfur main spec for all utilizations

➤ Quality Changes

- Reduced sulfur
- Introduction GTL-derived paraffinic naphtha
- N+A content minimum for reforming

➤ Sectoral Use

- Paraffinic-oriented naphtha to olefins
- N+A-oriented naphtha to reformer
- Reformer: Gasoline/components or BTX/petrochemicals

➤ Future Trends

- Asian petrochemicals naphtha-based
- Sharp rise in base petrochemicals, Asia Pacific and Mideast Gulf
- Need for feedstock flexibility
- Growing competition for reformer output
- No ethane impact until 2015 or beyond

Focus by Product: Kerosine (Jet)

➤ Specifications

- Non-transport IK, SKO, DPK specs - smoke and color
- Jet used for aviation - international common standard
- Key aviation fuel spec - freeze point
- Key Japanese heating spec (DPK or Jet) – smoke and color

➤ Quality Changes

- Gradual decrease in smoke (smoke point higher)
- Color will follow
- Jet/Aviation fuel will allow GTL use

➤ Sectoral Use

- Lighting, cooking (IK, SKO, DPK)
- Home heating (mainly Japan, Jet and DPK)
- Petrochemicals (solvents)

➤ Future Trends

- Illumination/cooking use (IK, SKO, DPK) falling
- Aviation demand growing at near double-digit rates
- Key drivers include rural electrification, cutting subsidies

Focus by Product: Gas Oil (ADO)

➤ Specifications

- Sulfur, cetane value (number/index) and PAH - top specs
- T90, pour point, density and viscosity - secondary specs
- ADO/road diesel generally better than general gas oil
- All ADO is gas oil; Not all gas oil is ADO
- Calling a fuel ADO does not make it a transport fuel

➤ Quality Changes

- Drive sulfur to nil; Increase cetane; Cap/draw down PAH
- More gradually reduce T90, density
- Spec-tightening more on ADO

➤ Sectoral Use

- Transport (ADO)
- General (industrial, power generation)
- Marine (bunker)

➤ Future Trends

- Sharp rise in ADO quality
- More gradual for general gas oil
- Blending volumes rise
- ADO demand overtakes general gas oil use
- Natural gas backs out general gas oil

Focus by Product: Fuel Oil

- Specifications
 - Mainly sulfur, viscosity
 - Metals content also important
 - Specs change by sectoral use
- Quality Changes
 - Drive down sulfur
 - Blend between LSWR and HSFO
 - Bunker may see big changes

➤ Sectoral Use

- Power generation
- Industrial
- Ships fuel

➤ Future Trends

- Gas substitution
- Improved bunker (mainly sulfur, metals)
- Elimination of direct-burn crude
- Increased blending

Asia-Pacific Product Focus through 2010

Product	Growth	Quality
LPG	Petrochemicals; Less so transport	Standard Saudi spec
Gasoline	All transport; Moderating	Focus octane, aromatics/benzene, olefins, sulfur; Phase out last leaded
Kerosine/Non-Jet	Little; Most in jet/aviation	Higher smoke/color point
Gas Oil/ADO	Mainly transport, industrial, power declining	Drive sulfur to nil; Increased cetane; Cap and then draw down PAH

Note: LPG, jet for aviation fuel and gas oil/HSFO bunkers have common international standard.

Mideast Gulf Can Offer Limited Help until 2011-2012

Mideast Gulf Monthly Gas Oil Exports, by Sulfur* - 2005

Suppliers/Loadports	Monthly Export Volume (In '000 Barrels)					
	1.0%S	0.5%S	0.25%S	0.20%S	0.05%S	0.005%S
ADNOC/Ruwais	-	1,350-2,250	on request	on request	-	-
BAPCO/Bahrain	442-662	1,472-4,048	on request	-	-	-
NIOC/B.M.S. + B.A. (Iran)	226-376	453-680	-	-	-	-
KPC/Abdullah, Ahmadi, Shuaiba	-	5,250-6,750	-	1,252	-	-
Qatar Pet./Mesaieed	-	-	-	-	195-389	-
Saudi Aramco/Jubail	-	1,200	on request	-	-	-
Saudi Aramco/Rabigh	-	limited	-	-	-	-
Saudi Aramco/Ras Tanura (Splitter)	-	1,508	term contracts 2004	on request	on request	on request
Saudi Aramco/Yanbu	-	1,125-1,313	on request	-	-	-
ExxonMobil/Yanbu	-	1,106-1,290	on request	on request	-	-
Shell/Jubail	-	1,050-1,200	on request	On request	on request	on request
Oman/Mina Al Fahal	-	-	-	-	-	219

Note: * Mideast Gulf gas oil varies from 7.36 to 7.63 barrels/ton.

