

LNG Shipping

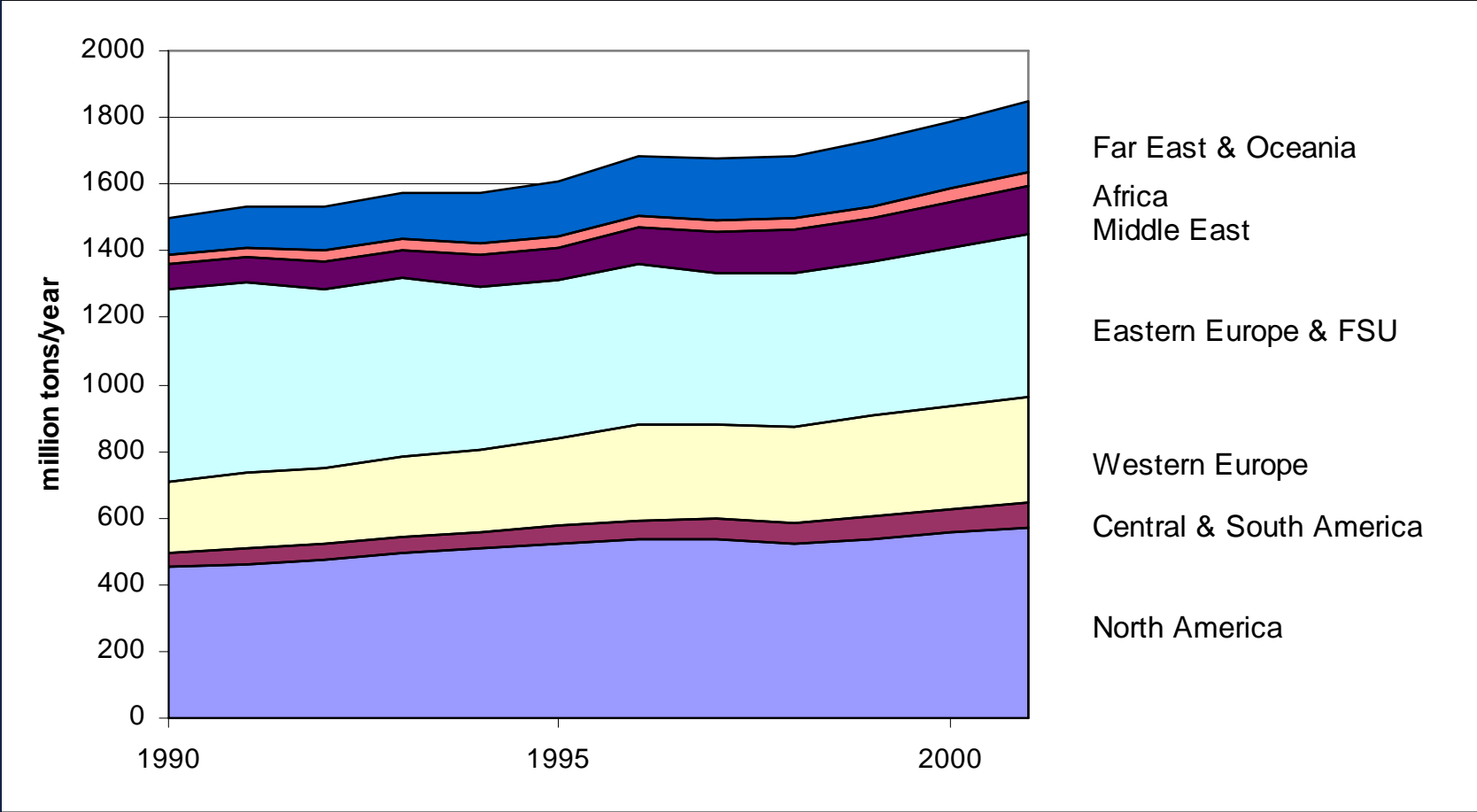
October 2006

Hauke L. Kite-Powell

Outline

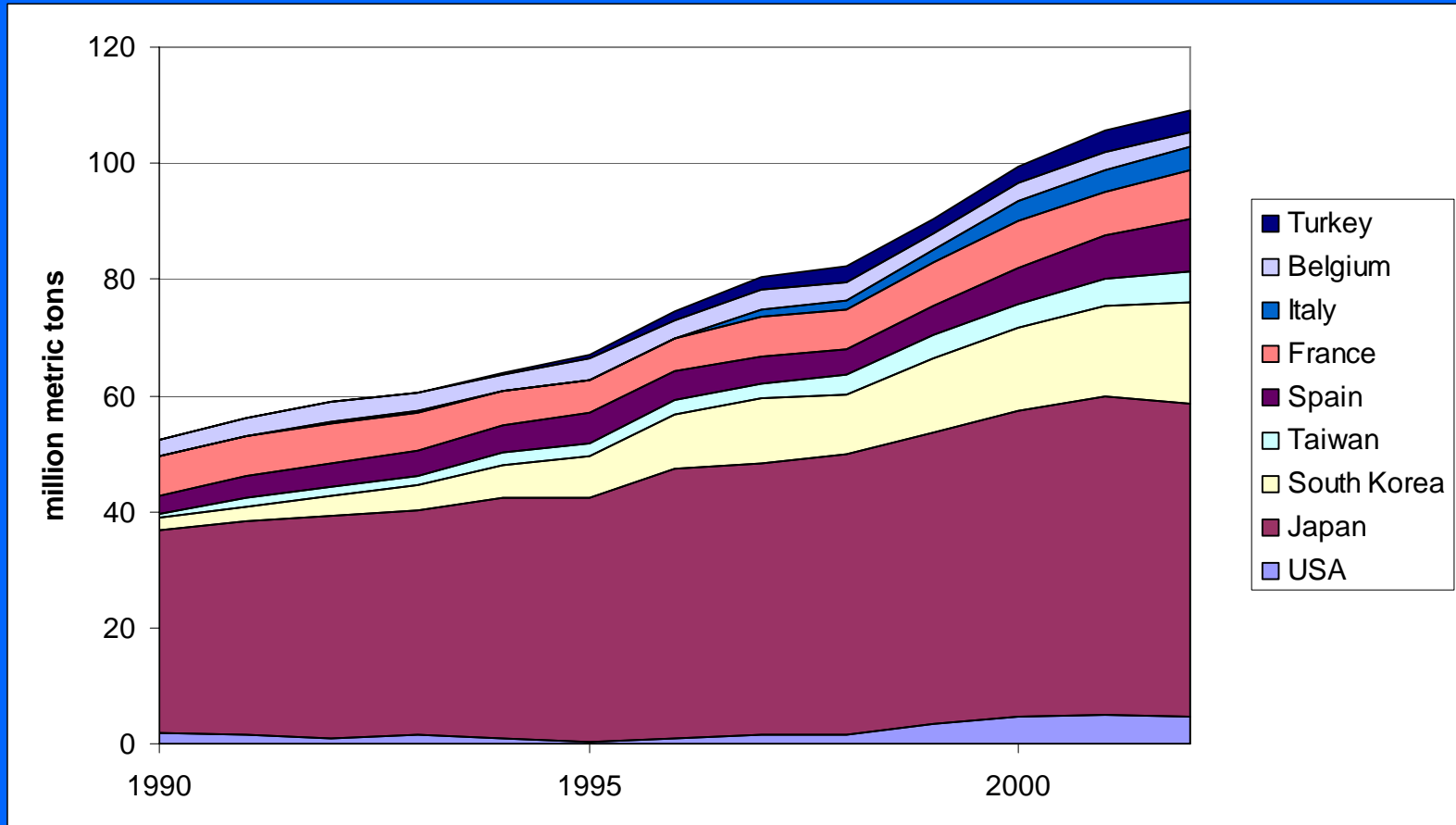
- **LNG shipping in context**
- shipping demand and supply
 - trade projections
 - fleet development
 - implications for fleet utilization
- trends and risks
 - charter terms
 - short term (“spot”) trades
 - structural changes

