Gaffney Cline

Market Advice and Estimates of Contemporary LNG Contract Prices

Report #1 June 2022

Prepared for

Australian Competition & Consumer Commission

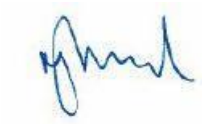
June 2022

Gaffney Cline

Document Approval and Distribution

Copies:	Electronic (PDF)
Project No:	PY-22-2022
Prepared for:	Australian Competition & Consumer Commission

Approved by Gaffney, Cline & Associates Limited

Project Manager:  June 2022

Nicholas Fulford, *Global Head, Gas & LNG*

Contributors: Ryan Pereira, *Global Director, Gas & LNG*

Nicholas Fulford, *Global Head, Gas & LNG*

Prabhat Agarwal, *Senior Advisor*

Fernando Della Valle, *Senior Advisor*

Reviewed by:  June 2022

Phil Solomon, *Executive Director*

Gaffney Cline

Table of Contents

List of Figures

List of Tables

Appendices

Gaffney Cline

Appendix II: Methodology for Normalising Contract Terms
Appendix III: Pricing Methodology

Basis of Opinion

This document reflects GaffneyCline's informed professional judgment based on accepted standards of professional investigation and, as applicable, the data and information provided by the Australian Competition & Consumer Commission (ACCC) and/or obtained from other sources (e.g., public domain), the scope of engagement, and the period over which the evaluation was undertaken.

In line with those accepted standards, this document does not in any way constitute or make a guarantee or prediction of results, and no warranty is implied or expressed that actual outcome will conform to the outcomes presented herein. GaffneyCline has not independently verified any information provided by, or at the direction of Australian Competition & Consumer Commission and/or obtained from other sources (e.g., public domain), and has accepted the accuracy and completeness of this data. GaffneyCline has no reason to believe that any material facts have been withheld but does not warrant that its inquiries have revealed all of the matters that a more extensive examination might otherwise disclose.

The opinions expressed herein are subject to and fully qualified by the generally accepted uncertainties associated with the interpretation of data and LNG market prices and do not reflect the totality of circumstances, scenarios and information that could potentially affect decisions made by the report's recipients and/or actual results. The opinions and statements contained in this report are made in good faith and in the belief that such opinions and statements are representative of prevailing physical and economic circumstances.

In performing this study, GaffneyCline is not aware that any conflict of interest has existed. As an independent consultancy, GaffneyCline is providing impartial technical, commercial, and strategic advice within the energy sector. GaffneyCline's remuneration was not in any way contingent on the contents of this report.

In the preparation of this document, GaffneyCline has maintained, and continues to maintain, a strict independent consultant-client relationship with the Australian Competition & Consumer Commission. Furthermore, the management and employees of GaffneyCline have no interest in any of the assets evaluated or are related with the analysis performed, as part of this report.

Staff members who prepared this report hold appropriate professional and educational qualifications and have the necessary levels of experience and expertise to perform the work.

This report relates specifically and solely to the subject matter as defined in the scope of work (SOW), as set out herein, and is conditional upon the specified assumptions. The report must be considered in its entirety and must only be used for the purpose for which it is intended.

Executive Summary

This report is the first in a series intended to assist in the estimation of medium term LNG prices based on an oil index, which is produced to inform the ACCC's LNG netback price series. As informed by the ACCC scope of work, this will be focused on publishing oil-linked longer-term forward LNG netback prices extending to 5 years, calculated by reference to an oil slope. The report should be read in conjunction with the previously published paper on methodology, which sets out the background and logic to the calculations and estimates adopted in this report.

While the methodology is considered robust and appropriate, it should be noted that the disruption to global supplies over the last several months has introduced a level of unpredictability and unprecedented price volatility which makes any attempt to forecast price levels exceptionally hard. The methodology report highlights many of the features that contribute to uncertainty, and the level of confidence that users of the netback series reports need to be aware of and apply.

Given the global gas market disruption, and the potential for major European supply interruptions during the second half of 2022 and into 2023, the prices derived from the analysis set out in this report may be impacted by rapidly changing market conditions and this should be taken into consideration in the context of any natural gas pricing negotiations in the coming months.