Characteristics of Asia-Pacific Refining

- Simple compared to West
- Quality units only now emphasized
- Reforming ratio low
- Vast range of refining, country size, sophistication
- Few true export refiners

Asia-Pacific Refining Capacity – by January 2005

	CDU	CCR	Severe Secondary	of which: HDC	Dist. HDT	of which: HDS	Resid HDS
South Asia	2,905	231	885	257	756	91	-
India	2,489	176	854	238	707	91	-
Pakistan	337	46	31	19	46	-	-
Bangladesh	31	3	-	-	2	-	-
Sri Lanka	48	6	-	-	1	-	-
SE ASIA	5,598	686	952	335	1,482	290	338
Brunei	12	5	-	-	-	-	-
Indonesia	1,112	99	250	111	134	23	49
Malaysia	534	99	89	29	80	-	-
Myanmar	57	-	5	-	-	-	-
Philippines	293	37	36	-	103	20	-
Singapore	1,343	131	151	80	343	44	-
Taiwan	1,206	142	227	20	492	203	289
Thailand	1,024	173	194	95	330	-	-
Vietnam	17	-	-	-	-	-	-
NE ASIA	13,624	1,360	4,129	667	4,440	870	977
Japan	4,113	709	1,081	170	3,009	832	610
China	6,164	347	2,659	371	737	-	121
South Korea	2,640	229	338	126	648	38	246
North Korea	70	7	-	-	-	-	-
Mongolia	20	3	-	-	-	-	-
Russian Far East	617	65	51	-	46	-	-
AUSTRALASIA	913	209	280	45	328	157	17
Australia	751	179	252	17	307	150	17
New Zealand	128	27	28	28	21	7	-
PNG	33.5	3	-	-	-	-	-
TOTAL	23,039	2,486	6,246	1,304	7,006	1,408	1,332

Asia Pacific: A Refinery Capacity Shortage?

- Not in aggregate
- Very much by subregion
- Large percentage of refining without international impact
- Increasing quality rather than quantity squeeze

Refining Pressure Points for Asia Pacific

- Too much R/FCC; Too little HDC
- Inadequate HDT, HDS, gasoline units, CCR
- Increasing competition between refining/ petrochemicals
- Increased gas substitution; Increased NGL impact
- Light-ends squeeze, naphtha vs. gasoline
- Meeting ADO growth, higher ADO quality

Future Refining Capacity

Asia-Pacific Refining Capacity - By January 2010 (In MBD)							
	CDU	CCR	Severe Secondary	of which: HDC	Dist. HDT	of which: HDS	Resid HDS
South Asia	4,543	475	1,743	524	1,322	373	-
India	4,009	383	1,655	478	1,212	373	-
Pakistan	455	73	88	46	88	-	-
Bangladesh	31	13	-	-	11	-	-
Sri Lanka	48	6	-	-	11	-	-
SE ASIA	6,803	909	1,385	452	1,965	491	387
Brunei	12	5	-	-	-	-	-
Indonesia	1,525	198	396	111	293	48	98
Malaysia	534	99	89	29	80	-	-
Myanmar	57	-	5	-	-	-	-
Philippines	320	53	56	-	123	20	-
Singapore	1,427	131	186	115	363	64	-
Taiwan	1,386	180	314	50	622	271	289
Thailand	1,385	231	271	147	455	88	-
Vietnam	157	12	68	-	29	-	-
NE ASIA	18,482	1,982	6,310	1,533	5,982	1,001	1,307
Japan	4,682	1,030	1,272	165	3,244	943	560
China	10,399	597	4,315	1,134	1,926	-	305
South Korea	2,812	290	662	224	740	58	442
North Korea	70	7	-	-	-	-	-
Mongolia	30	3	-	-	-	-	-
Russian Far East	489	55	61	10	72	-	-
AUSTRALASIA	969	193	282	49	373	198	11
Australia	779	163	249	16	325	164	11
New Zealand	153	26	33	33	48	34	-
PNG	37	4	-	-	-	-	-
TOTAL	30,797	3,559	9,720	2,558	9,642	2,063	1,705

Some Thoughts on Future Capacity – by Country

- China largest gains, but domestic-oriented
- India next largest, but export-oriented
- India focused more on quality, China on quantity
- Strong margins have halted refinery closures
- Smaller gains in Taiwan, Thailand, South Korea, Pakistan, Vietnam, Indonesia

Some Thoughts on Future Capacity by Units & Quality

- Need to meet *Triple Witching Hour* for ADO – HDC, HDT, HDS
- Light-ends squeeze; Eased by condensate splitters?
- HDS capacity still concentrated in Japan
- Refineries running short of hydrogen
- Uncertainty as to how long margins will last

The Future of Singapore

- Storage capacity additions, not refining (i.e. Kuo, Concord)
- More blending over incremental refining
- Increased horizontal integration with petrochemicals
- Potential of LNG trading limited
- IMO can devastate bunker trade
- Who can rival for foreseeable future
- Operational efficiency unparalleled