Natural Gas Consumption

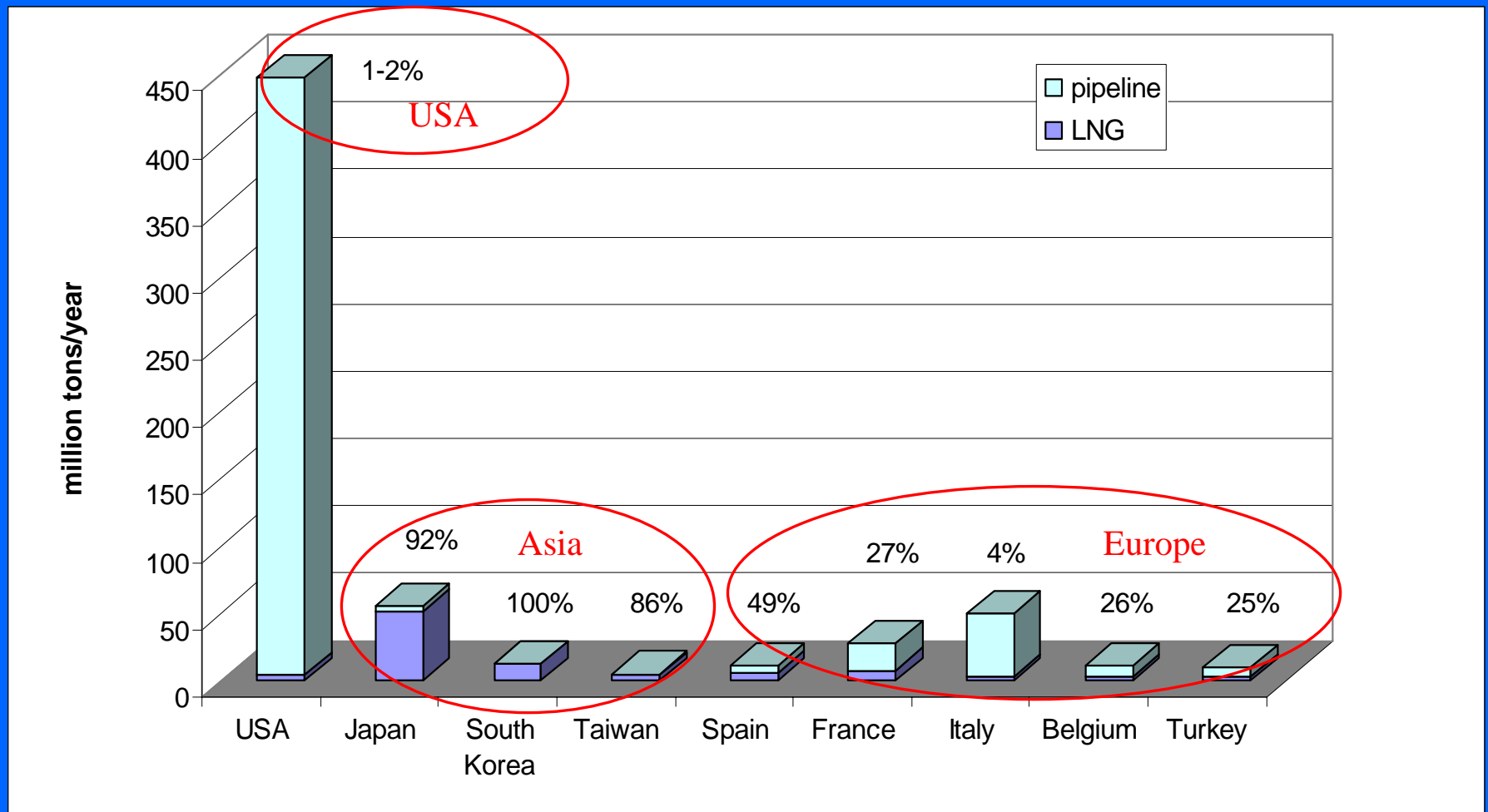


LNG Consumption

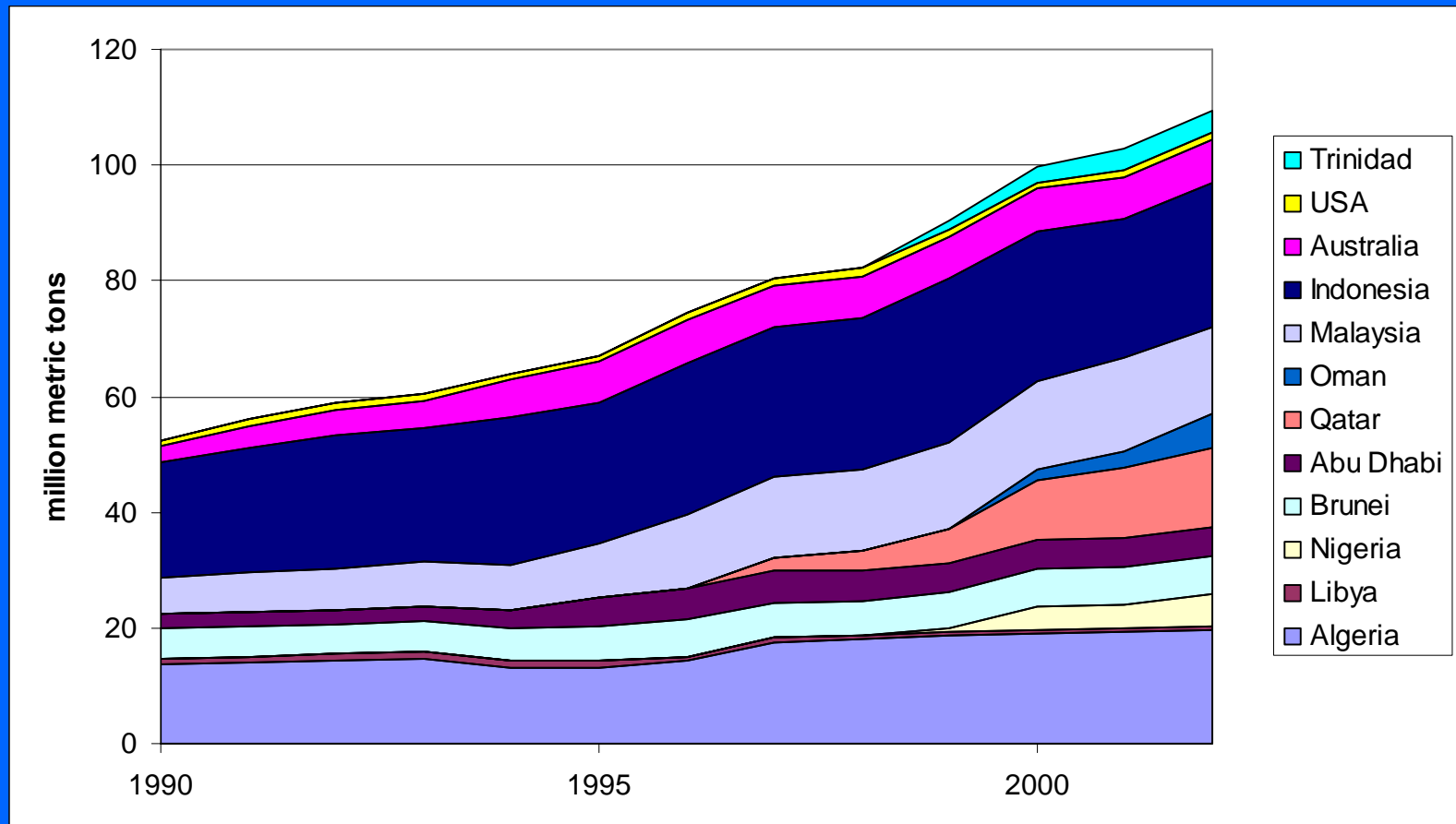
about 6% of world natural gas consumption