Notwithstanding the exceptional features set out above, the methodology developed by GaffneyCline (see box 1 below) sets out an estimated oil slope for medium term LNG contracts for Asia delivery of 12.8%.

Box 1: Methodology to estimate medium-term LNG contract prices[1]

GaffneyCline estimates the oil slopes for medium-term LNG contracts using prices observed under medium-term LNG contracts entered into over the previous 12 months. If there is sufficient data for medium term LNG contracts (e.g. 5 or more transactions with full or partial reported oil slope within the previous 12 months), then the volume weighted average of these slopes will be used as the primary input derive LNG oil slope estimates.

If there is insufficient data on medium-term contracts, three main sources of insight can be applied to understanding contemporary LNG contract pricing, in addition to reported contracts of the duration of interest (3-6 years). These are:

1. Short term international tenders
2. Long run cost of US LNG Exports
3. Long term contract signings

The relationship between these three sources varies, based on the market conditions prevailing. For example, when there is considerable volatility in the market, shorter term/international tender prices can depart substantially from longer term market fundamentals, and are less helpful in signalling an oil slope up to 5 years out.

Conversely, when the market is very well correlated, and volatility is low, tender prices are a much better signal for a 5 year look ahead and deserve greater emphasis in the approximation process.

When average levels of correlation / price volatility apply, a 5 year look ahead is likely to be equally affected by shorter term, longer term, and calculated long run costs of LNG delivered from the US.

Recognising these dynamics, in the event that the alternative data sources are used to complement data on medium-term LNG contracts, they will be weighted differently depending on the observed volatility in key oil and gas price indices over the previous 12 months:

- Where oil and gas indices have experienced high volatility and have been **less than 40%** correlated, more weight will be given to longer term deals
- Where oil and gas indices have experienced average volatility and have been **more than 40% and less than 60%** correlated, equal weight will be given to the three measures
- Where oil and gas indices have experienced low volatility and have been **more than 60%** correlated, more weight will be given to shorter term deals.

These three parameters will be combined to produce a single slope data point, and combined with medium-term LNG contract slope data using a simple arithmetic average to generate the final six monthly oil slope estimate. See Appendix III for a detailed explanation of the methodology.

The starting point for the estimated oil slope is the analysis of medium-term contracts. However, we have that observed no medium-term oil indexed contracts have been entered into within the last 12 months.

We therefore move to a secondary analysis, taking a combination (that depends on the degree of market volatility) of international tenders, US LRMC and long term SPAs. Based on the

[1] See the ACCC website for a full explanation of GaffneyCline's methodology https://www.accc.gov.au/regulated-infrastructure/energy/gas-inquiry-2017-2025/lng-netback-price-series-review

methodology set out, in a volatile market such as the one that exists today, we place a weighting on the various input parameters in the proportion of 1:2:3:

- Least weighting on international tenders (on the basis they reflect short term market pressures)
- Medium weighting on US LRMC
- Most weighting on Long Term SPAs

By applying the process to the data and calculations set out above, the following oil slope estimation is calculated (without reference to the non-conforming but illustrative data points from the assessment of medium term contracts).

Contract Type	Weights	Slope	Section
Volume weighted international tenders	1	16.9%	3.2
LRMC US exports converted to slope	2	12.4%	3.3
Volume weighted long term deals*	3	11.7%	3.4
Published Slope Estimate		**12.8%**	
*Long term slope of 11.1% is adjusted +5% for financing benefits			

Note that these estimates are sensitive to assumptions about market volatility and the corresponding weighting (as explained in box 1 and appendix III). For example, a greater weight for international tenders would result in a higher average slope.

Note regarding current unprecedented volatility in global gas markets

Current volatile global gas market conditions do not readily lend themselves to price forecasting. Whilst the current near term market volatility persists, historic measures of oil and gas correlation, price volatility and other fundamental features of the oil slope derivation in this report have less applicability than in more stable times.

In particular, it is possible, perhaps likely, that the next few months will see significant disruption in gas pipeline imports to Europe. Such an out turn will in turn fundamentally influence both LNG prices globally, and local gas market prices around the world.

