LNG - Current and Future Trends

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Jonathan Stern and
Anthony Way

THE OXFORD INSTITUTE FOR ENERGY STUDIES
A RECOGNIZED INDEPENDENT CENTRE OF THE UNIVERSITY OF OXFORD

T W C O G LLP
OIL & GAS CONSULTANCY
London & Singapore

LNG Market Liberalisation

- Gas and LNG - an exciting era of growth and liberalisation in the Asian market.

- Underlying commercial fundamentals are going through huge changes, away from long-term sales arrangements with large incumbent buyers towards a more flexible approach to LNG supply.

- Four factors seem to be causing this change:
  1. Growth in demand;
  2. Low LNG prices;
  3. Commoditisation of LNG; and
  4. Deregulation of the China, Korea and Japan markets.

LNG Market Liberalisation

1. **Growth in demand.** The role of gas/LNG in reducing carbon emissions has been recognised in the Asian market. For the foreseeable future, replacement of coal (and oil) fired power is a bigger factor influencing gas/LNG demand than the rise of renewables. Another factor is the use of LNG as bunker fuel.

2. **Low prices for gas/LNG**. The Asian market is, like the rest of the world, currently oversupplied with gas/LNG. We are living in a period of suppressed prices as a result, which is likely to remain for at least another five years.

3. **Commoditisation of LNG.** Spot and short term sales arrangements are now more that 25% of LNG sales and purchase transactions. Although not yet exchange traded for supply to Asian markets (trading is still bilateral) the move away from long-term contracting is startling and probably permanent.

4. **Deregulation of the China, Korea and Japan markets.**

Liberalising Gas and LNG Markets - Summary

- Despite its significant growth, LNG trading has not yet reached sufficient critical mass where there is real depth and liquidity in the market.

- Comparison with the much larger gas/LNG markets in Europe and the US is revealing - these markets are far more advanced markets and commoditisation is widely seen.

- This changing commercial environment is leading to a large number opportunities and challenges.

- One of the largest challenges is the issue of counter-party credit risk as new entrants join the market - now looking like an issue that needs to be addressed.

  For example - A 15-year contract for 3 bcm/yr of gas (2.1 million tonnes/y LNG; 290 MMSCFD gas) carries a Take-or-Pay of US$ 8 billion.

LNG as a Commodity

- LNG has a high Cost of Carry
  For example, LNG is 10x more expensive to transport than crude oil.

- LNG is a flexible product with reduced supply risks.