LNG Fraction of Natural Gas Consumption



LNG Supply



LNG Shipping Demand: Established Trade Routes

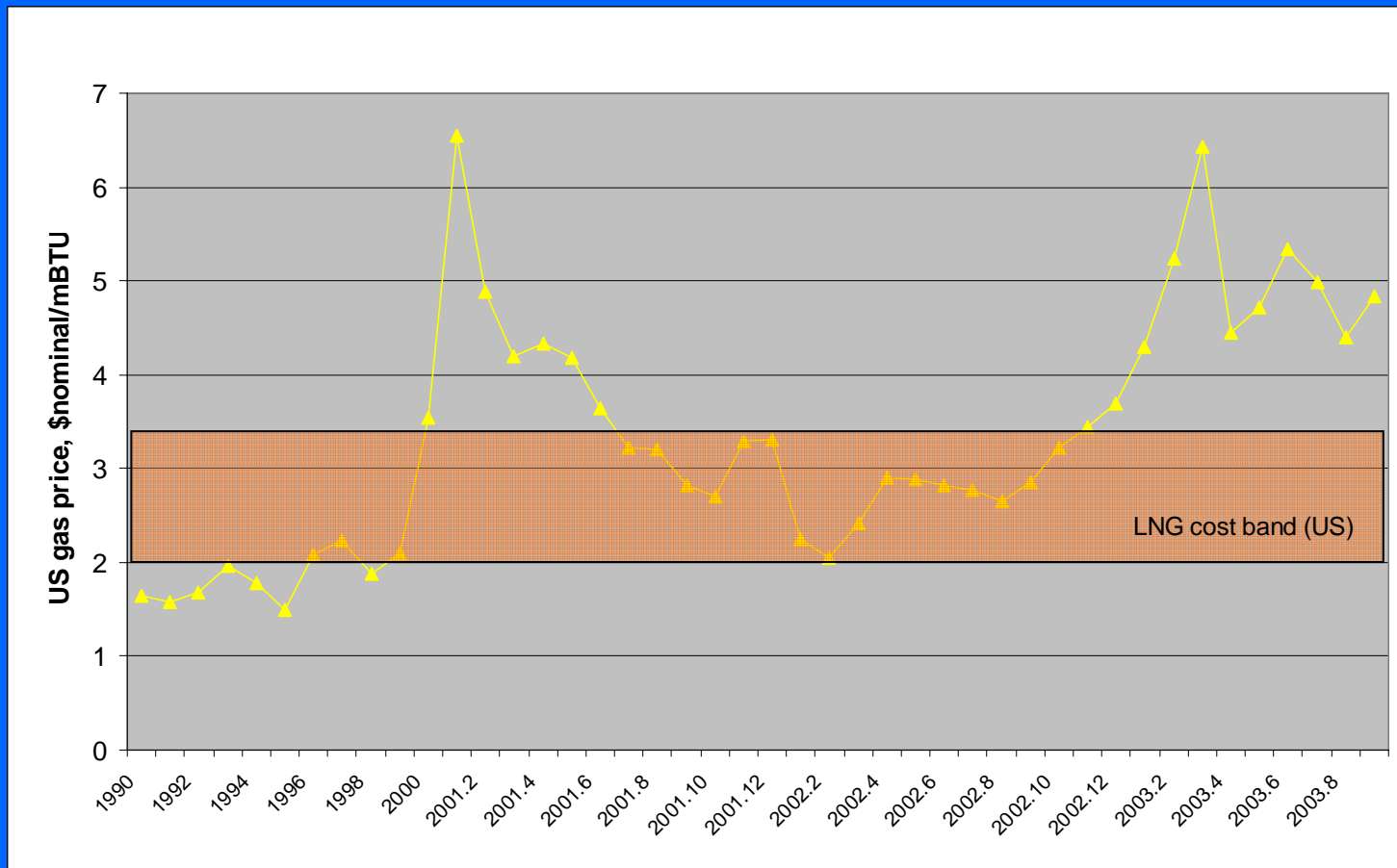
- Pacific basin:
 - Arabian Gulf → Japan, Korea, Taiwan (40%)
 - Malaysia → Japan, Korea, Taiwan
 - Indonesia → Japan, Korea, Taiwan (20%)
 - Australia → Japan (10%)
 - US (Alaska) → Japan
- Atlantic basin:
 - Algeria → Europe, US
 - Nigeria → Italy, Spain, France, Turkey (15%)
 - Libya → Spain
 - Trinidad → Spain, US

Map removed due to copyright restrictions.

The LNG Supply Chain

	typical capital cost (\$ billion)	contribution to cost of delivered LNG (\$/million BTU)
gas production	1 - 2	0.5 – 1.0
liquefaction plant	2 - 3	1.7 – 2.4
LNG shipping	1 - 2	0.5 – 1.6
receiving & regasification terminal	0.4 - 1	0.5 – 1.0
total	4 - 8	3.2 – 6.0

US Gas Price and LNG Cost



Outline

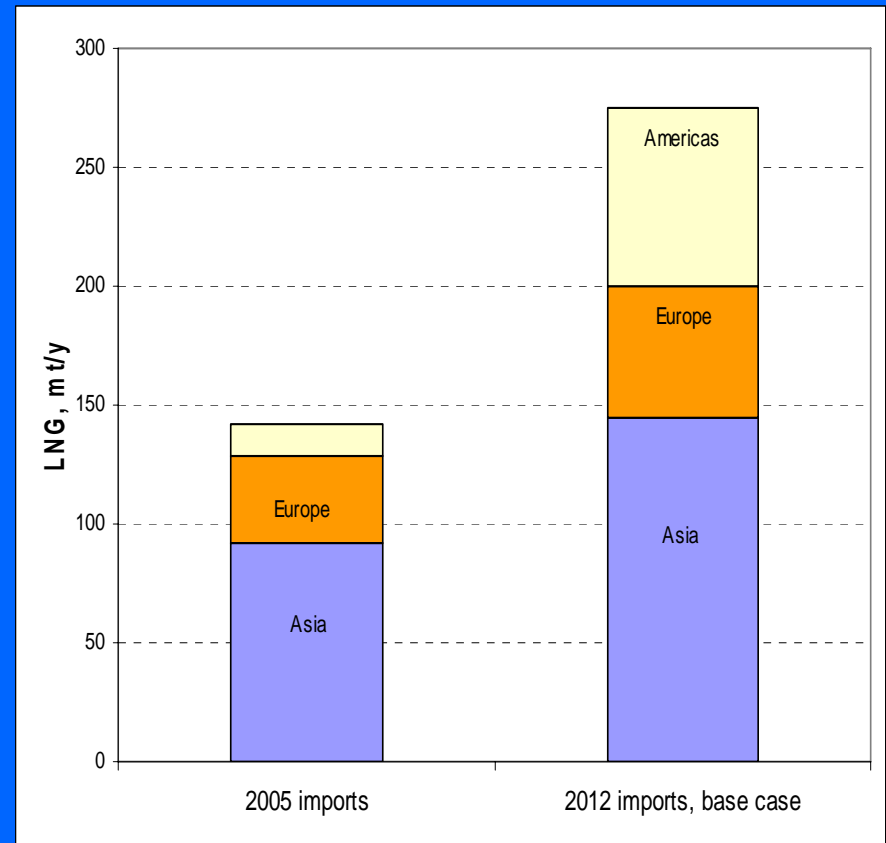
- LNG shipping in context
- **shipping demand and supply**
 - **trade projections**
 - demand for LNG & import facilities
 - LNG supply (liquefaction trains)
 - fleet development
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LNG Demand Growth, 2010

- Asia: 7% annual growth
 - India and China – new importers; **projections revised upward**
 - Taiwan and South Korea
 - Japan – stated goal of increasing gas fraction
 - seasonal demand peaks
- United States: 30% annual growth?
 - gas consumption: 450 mt/year; LNG 6 mt (2003)
 - import capacity: 20 mt/year (all four facilities open)
 - existing terminals plan to expand to 30 mt/year
 - proposals for 50 mt/y – only a few of these are likely to be built
 - **Gulf Coast, Mexico terminals: strong progress**
- Europe: 5% annual growth
 - import capacity 35 mt/y
 - may build to 80 mt/year by 2010
 - UK as import hub? **progress on terminal plans**

LNG Consumption

- 141.7 mt in 2005
- about 6% of world natural gas consumption
- growth to 2012:
 - Asia: 8%
 - Europe: 4%
 - Americas: 20%+



North American Import Facility Projects – USA (1)

Cabrillo Port	Oxnard, CA	6.0 mt/y	BHP Billiton	2008
Calhoun LNG	TX	6.5-7.5 mt/y	Calhoun LNG	FERC pending 2009 startup
Compass Pass LLC	offshore LA	7.5 mt/y	Conoco Phillips	pending CG approval
Corpus Christi	TX	19.5 mt/y	Cheniere Energy	Q4 2007 constr. OK
Corpus Christi Bay	Corpus Christi, TX	7.5 mt/y	Occidental	FERC approval 2005
Crown Landing	NJ	9.0 mt/y	BP	2008 EIS OK
Freeport	TX	11.5 mt/y	Freeport LNG	under constr.
Northeast Gateway	Gloucester, MA	6.0 mt/y	Excelerate	shipboard regas, 2007
Gulf Gateway	offshore LA	3.7 mt/y	Excelerate	shipb. regas, operating
Cameron LNG	Hackberry, LA	11.0 mt/y	Sempra Energy	under constr. 2007 startup
Broadwater	Long Island Sound	7.5 mt/y	TransCanada, Shell	