This being the case, shorter term gas sale and purchase agreements could carry a very significant premium over oil, medium term contracts less so, and long term contracts (more than 10 years) will be least affected. The flexibility of the methodology referenced in this report therefore serves to cater for adapting market conditions and allows for a changing weighting in the parameters that influence the estimations.

General market sentiment, reflected in the short term analysis set out in this report, suggests that an oil slope in the region of 17% or more is likely to apply to LNG delivered in the shorter term. In the longer term, forward markets suggest that oil and gas prices will stabilize and return to a relationship reflected by the thermal energy contained in the fuel adjusted for regas costs, potentially in the region of 12-14%.

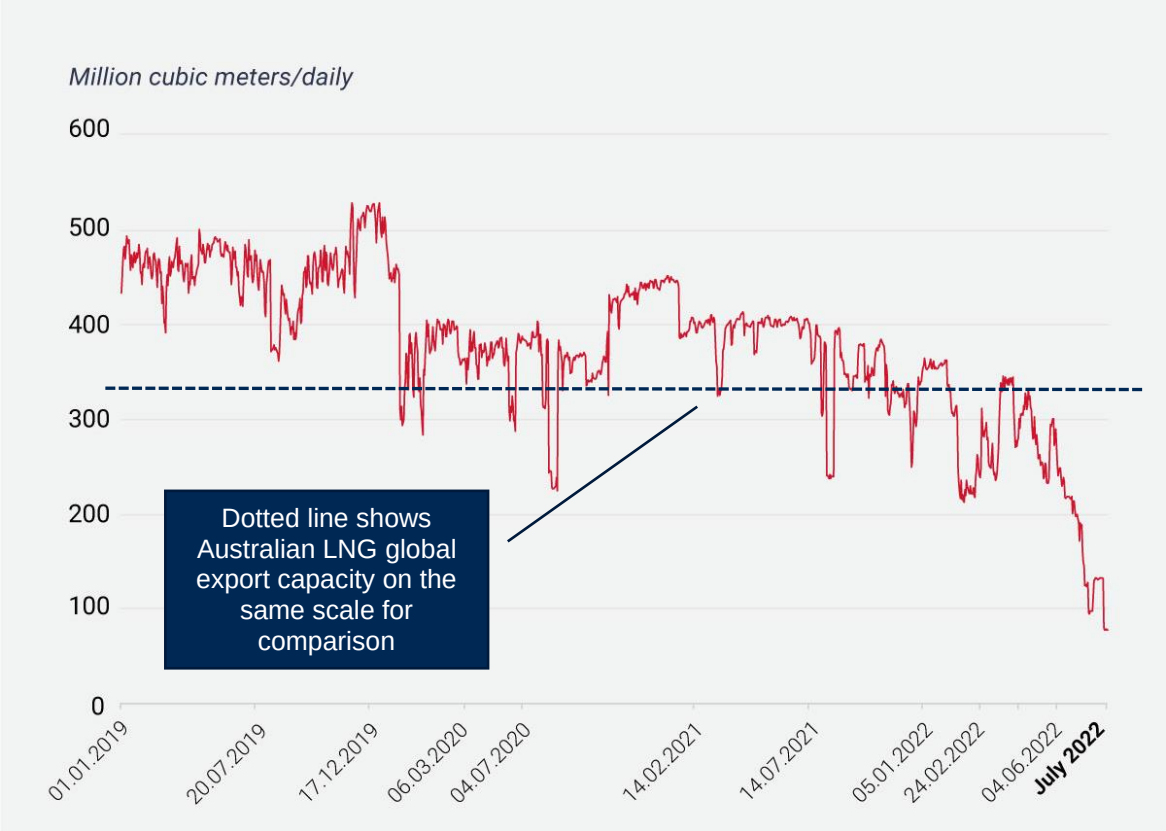
The methodology developed by GaffneyCline sets out an estimated oil slope for medium term LNG contracts for Asia delivery of 12.8%. This is supported with reference to data from one of the shorter duration SPAs and one of the longer duration tenders (which show a slope of between 13% and 14%), longer term deals from Qatar being reported (with a slope of around

12%), but with shorter term durations attracting up to a 17% slope. It is also consistent with the 12.9% referenced in section 3.1 from non-conforming medium term contracts, adding further confidence to the estimate.