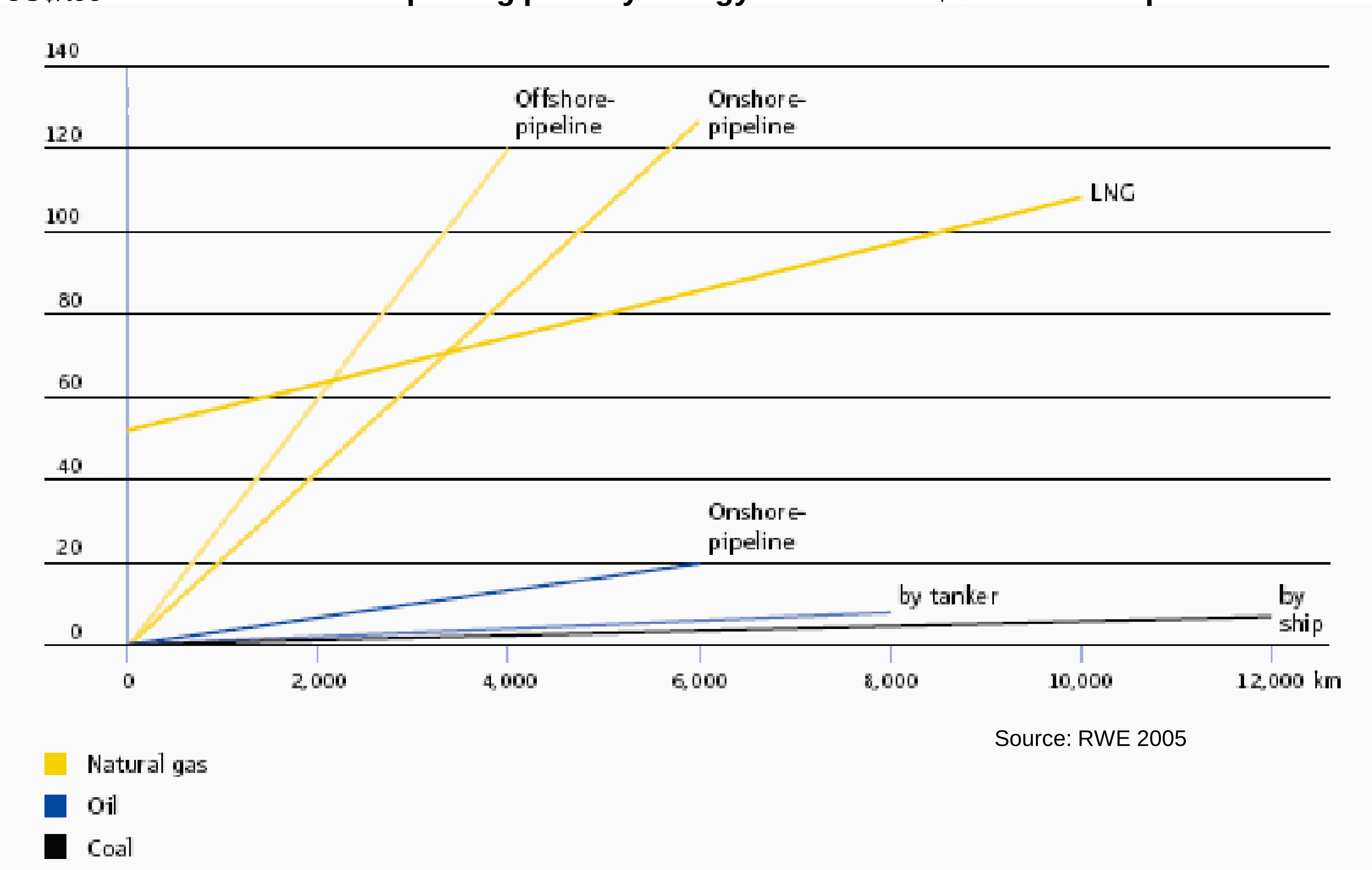
- The market for spot/short term LNG is about 30% of all cargoes

- LNG Shipping is commercially routine, although costly.

Transportation costs

US$/toe

Costs of transporting primary energy sources US$ / tonne oil equivalent



Source: RWE 2005

LNG Sales and Transportation

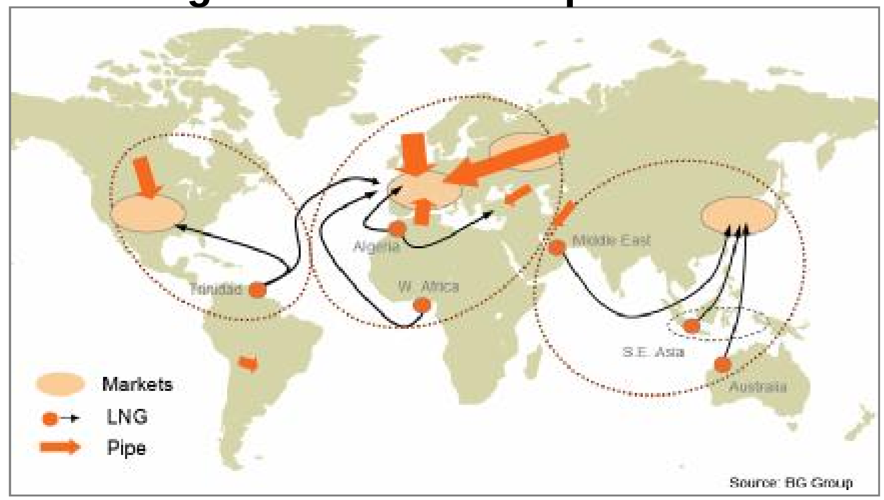
- LNG historically was sold on long term Take or Pay contracts with National gas monopolies