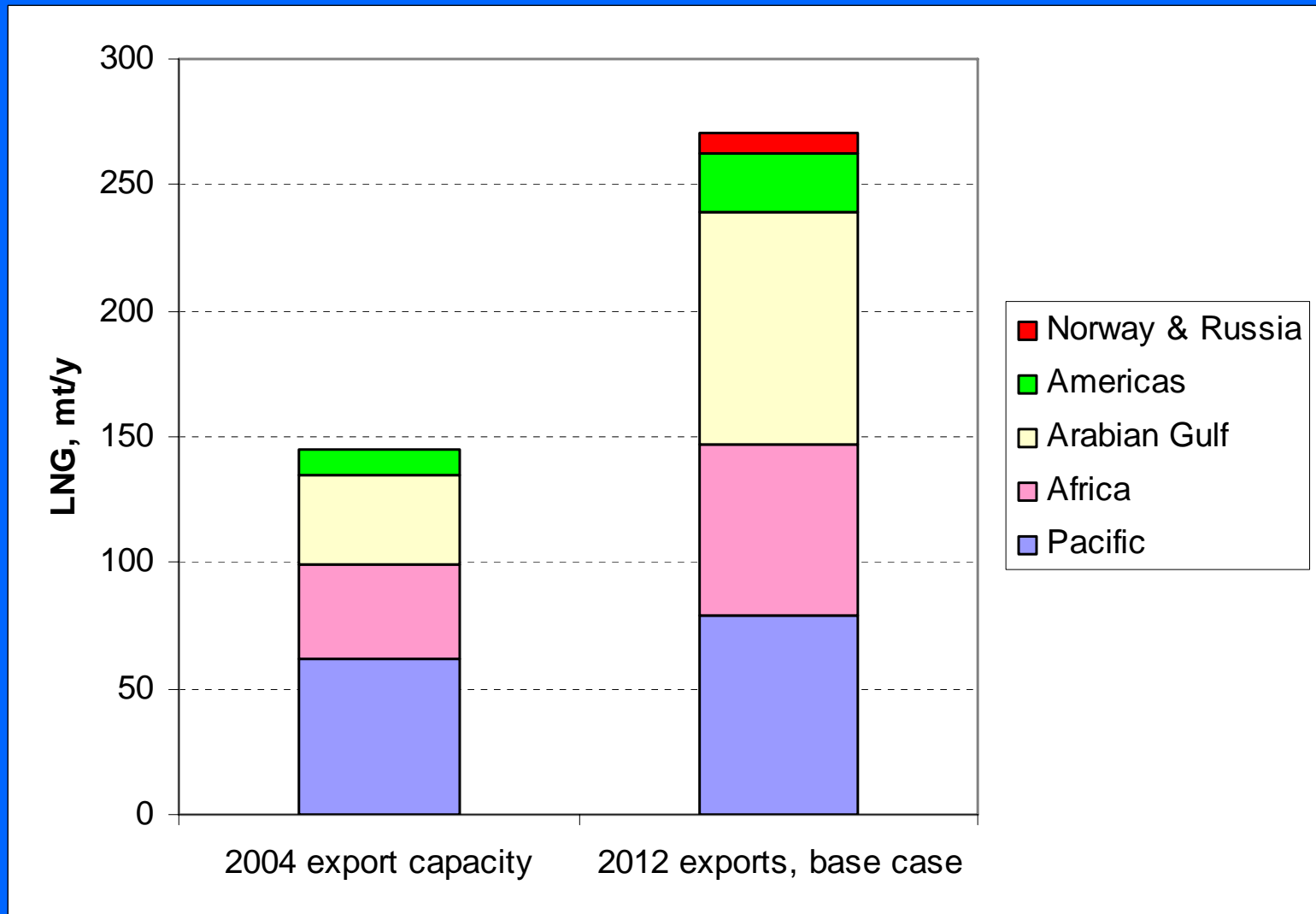
North American Import Facility Projects – USA (2)

Main Pass	offshore LA	18.7 mt/y	Freeport McMoRan	pending approvals
Pearl Crossing	offshore LA	?	ExxonMobil	on hold
Pelican Island	Galveston, TX	9.0 mt/y	BP	no firm plans
Sempra Eng.	Port Arthur, TX	11.0 mt/y	Sempra	EIS OK 2009
Port Pelican	offshore LA	?	ChevronTex	on hold
Sabine Pass	LA	20-30 mt/y	Cheniere Energy	final approvals 2008 startup
Golden Pass	Sabine Pass, TX	15.0 mt/y	ExxonMobil, Qatar Petro	2009
Terminal Island	Long Beach, CA	7.5 mt/y	Mitsubishi, ConocoPhillips	2008
Ventura	offshore CA	7.5 mt/y	Crystal Energy	
Vista del Sol	Corpus Christi, TX	7.5 mt/y	ExxonMobil	2009
Gulf Landing	W.Cameron, LA (offshore)	7.5 mt/y	Shell	2008/09 MarAd appr.

North American Import Facility Projects – non-US

Bear Head	Point Tupper, Nova Scotia	7.5-11.0 mt/y	Anadarko Petroleum	under constr.; delayed (07)
Canaport	St. John, New Brunswick	3.7 mt/y	Irving Oil, Repsol YPF	2008 under constr.
Gros Cacouna	Quebec	3.7 mt/y	TransCanada, Petro-Canada	2008
Keltic LNG	Goldboro, Nova Scotia	3.7-14.0 mt/y	Keltic Petrochemical	2007-09
Point Tupper	Nova Scotia	3.7 mt/y	Statia Terminals	
Calypso & High Rock	Bahamas	6 mt/y	El Paso, Florida P&L, Tractebel	2008
Altamira	Tamaulipas, Gulf Coast	9.7 mt/y	Shell, Total, Mitsui	nearing completion
Coronado Islands	Baja California	5.2-10.5 mt/y	Chevron	2008 approved
Costa Azul	Baja California	7.5 mt/y	Sempra Energy	2007 approved
Manzanillo	Colima, Mex	3.7 mt/y	Mex. state power co.	2007

LNG Supply



New LNG Supply Projects: Under Construction/Advanced Planning

source	market	plans
Algeria	Europe, US	expansion, online 2006
Angola	Europe, US	1 project, startup 2007
Australia	China, Japan, US	3 projects, startup 2004 to 2006
Egypt	Europe, US	4 projects, startup 2004 through 2006
Equatorial Guinea	US	1 project, startup 2007
Indonesia	Pacific	expansion plus 1 new project, startup 2007
Iran	Asia (India)	3 possible projects (Pars field), startup 2009
Malaysia	India/Japan	3 new projects plus recent expansion
Nigeria	Europe, US	expanding capacity, online 2006/07
Norway	US, Europe	1 project, startup 2005
Oman	Europe, Korea	expansion, online 2005
Qatar	Pacific & Atlantic basins	expansion plus 3 large new projects
Peru	Mexico	1 project, startup 2008
Russia	Japan, Korea	1 large project, startup 2006
Ukraine	?	one LNG plant, startup 2007/08
Venezuela	Atlantic basin	2 projects, startup 2004 and 2008

Shipping Demand Projection

- trade route distance increasing
 - average 2,300 nm today
 - Oman/Qatar to Europe: 4,000-6,000 nm
 - Oman/Qatar to N. America: 8,000 nm
- base case growth to 2010: 19%/year
 - low case 11%
 - high case 25%
 - strongest growth 2007/08/09

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LNG Tank Designs: Spherical Tank (Moss)

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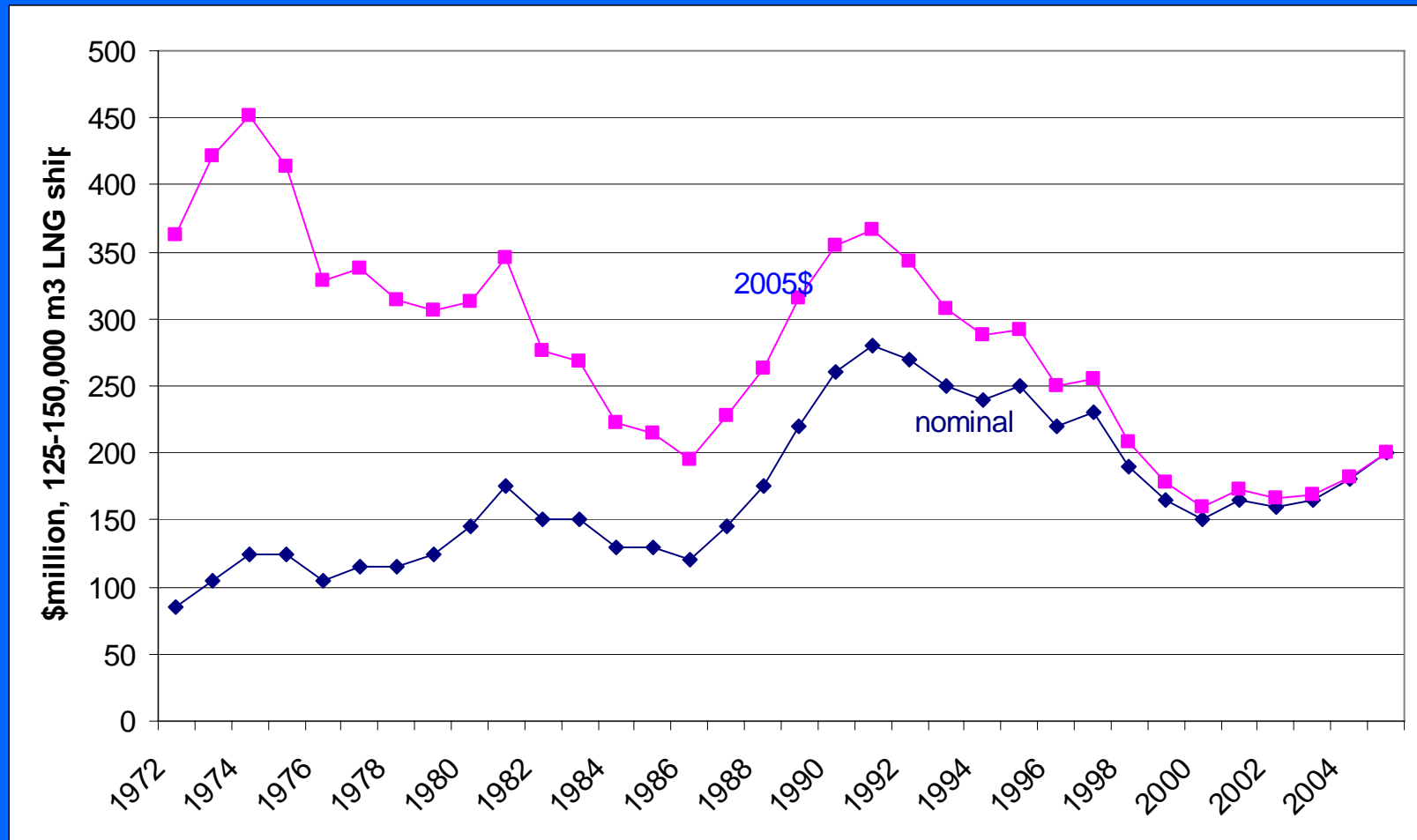
LNG Tank Designs: Prismatic Membrane Tank