1 Overview of LNG Market Developments

The Ukrainian situation, the sanctions on Russia and the related geopolitical tensions have thrust natural gas supplies to Europe and the rest of the world to the top of the global agenda. The fallout for gas pricing globally has been substantial. How these tensions unfold will directly impact any gas pricing negotiation in the short to medium term at the very least, and may have long lasting consequences.

Figure 1: Daily Russian Exports to Europe w/ Australian LNG global export capacity for comparison



Source: IEA / GaffneyCline analysis

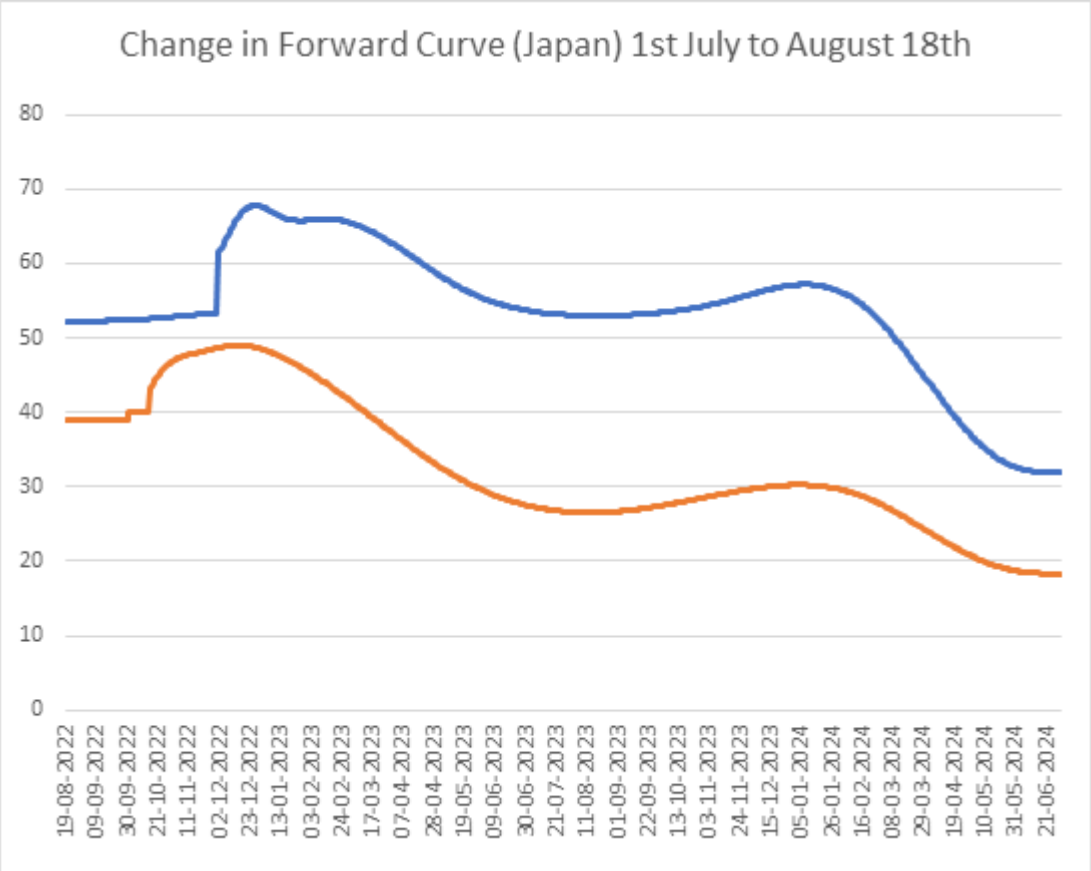
As shown on the graph above, typical daily Russian natural gas exports to Europe are slightly higher than total Australian LNG export capacity, which helps to demonstrate the materiality of these curtailments. In global terms the under deliveries have peaked at a figure approximating to 4% of global natural gas production, and for some European countries like Germany, Russian pipeline gas amounted to up to 45% of their national supply portfolio.