- Typically ‘milk run’ dedicated fleets of ships
  - NOCs / IOCs now trade LNG

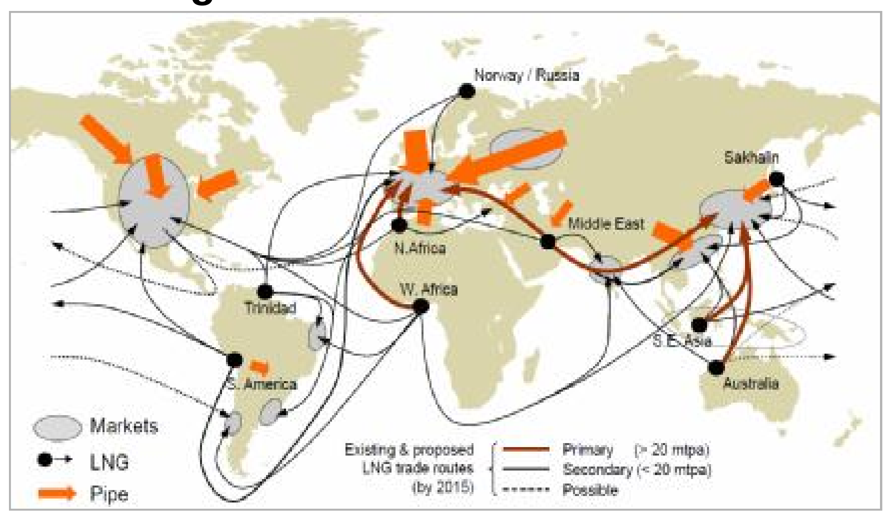
FOB – Free On Board
- More flexible for the buyer who can take the cargo wherever the market is most attractive

DES – Delivered ex Ship
- Removes transport risk for Buyer
- Contracts now also can have flexible destination clauses