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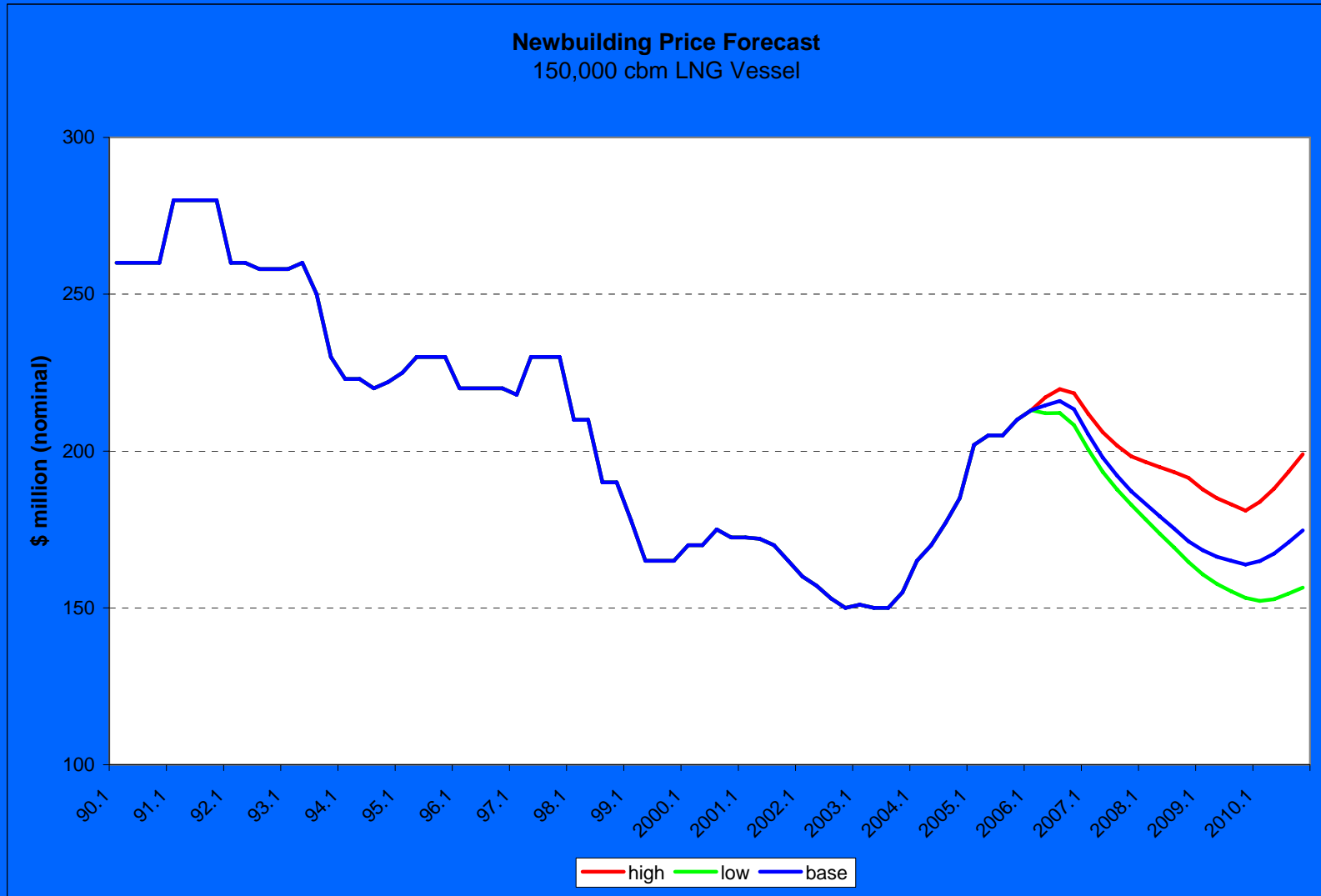
LNG Fleet, Q2 2006

- 200 ships
- 23.9 million m³ cargo capacity
- vessel classes:
 - Med-max: 75,000 m³
 - Conventional: 135-160,000 m³
 - “Atlantic-max”: 175,000 m³
 - Q-flex: 215,000 m³ (20+ on order)
 - Q-max: 260,000+ m³ (first orders just placed)
- well maintained (only 4 large LNG vessels scrapped to date), but retirements coming

Newbuilding Price (Conventional LNGC)



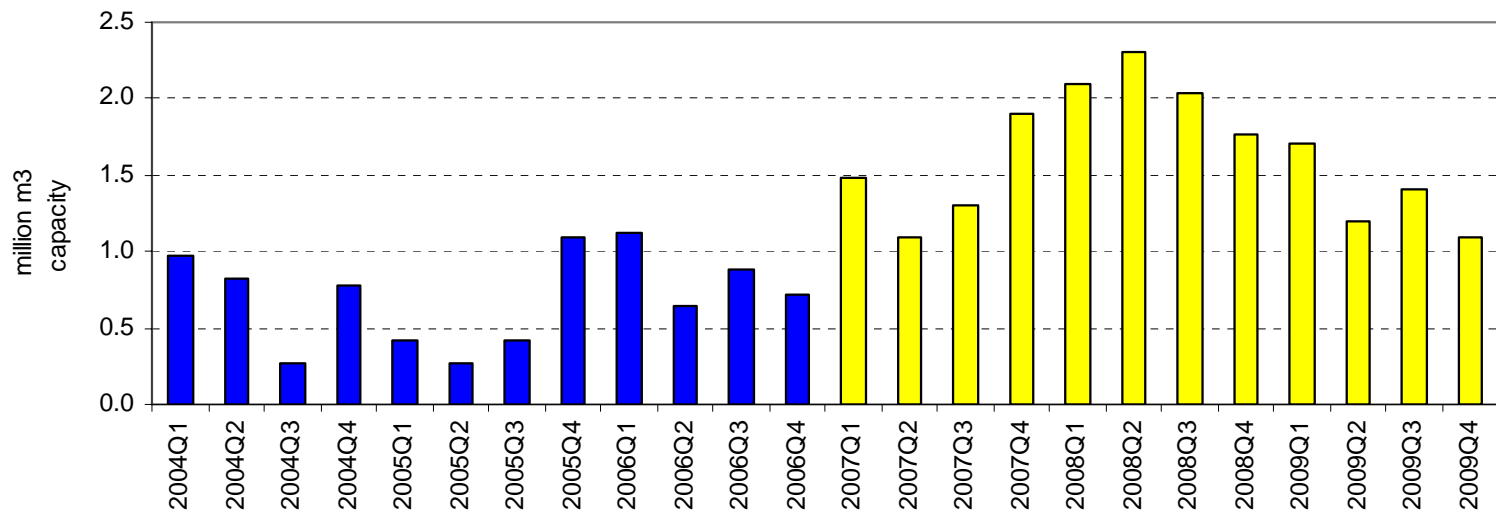
Newbuilding Price Projection 150,000 m³ LNGC