As might be expected, spot natural gas prices have reacted in recent months, with a sharp upward movement which is affecting forward prices not only for the coming winter, but further out. As an illustration, the chart below shows how much the forward curve for Japan delivery changed between July 1st (orange line) and August 18th (blue line). In that approximate 6 week period, forward prices rose by over $20/MMBtu (to approach a peak record high of almost $70/MMBtu) during a period of time where the price of oil (in MMBtu) remained reasonably stable at around $18/MMBtu on an equivalent basis.

In very approximate terms, this meant the oil price index rose from about 21% to 42% for deliveries in mid-2023 and from 14.5% to 25% for deliveries in mid-2024.

Long term contracts on the other hand with 15-20 year term had been being signed at somewhere above 12%, with none that we have seen yet breaking into the 13% band, though it is possible we may see this change if the gas crisis extends or worsens over the winter.

Figure 2: Change in Spot Price for Japan delivery (July to August 2022)



Source: GaffneyCline analysis / ICIS (Orange – forward curve 1st July, Blue – 1st August)

There is evidence that the high prices in price elastic importing countries are slowing down some negotiations, for example with Petronet in India announcing a suspension in their negotiations with Qatar, citing difficult trading conditions.

However, several long term deals (15-20 years) have been signed in the last few months with US suppliers. These long term deals have been reported to include tolling rates in the $2/MMBtu to $2.10/MMBtu range, which are not materially different to the recent trend, and with the Henry Hub multiple at around 111% rather than the traditional 115%. Clearly the feedstock element determining the cost of US exports has been significantly impacted, with the Henry Hub wholesale index reaching near record levels of $10/MMBtu (highs previously experienced in 2008) and markets reporting record high volatility.

However, the sharp increase in Henry Hub is less long lasting than in European and Asian markets with a re-stablisation in the forward curve to just over $6/MMBtu for January 2024. Translated into oil slope levels, this would place January 2024 oil indices, on a delivered to Asia basis, at around 12.5%, based on the January 2024 Brent futures price of $88/barrel. This is significantly less than the spot price and demonstrates that while short term pricing is responding to the supply disruptions, longer term trends are far more stable.

Another useful reference is a 20 year contract signed at the end of July 2022, which is scheduled to start deliveries in 2025. This gives rise to a derived oil slope of 11% to 11.1% which also suggests that the market is assuming that the current disarray will have stabilised by then.

However, pricing trends continue to be influenced by broader market fundamentals that exist outside the current disruption which have also changed considerably in recent years.

The LNG sector encountered possibly the lowest point in its entire history when in mid-2020 COVID related demand destruction and a structural oversupply in the global LNG market caused spot prices to fall to unprecedented low levels, and some liquefaction plants were shut down for lack of market. Subsequently, faster than anticipated demand recovery and growth, especially in Asia, and delays in new plant construction and FID (e.g. including but not limited to Mozambique, some US projects which have since picked up pace again) coupled with unplanned outages at LNG facilities (e.g. including but not limited to Hammerfest in Norway, Prelude and for a brief period US Gulf Coast facility disruptions due to weather) saw a gradual increase in price to the point where supply shortages became apparent by winter of 2021/22.

During 2021, LNG imports reached 372.3 Million Tonnes (MT), a 4.5% increase over 2020 with Asia growing by 7.1% largely fed by China (15% growth), power generation in South Korea, Brazilian demand to substitute for Hydropower, and substitutes for lower European pipeline imports arising from growing interruptions in Russian pipeline gas supplies.

With the rising market pressures in 2021, many of the US LNG export projects that had struggled to attract market demand and financing were able to approach buyers anew. They rapidly aggregated sufficient demand and take or pay commitments to achieve FID and move to construction phase. As a result of projects already under construction, the United States added 22.3 MT of new volumes in 2021, recording a 49.8% rise in exports over the previous year and becoming Europe's leading LNG supplier.