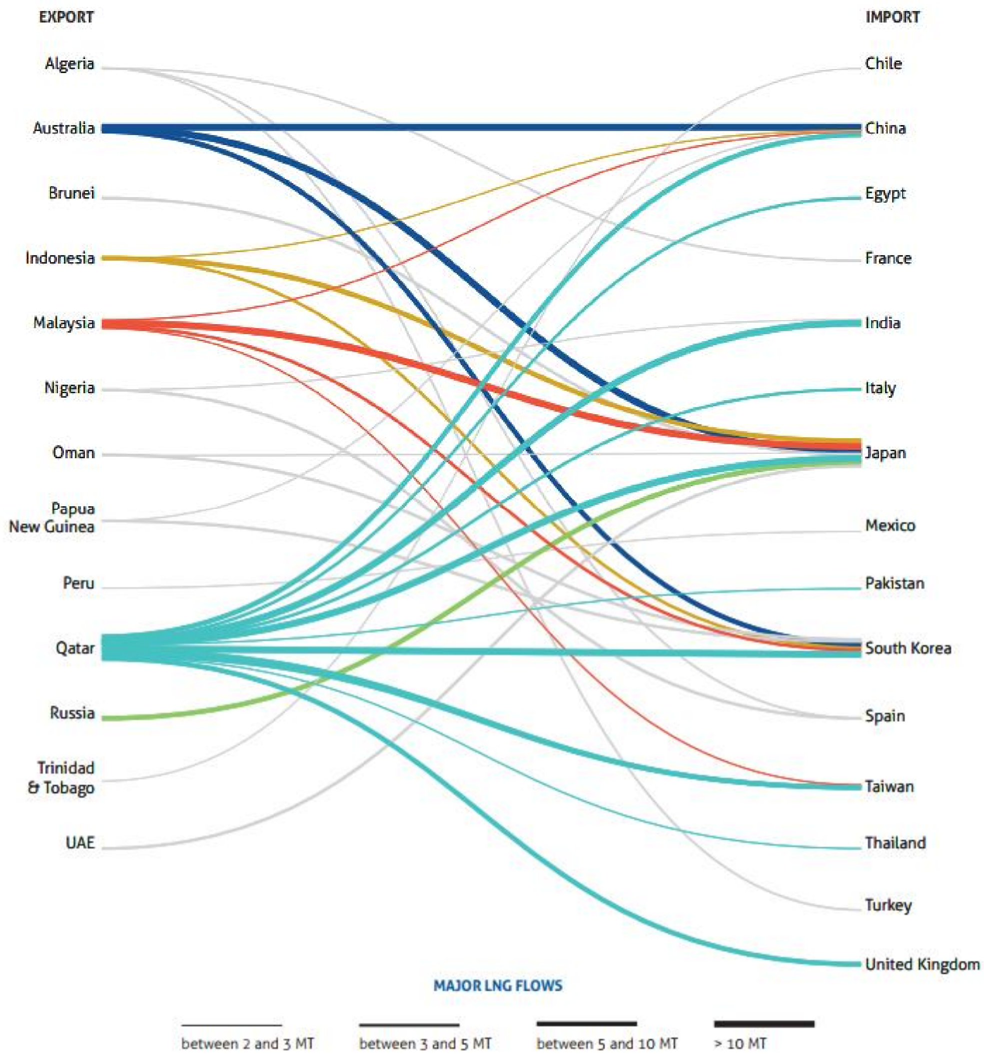
Global gas trade – recent past



Global gas trade – evolution



The LNG Market in 2016



264 million tons of LNG imported
+7.5% increase from 2015

340 mtpa of liquefaction capacity

830 mtpa of regasification capacity

28% of total trade on a spot basis
75.6 million tons or ~1,000+ cargoes

73% of global LNG demand in Asia

19 exporting countries

39 importing countries

China, India, Middle East **growing demand**

Japan, Korea & Europe **declining demand**

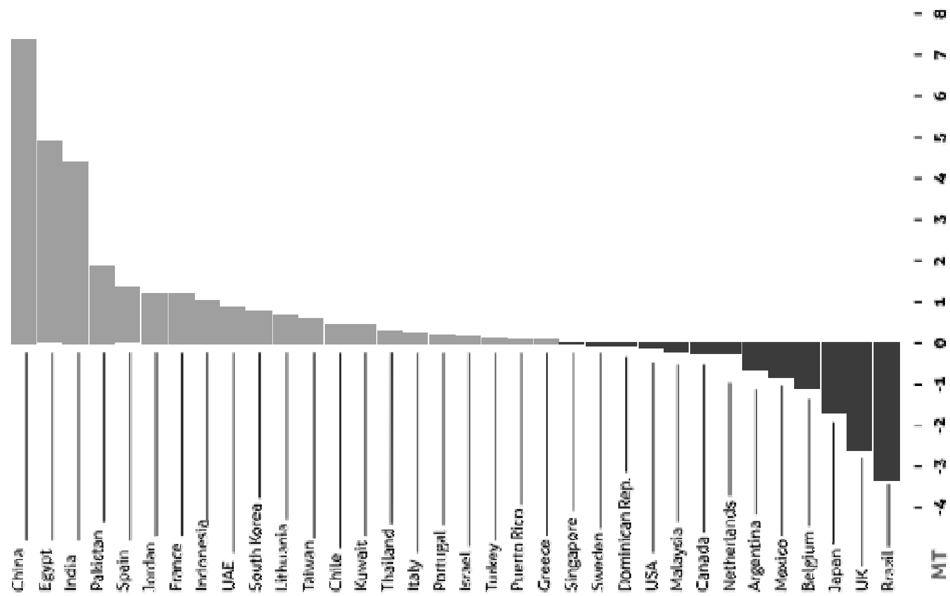
Source: GIIGNL

Changing Trends

Changing Trends in LNG Markets

- **Over-supply and reduced pricing** have fuelled new demand
- Displacement of coal from **renewables driving gas demand**
- **Economic downturn** in traditional energy buyers markets
- Micro-demand influenced by **climate change**
- Increased competition from **market de-regulation**
- LNG traders helping to **commoditise LNG**

Change in LNG Imports 2016 v 2015



Source: GIIGNL

Changing approach to manage new risks
Spot & short term trading increases flexibility
Allows for better risk management

Changing Trends

Long Term Contracts

- **Reducing term:** 15 and 20 years contracts much less common
- **Increasing Flexibility:** Increasing Buyer’s option to change the volumes in shorter time frames (90DS v ADP)
- **Price Indices:** Move from JCC to Brent for better risk management
- **Delivery:** Sellers move to reduce FOB sales & retain portfolio value (e.g. Shell sells no FOB LNG)

Spot & Short Term Contracts

- **Increasing Volume:** more 3 to 5 year term contracts
- **Pricing:** increase in types of pricing index and creativity