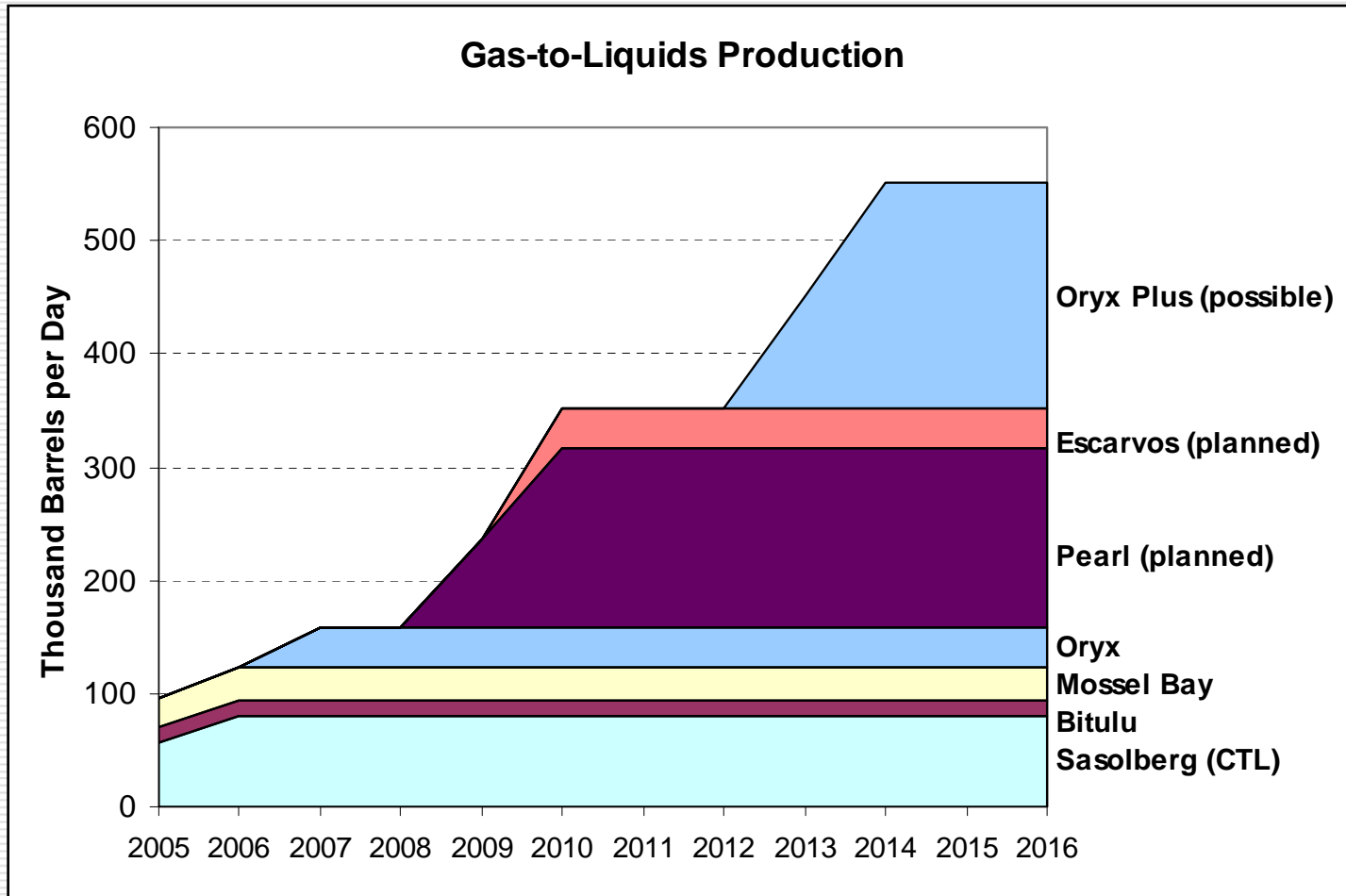
Condensate & Condensate Splitters

- Structural shift to gas also produces NGLs
- Condensate will have greatest impact
- Condensate always at least half naphtha
- Can ease light-ends squeeze
- Has impact on gas oil/ADO as well

GTL and Syncrudes

- GTL commercial promise only post-2010
- Ballooning EPC costs cause postponement
- Large-scale GTL depends on large-volume, cheap gas
- Likely only in Mideast Gulf, West Africa, in future CIS

GTL Projects



Bio-Fuels

- Limited impact
- Ethanol a component; Bio-diesel a force multiplier
- Bio-diesel's value in upgrading general gas oil
- Bio-waste use?

Conclusions - 1

- Asia Pacific will remain epicenter of demand growth
- Transport fuels focus on continued expansion
- Asia-Pacific demand, sectoral use differs
- Quality progressive, cumulative and irreversible
- Quality, not quantity, increasingly will dominate
- Asia-Pacific quality catching up
- Demand winners: Gasoline, ADO, Naphtha, Jet, Bunker
- Demand Losers: Non-transport Kerosine & Gas Oil, stationary Fuel Oil

Conclusions - 2

- China will lead, but slower growth
- India becomes major exporter
- Japan will export, or shrink refining sector
- South Korean hopes on China
- Singapore's future will focus on blending, quality niches
- Asia-Pacific refining will become both bigger & better
- Gas impact on oil products can only grow
- Sustained but more modest growth post-2010