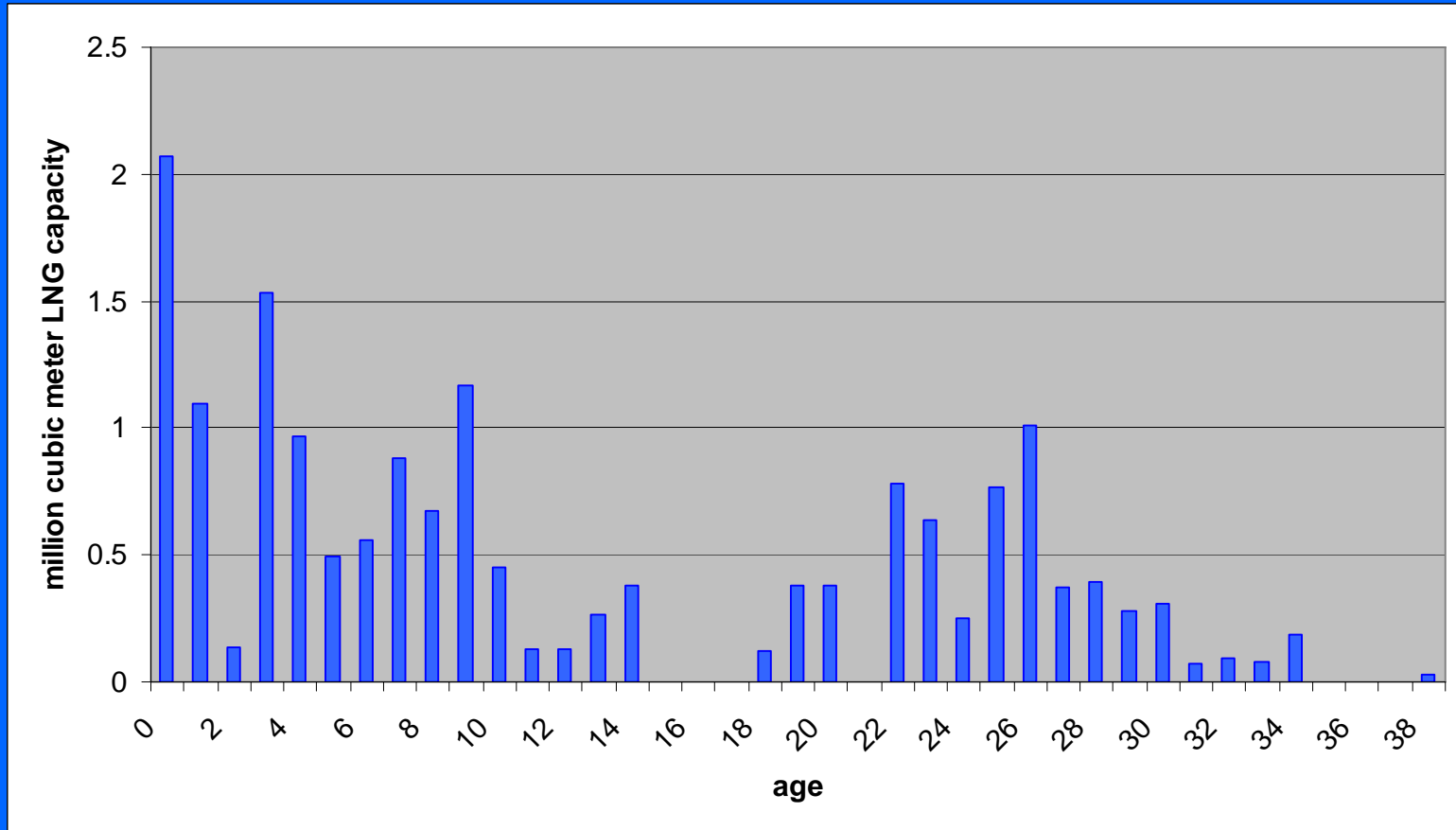
Orderbook (as of late May 06)

Yard	remaining 2006 deliveries	2007 deliveries	2008 deliveries	2009-10 deliveries
Daewoo, Korea	5	8	14	9
Hyundai, Korea	--	10	8	6
Samsung, Korea	4	9	11	11
Kawasaki, Japan	3	2	3	1
Mitsubishi, Japan	1	3	4	1
Mitsui, Japan	--	--	1	--
Universal, Japan	--	1	--	1
Koyo Dock, Japan	--	1	1	1
Hudong, China	--	1	2	2
Izar, Spain	--	1	--	--
Chantiers de l'Atlantique, France	3	--	--	--

Fleet Growth Projection



LNG Shipping Supply: Fleet Age Profile



LNG Fleet: Major Owners (2003)

Owner	Fleet	Orderbook
Mitsui OSK Lines (MOL)	5 outright; interests in 38	interests in 15, firm
Malaysia International Shipping Corp. (MISC)	11; interests in 16	5 firm
Qatar Liquefied Gas (MOL, NYK, K Line)	10	3 firm
Shell Group	9	1 firm
National Gas Shipping Co. (Abu Dhabi)	8	
Nigeria LNG	8	4 firm
ProNav Schiffahrtskontor (Germany; MOL affiliate)	8	
Australia LNG Ship Operating (Shell, BP)	6	1 firm, 2 options
Golar LNG	6	4 firm, 2 options
Hyundai Merchant Marine	6	
SNTM-HYPROC (Algeria)	6	

LNG Fleet: Major Charterers (2003)

Pertamina	27 ships	Indonesia's state oil&gas co.
RasGas	19 ships	Ras Laffan, Qatar (63% Qatar Petroleum, 25% ExxonMobil, 4% Itochu, 3% Nissho Iwai, 5% Korea Gas Corp.)
Petronas	15 ships	Malaysia's national petroleum corp.
Adgas	8 ships	Abu Dhabi Gas Liquefaction Limited (Das Island, Abu Dhabi), part of Abu Dhabi National Oil Company (ADNOC) Group
NWSSS	8 ships	Northwest Shelf, Australia (Woodside Energy, Shell Development, BHP Petroleum, BP Developments, Chevron Australia, Japan Australia LNG)
Brunei LNG	7 ships	Bruneian government and Royal Dutch Shell
Gaz de France	6 ships	Semi-public French gas company
Nigeria LNG	6 ships	Finima, Bonny Island, Nigeria (Nigerian National Petroleum Corp., Shell Gas, Elf, Agip)

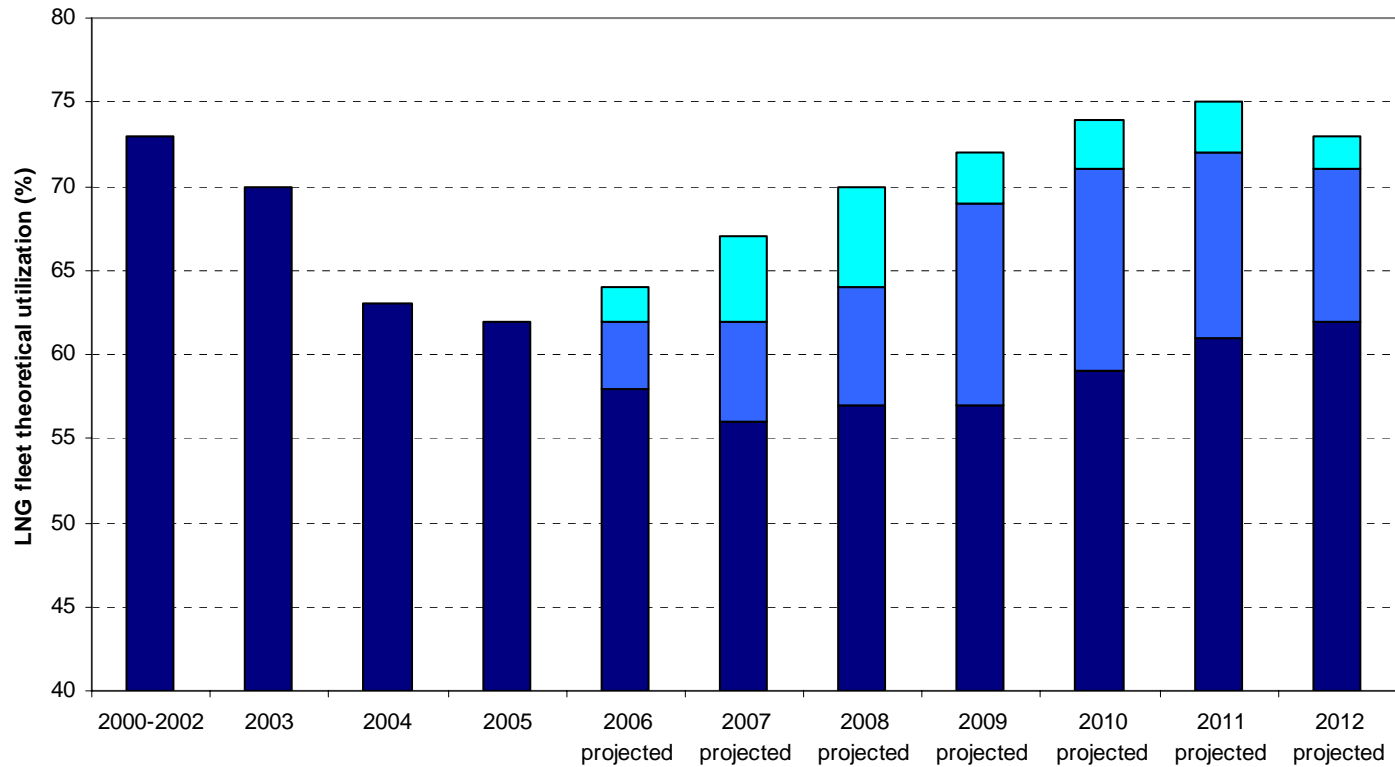
LNG Fleet: Major Operators (2003)

Shell Tankers	13 ships
Golar	13 ships
Nippon Yusen Kaisha (NYK) Line	10 ships
Mitsui OSK Lines (MOL)	8 ships
ProNav Schiffahrtskontor (MOL affiliate)	8 ships
Hyundai Merchant Marine	6 ships
SNTM-HYPROC (Algeria)	6 ships