A Market and Participants

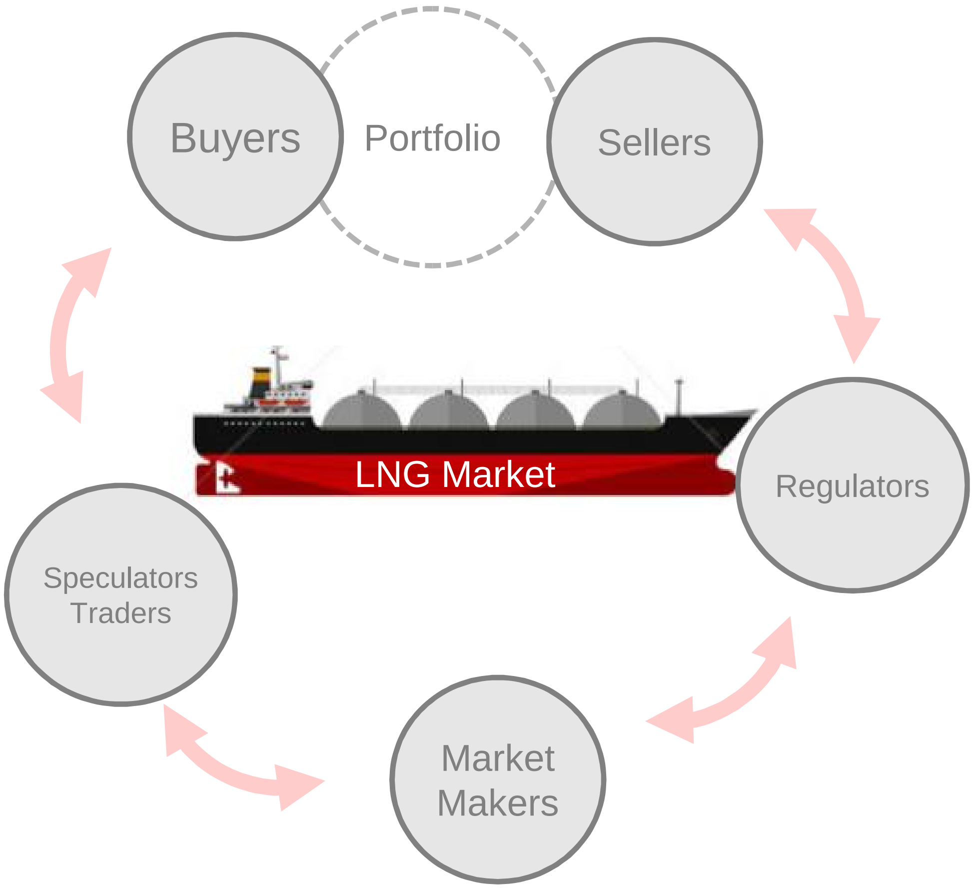
Buyers: manage physical risk of demand and optimise for value (cost)

Sellers: manage physical risk of production performance & shipping and optimise for value (price)

Speculators: banks & traders looking for arbitrage and to profit from managing or "warehouse" risk for clients

Market Makers: limited role in LNG Markets, brokers, traders & banks have injected liquidity into the LNG market

Regulators: government regulators oversee transactions and physical market operations



Varied levels of sophistication in all market participants across LNG market

Spot & Short Term Market Characteristics

Characteristic	Oil Market	LNG Market
Products	• Physical delivery • Financially settled (contracts for difference) • Vanilla and Exotic Options • Refinery spreads • Location spreads • Cross commodity swaps (oil for oil products)	• Physical delivery • Some financially settled contracts (European gas markets) • Limited financially settled contracts in Asia (Platts JKM swaps) • Limited vanilla options traded
Transactions	• Exchange listed futures & OTC spot and short term	• OTC • Early days of exchange listings in Singapore
Contract Form	• Standardised commodity agreement • Standardised shipping & transportation • Simple quality and assay process	• Asia: bi-laterally negotiated (master) agreements • Europe: European Federation of Energy Traders Master DES LNG SPA • Non-standardised shipping, ship vetting, quality requirements etc

Spot & Short Term Market Characteristics

Characteristic	Oil Market	LNG Market
Price Signals	• Base Price ± Quality Adjustment • (e.g WTI, Brent)	• Fixed spot pricing • Index linked to European & US Markets • Index linked to Price Reporting Agencies (Platt's JKM in Asia) • Oil linked (Brent, JCC) • Exotics e.g. power market pass through
Liquidity	• Very high liquidity • High supply/demand information flow • Frequent intra-day price updates • Reflected in small bid-offer spreads & small regional variations in pricing	• Limited, large parcel sizes (e.g. one cargo) restricts volume of trades • Restricted supply/demand information & pricing updates • Wide bid-offer spreads and large regional variations
Regulation	• Highly regulated	• Mixed and multiple regulatory regimes
Credit	• Exchange: Automated daily credit clearing • OTC: LOC, automated, pre-pay	• Large credit requirement due to parcel size • Typically LOC even amongst largest players • Pre-payments are increasing