In addition to these increases in US export volumes, another feature of industry growth which has been facilitating a widening range of commercial operations has been the increase in freight capacity. In 2021, 68 new vessels were added to the LNG fleet, bringing it above 700 vessels. Charter rates, which had also fallen in 2020, recovered along with LNG prices and have remained strong for the last 12 months or more.

The LNG market has also grown through the addition of new regas capacity, which increased by 46 MTPA in 2021 reaching 993 MTPA, largely as a result of large new facilities in Brazil, Croatia, Indonesia and Kuwait. With the threat to gas security in Europe that has arisen in the last few months, Floating Storage and Regasification Units (FSRUs) are attracting a great deal of attention, with multiple projects being proposed in Germany, Italy, Netherlands and other potential locations.

The proportion of LNG traded on a spot basis in 2021 was lower than in 2020, partly as a result of the very high spot/index prices that applied, with around 36.6% of LNG trade being

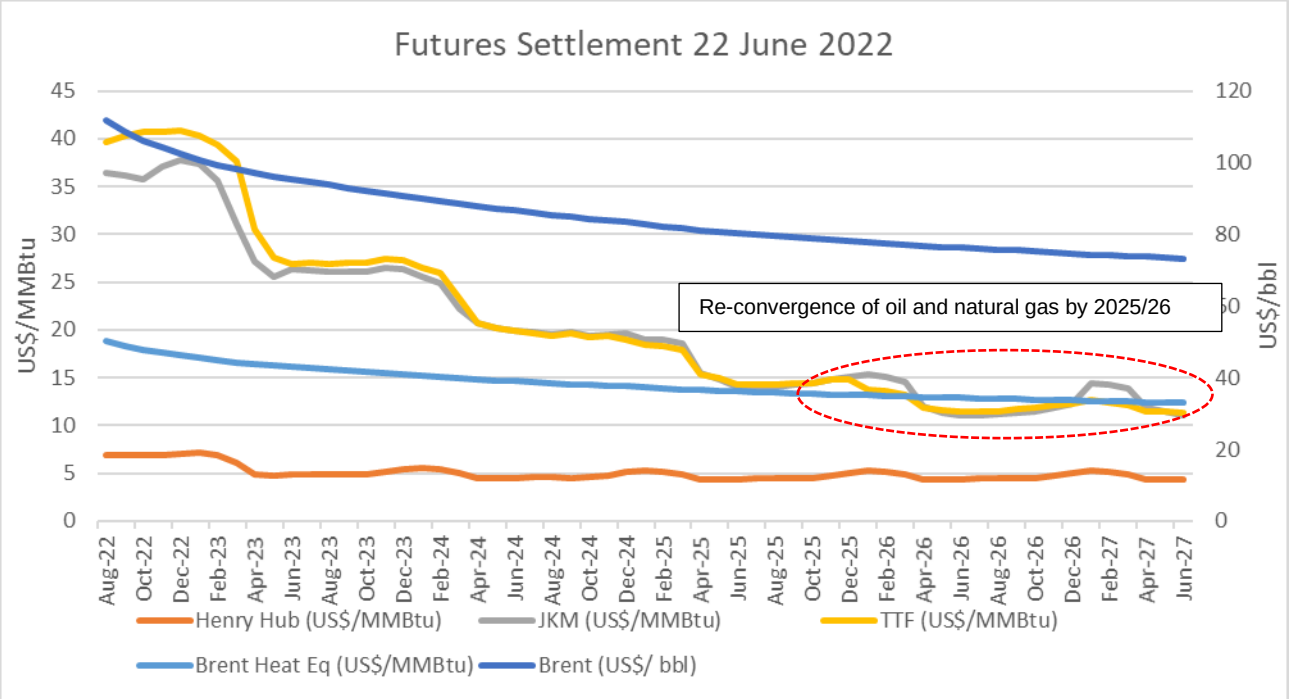
done on this basis, compared to 40% in 2020. Re-exports remain a relatively low proportion of trades, mainly owing to the material differences in regional pricing conditions that are necessary to make it economic. However, this is another feature of the LNG market which contributes to liquidity and the growing adoption of creative solutions which are continuing to bring change to the sector.