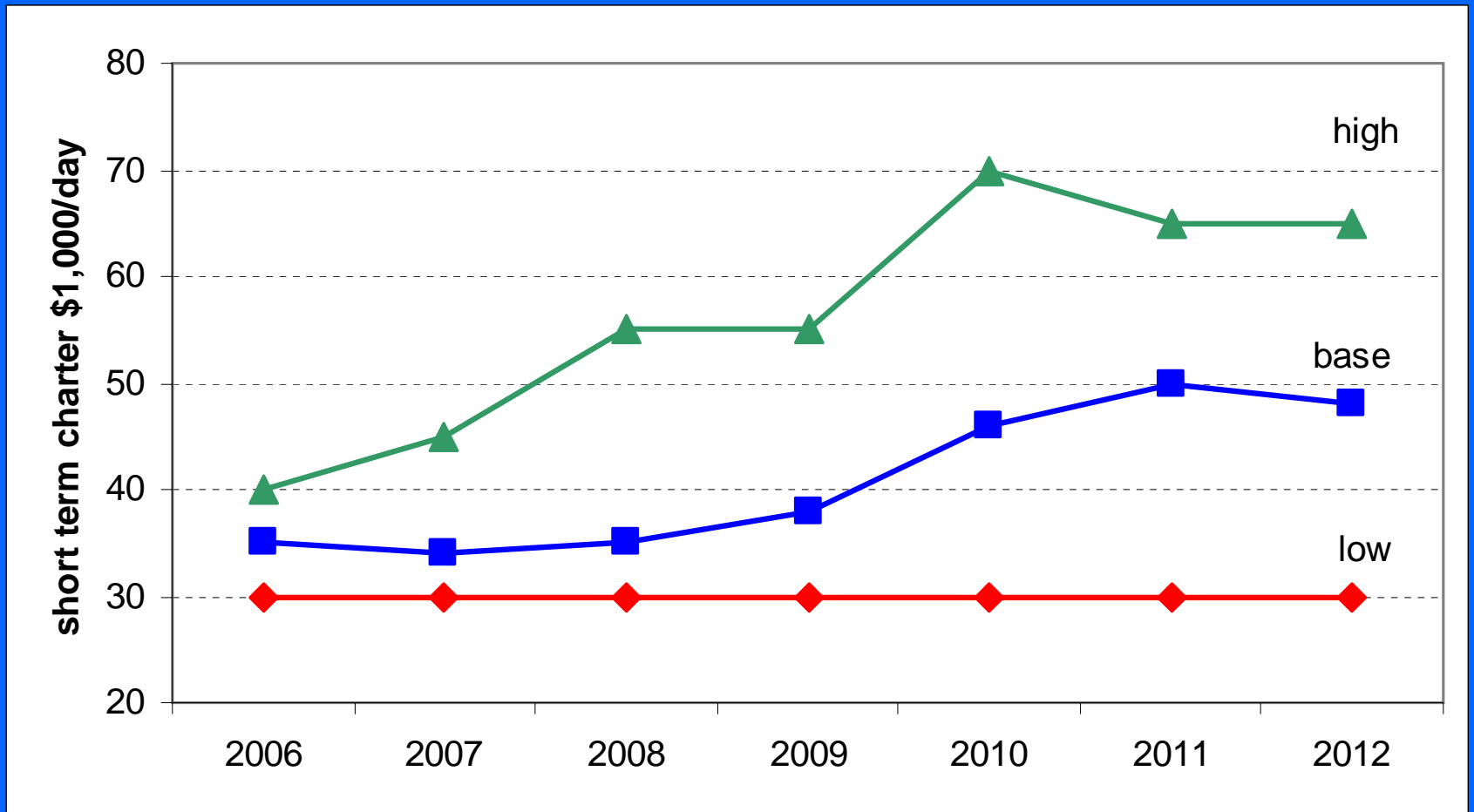
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Fleet Utilization Projection



Conventional LNGC Short Term Charter Rate Projection



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Trend: Shorter Contracts

- traditional contracts: 20-25 years, bareboat
- today: typically shorter (10 years and less) time charters, more flexible (that is, more risk – and opportunity – for owners)
- no commodity market (yet)
 - each potential fixture negotiation involves a select, small number of possible vessels
 - rates based largely on delivered energy content cost

Outline

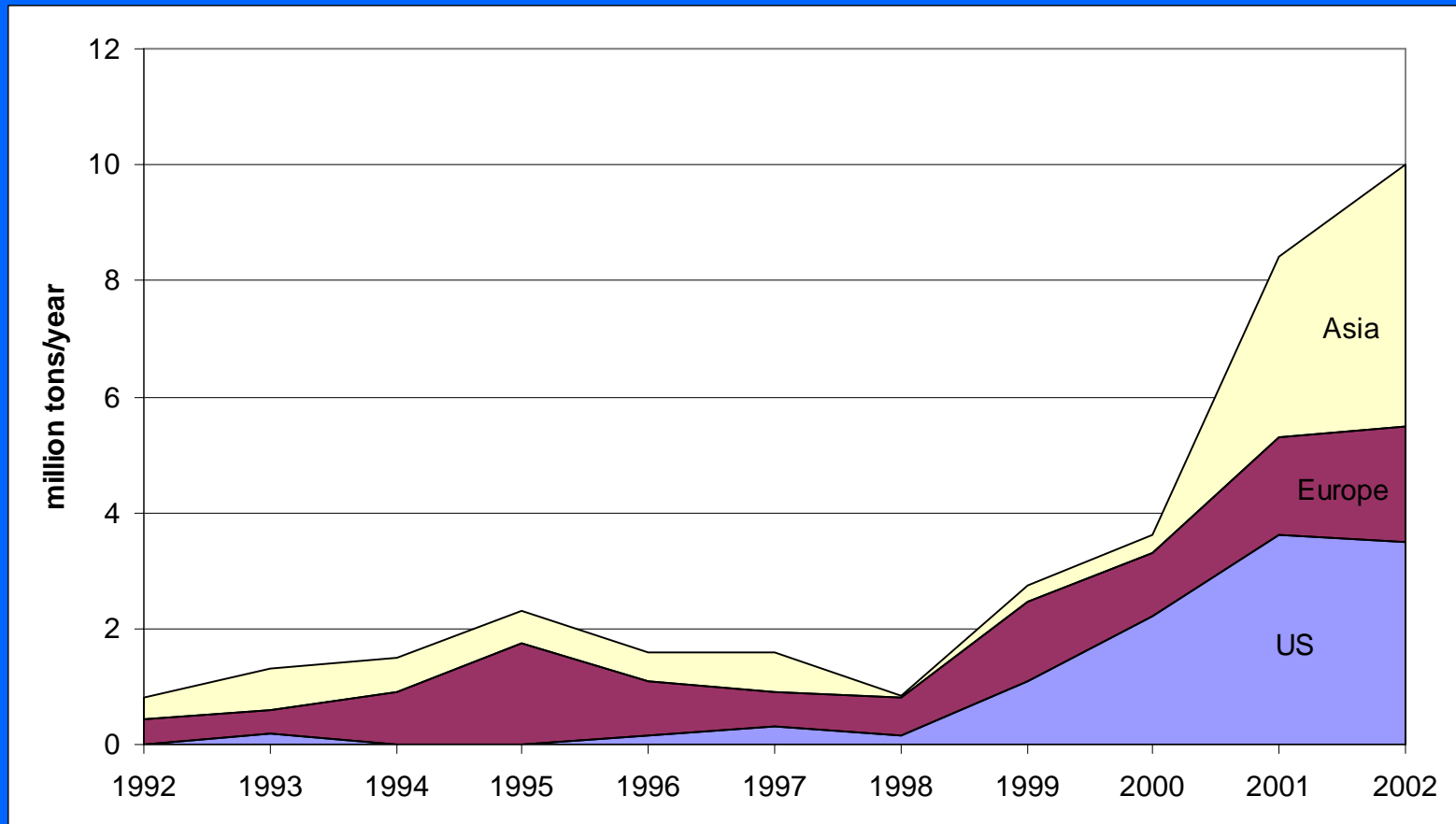
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“Spot” Market Growing

- excess supply capacity
- underutilized fleet
- demand fluctuations and import terminal capacity
 - Atlantic market (US)
 - Pacific market (Korea, Japan, India)
- “compartmentalized”