LNG is inherently less fungible than oil, creating a barrier to efficient trade

The Difficult Issue of Asian LNG Pricing

Price	Description	Issues
Fixed Price	• Most common pricing for spot trades (single cargoes) with short delivery (within 90 days) • Price agreed on execution of trade prior to delivery, typically in US$/MMBtu	• Fixed price prior to delivery, typically 90 days prior • Potential to fix in other units e.g. recent Chinese deliveries in US$/m3 • Not usually seen in multiple cargo trades • Limited risk management ability in Asia (JKM swaps)
Platts JKM Index (Japan & Korea Marker)	• Platts reported price of spot LNG delivered into Japan and Korea in US$/MMBtu • Spot and short term trades would have floating price prior to delivery • Final price on delivery linked to the average of this index • Limited use as pricing structure in spot and short term contracts, gaining in popularity	• Data is "heard" by Platts, interviewing Buyers, Sellers, Traders & Brokers • Price only reported, other terms of transactions are unknown • More Buyer's in survey than others • Lagging indicator based on trades done • Some scepticism in industry on validity of a price index with no adjustment for terms • Floating JKM index price risk can be partly managed (fixed) using JKM swaps (thinly traded)
Other Index	• Other Price Reporting agencies (e.g. Heren and Argus) also provide a similar index for North East Asian LNG pricing	• Is the Asian spot LNG market large enough to support another 2+ indices using similar methodologies? • Currently Platts JKM is most widely used & referenced

The Difficult Issue of Asian LNG Pricing

Price	Description	Issues
NBP/TTF /Henry Hub	• Floating prices indexed to European or US gas hub pricing • Final price is typically an average of a gas hub index (month ahead, day ahead etc) prior to delivery • Typically used for a < 1 year term transaction with multiple cargoes	• Relevant if HH & NBP are setting global spot LNG price signal during low LNG demand periods • Limited use amongst Asian/Australian based produces & Asian Buyers • Very popular with European based Buyers & Traders • Very large “paper” market to manage risk
Oil Index (JCC & Brent)	• Traditional pricing structure familiar in long term contracts • Price of LNG fixed at delivery as a function of an oil index • Frequently used in >1 year term transactions with multiple cargoes	• Move from JCC to Brent index for both Buyers and Sellers • Brent index floating prices are much easier to manage risk with Brent “paper”
Exotic	• Any combination of the above/others • Blend of gas hub and oil contracts have been traded recently • Prices linked to other markets e.g. power markets	

LNG Buyers Portfolio Approach to Pricing Risk

	PORTFOLIO APPROACH MIX OF LONG/MEDIUM/SHORT & SPOT STRATEGY TO MANAGE SUPPLY & DEMAND REQUIREMENTS LNG TRADING DESK TO ENACT THIS MANAGEMENT THROUGH TO THE SHORT TERM		
	LONG TERM CONTRACTS	MEDIUM TERM CONTRACTS	SHORT TERM & SPOT
ROLE IN PORTOFOLIO	• Security of Supply	• Fundamental structural changes in supply or demand out to 4 years	• Short term changes in supply/demand from weather or operational issues
TERM	• Historically 15 year plus contracts • Recently up to 10 year contracts but from existing LNG facilities (contract renewal) • Reduction in term drives mainly by uncertainty over future supply/demand balance in LNG • In the future will a 10 year term underwrite a new LNG ?	• 1 to 4 year term agreement for multiple deliveries	• Up to 1 year term transactions for a single (spot) or multiple cargo deliveries

LNG Buyers Portfolio Approach to Pricing Risk

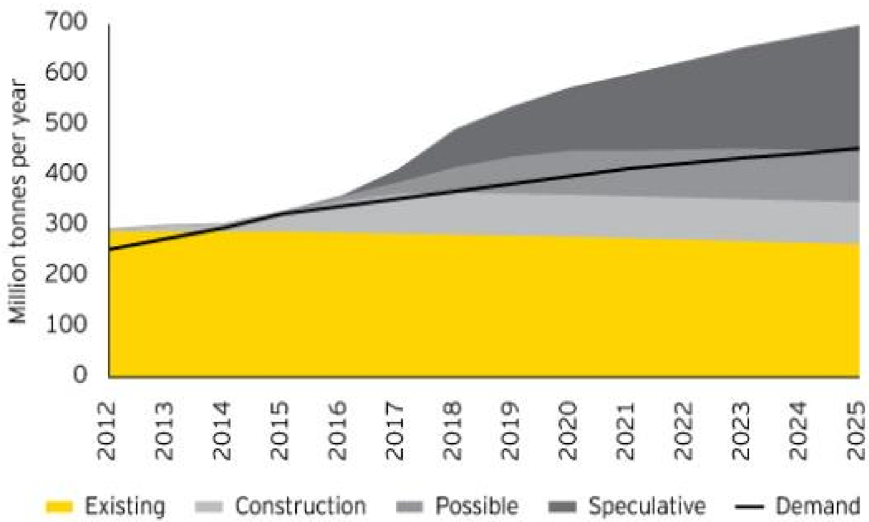
	LONG TERM CONTRACTS	MEDIUM TERM CONTRACTS	SHORT TERM & SPOT
PRICING STRUCTURES	• Oil indexation with s-curves and recent Henry Hub indexation & tolling • Recent simplification of oil indexation, use of Brent for risk management & reduction in s-curve formulae	• Similar to long term agreements • Exotic pricing or multiple pricing options can be introduced • Increase in gas hub linked pricing	• Both fixed and floating prices
MANAGE PRICE RISK	• ~5 yearly price reviews • Price reviews may reference Buyers broader Asian LNG markets e.g. JKT or JKTC • Should reflect supply/demand fundamentals of regional LNG market • High pricing uncertainty and a challenging process in markets with alternative sources of gas supply e.g. pipeline gas into China	• Oil & Gas hub linked pricing can be manage using forward/futures markets • Oil linked pricing is cheaper and easier to manage using traded indices (e.g. Brent not JCC) • Influence of shorter term supply/demand disruptions on pricing	• Spot cargoes purchases or sold as required to manage either physical or pricing risk • Futures and forwards markets used to manage short term multiple deliveries on oil or gas hub pricing • Growing trade in JKM Swaps can be used to manage deliveries into Asia either fixed or floating • Highly influenced by supply/demand disruptions & market sentiment

LNG Buyers Portfolio Approach to Pricing Risk

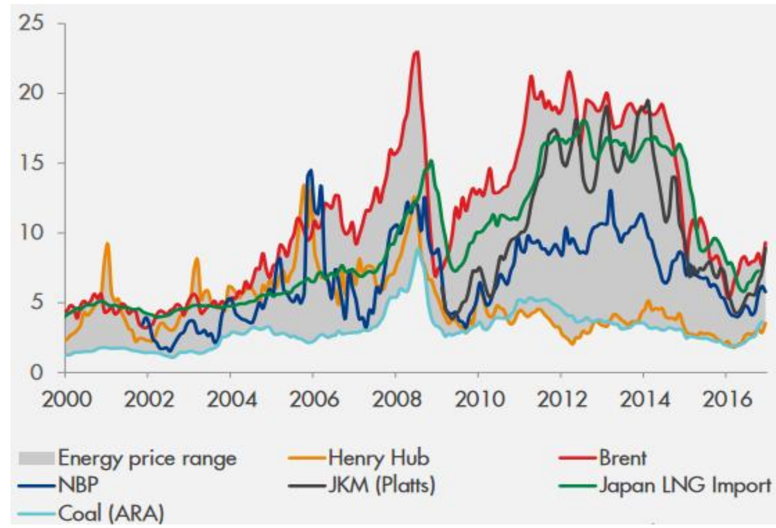
	LONG TERM CONTRACTS	MEDIUM TERM CONTRACTS	SHORT TERM & SPOT
FLEXIBILITY	• Limited FOB contracts now available, even FOB contracts have historically contained destination restrictions • Typically volume flexibility limited to <10% of the ACQ • Flexibility usually nominated annually during the ADP process • Recent increases in Buyer’s volume flexibilities	• Higher degrees of flexibility available over long term • Volume and timing flexibility • Winter weightings & options on additional cargoes • Limited destination restrictions	• Highest degree of flexibility

LNG Supply / Demand Outlook

Global LNG capacity and demand



Global LNG prices ($/MMBtu)



Much of the success of the European liberalisation process resulted from the surplus of supply, combined with reduced gas demand that coincided with the regulatory measures introduced by European governments.