LNG Spot Market

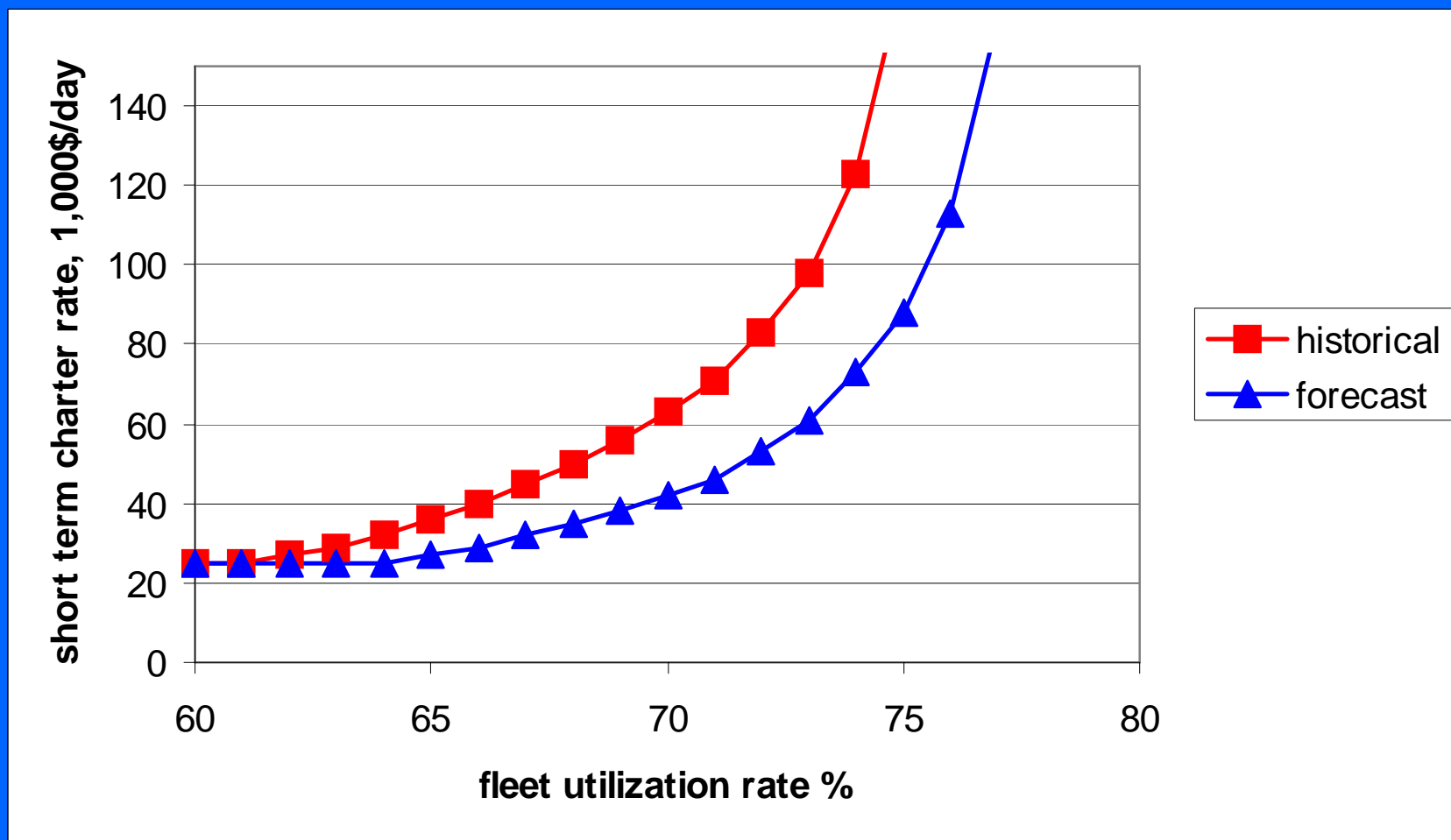
LNG trades of 2 years or less duration (estimated)



“Spot” Trade Participation

- 75% of short term fixtures have been vessels within their own contract trades (particularly on Pacific routes)
- most “spot” voyages to date on Atlantic routes, “Atlantic” owners
 - Africa, Arabia to Europe, US
 - Trinidad to US, Europe
- Asian routes & vessels becoming more engaged (MISC)

Fleet Utilization and Short Term Charter Rates



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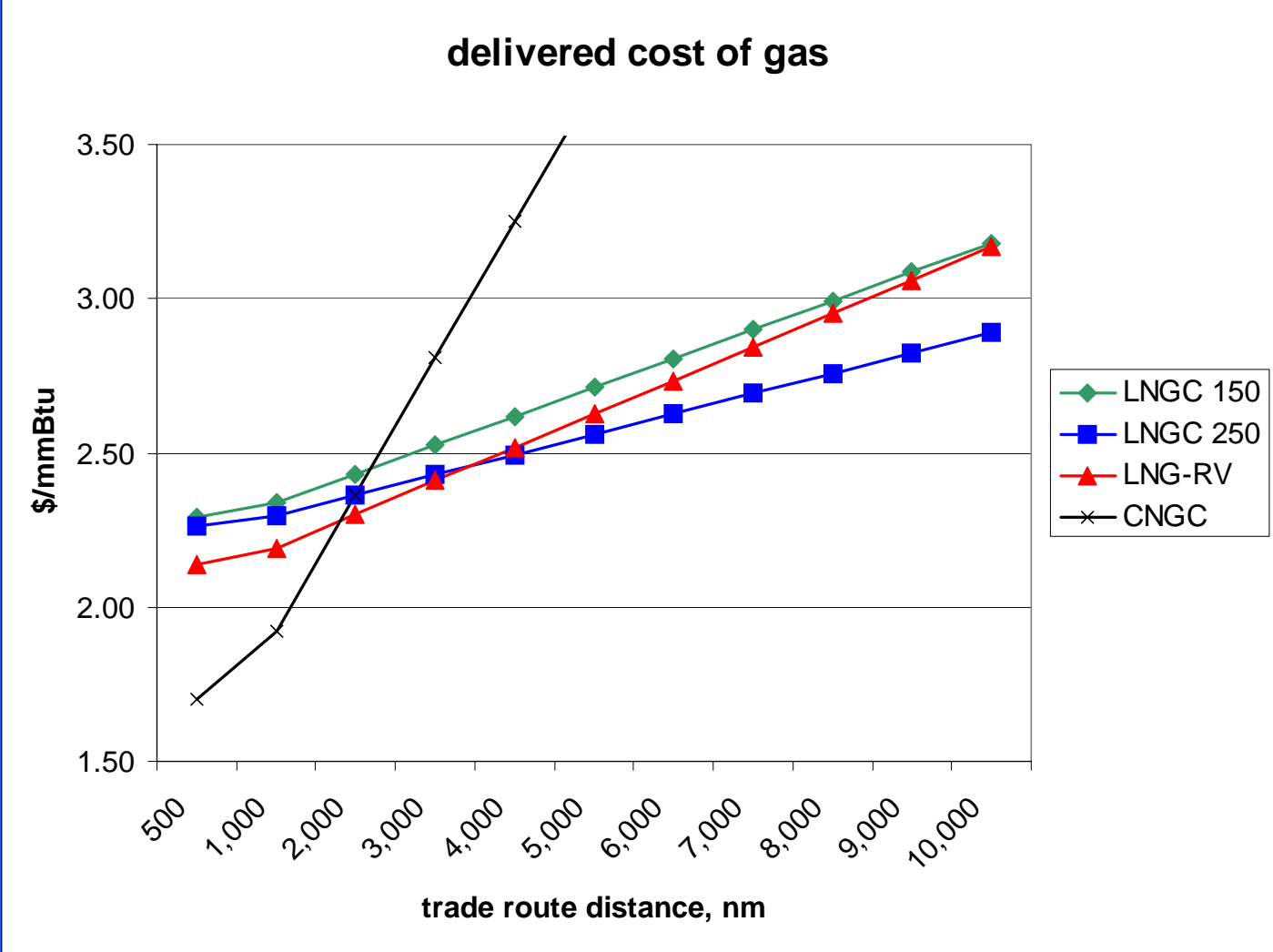
Changing Shipping Field

- Traditional Asian players (Japan, Malaysia) positioning for Atlantic market, spot trade role
- Acquisitions
 - Teekay (Tapias)
 - Golar (stake in K Line)
- New players – Greek owners
 - Anangel
 - Tsakos Energy Navigation
 - Dynacom
 - others

LNG Shipping Trends

- More choices in power plants
 - Dual fuel diesel-electric
 - Traditional slow-speed diesel w/reliquefaction
 - Gas turbine?
- Greater range of vessel capacity and regas options
- More flexible/efficient fleet utilization

Delivered Cost of LNG



Summary: LNG Shipping Prospects

Opportunities:

- for the long run, trade is set to grow; ships are needed
- spot market growth – has been lucrative
- fleet utilization has been high
- newbuilding prices are low

Risks:

- catastrophic accident could derail (US) terminal plans
- project delays can slow trade growth
- strong fleet growth -- utilization rates headed down short-term
- risk shifting to owners (contract patterns)
- technological change

Summary

- LNG trade volume to grow by 80-130% to 2010
 - import facilities?
- LNG “spot” market has softened; rebound not likely until 2006/07
- ordering is accelerating; 2008 slots filling fast; newbuild prices firming up
- new entrants: acquisitions, speculative ordering
- shift in time charters and growing spot market are pushing LNG toward the “standard” bulk shipping market model – within limits