Surplus supply of LNG greatly above global demand, will be a feature of the LNG market probably for the next 5 to 10 years.

LNG Contracting in 2016

Up to approximately 22 MT of Long Term contracts concluded in 2016

Origin	Export country/exporter	Buyer	Import country	ACQ (MTPA)	Duration (years)	Comments	Start	Delivery format
LONG & MEDIUM TERM SALES (>4 YEARS)	Indonesia / Tangguh Expansion / BP	PLN	Indonesia	20 cargoes/year until 2019. Then 44 cargoes/ year from 2020	17		2017	DES
	Mozambique Area 4 Project	BP	BP Portfolio	>3.3	20+		2021-2022	FOB
	Portfolio / BP	CPC	Taiwan	0.7	5	Option to extend for 4 years	2017	DES
	Portfolio / BP	PTT	Thailand	1	20		2017	DES
	Portfolio / Chevron	ENN	China	0.65	10		2018-2019	DES
	Portfolio / Origin Energy Limited	ENN	China	0.28	5	Option to extend for 5 years	2018-2019	DES
	Portfolio / Total	ENN	China	0.5	10		2018-2019	DES
	Portfolio / Chevron	Pertamina	Multiple	0.2	6		2016	FOB
	Portfolio / ENGIE	AES	Dominican Republic	0.7	12		2017	DES
	Portfolio / JERA	Centrica	UK	0.5	5	This is a flexible sales arrangement	2019	DES
	Portfolio / Ocean LNG Limited	CELSE - Centrais Elétricas de Sergipe S.A.	Brazil	1.3	25	First SPA to be entered into by Ocean LNG	2020	DES
	Portfolio / Petronas	Hokuriku Electric	Japan	up to 6 cargoes per annum	10		2018	DES
	Portfolio / Petronas	Toho Gas	Japan	7 to 9 cargoes per annum	10		2017	DES
	Portfolio / Total	Pertamina	Indonesia	0.4 to 1	15		2020	DES
	Qatar / Qatargas II / Qatargas	Global Energy Infrastructure Ltd. (GEIL)	Pakistan	1.3	20	There are provisions allowing the volume to increase to 2.3MTPA	2018	DES
	Qatar / Qatargas II T1 / Qatargas	Pakistan State Oil	Pakistan	3.75	15		2016	DES
	Qatar / Qatargas III / Qatargas	RWE Supply & Trading	Multiple	1.1	7.5		2016	DES
	Qatar / RasGas III / RasGas	EDF	France	2	4		2017	DES
	USA / Calcasieu Pass LNG / Venture Global	Shell	Multiple	1	20		2019	FOB
	USA / Cameron LNG Project / Diamond Gas	Toho Gas	Japan	3 cargoes per annum (approx. 0.2 MTPA)	19		2019	DES
	USA / Corpus Christi / Pertamina	Total	Multiple	0.4	15		2020	FOB

LNG Contracting in 2016

LONG TERM CONTRACTS (> 4 years)

- Majority of LNG contracted on a DES basis (17 MT / 78%) as portfolio players strongly value DES over FOB
- Term averaged 12 years and ACQ averaged 1 mtpa, indications of a reduction in contracting in light of supply/demand and price uncertainty
- Sellers mainly portfolio players or traditional producers; Buyers mainly end users
- Limited number of long term deals concluded by trading houses (e.g. Gunvor into Pakistan)
- Pricing into Middle East and Asia reported to be **11% to 12% DES**
- Increasing use of Brent as Index over JCC (Brent easier to hedge/risk manage)

LNG Market Key Themes

- Traditional Asian Buyers facing demand reduction and increasing demand volatility – changing the ratio of ST vs LT contracts in their portfolios
- Term and volumes reductions across long term contracts as Buyers particularly in Asia, look to manage future uncertainty
- Increased LNG supply from gas hub indexed markets with high swing options e.g. US LNG
- Destination restriction/diversion becoming more balanced for the Buyer
- Increased use of Brent indexation over JCC as long term Buyers look to more sophisticated methods of managing both price and volume risk
- Increasing reference in the short term markets to "Asian LNG Pricing" with a handful of short term deals concluded on Platt's JKM Index
- Growth in 2016 in "LNG paper" with around 12 counter-parties now managing risk with Platt's JKM contracts for difference

Gas and LNG Sales Agreements

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