Since 2020, the relationship between the price of natural gas and that of oil has become increasingly uncorrelated, as each commodity has responded to its own market conditions. With fuel switching offering both operational and economic challenges, the structural separation of the oil and natural gas markets continues to lessen the linkages between the two, though in the longer term, market forces should enable both commodities to establish a more stable relationship.

The market tightness and supply shortages in the LNG sector mean that during 2021 natural gas indices demonstrated a higher price than oil by a factor of 2.85 on an energy equivalence basis, and for the first 6 months of 2022, the factor has risen above 3.

The graph below indicates that the forward market is anticipating a gradual convergence of oil and gas prices, but this is not anticipated to happen until the 2025/6 timeframe and clearly this realignment is at risk until the security situation in Europe is resolved and Russian gas imports are substituted from other sources or return to a much more reliable basis.

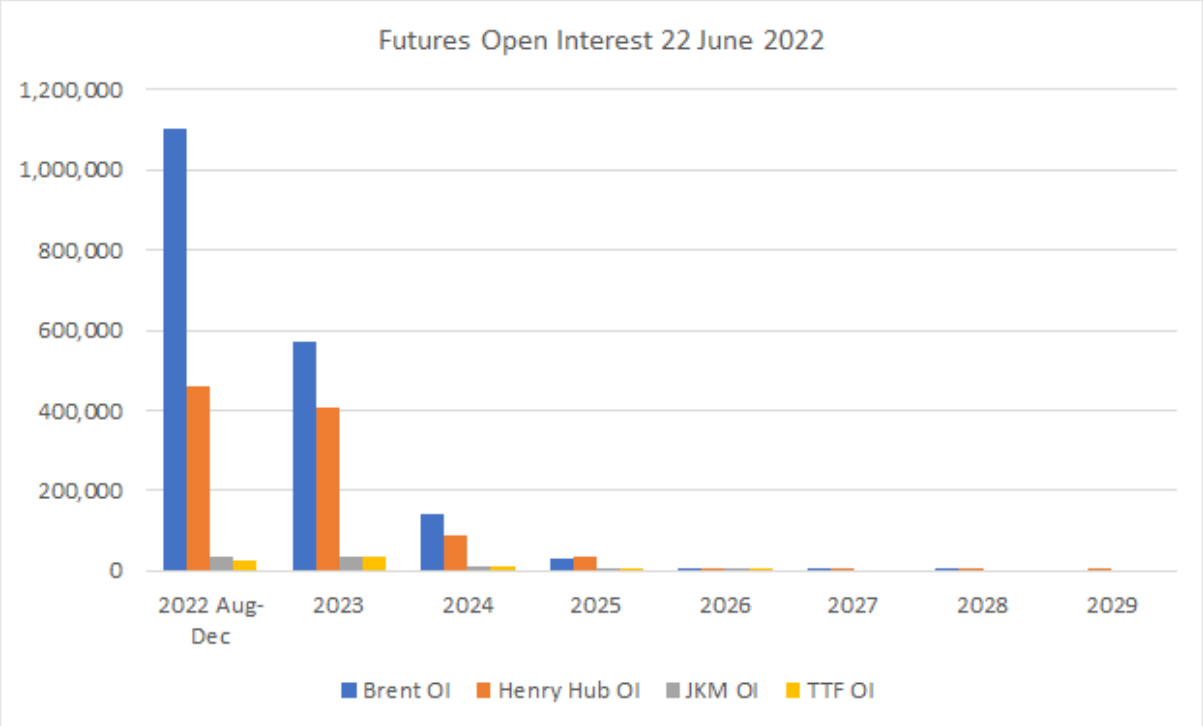
Figure 3: Forward Market Price Curves



Source: ICE, CME and GaffneyCline Analysis

From the chart above it can be seen that Henry hub converges to a long term average of around US$4.7/MMBtu from one year onwards. From the chart below for open interests[2], Henry Hub is heavily traded up to 2025 thus making the long term price of US$4.7/MMBtu a reliable indication of long-term market expectations. However, JKM and TTF futures prices are gradually converging to oil equivalent prices in 2025/26 in a very thin market. Thus, the reliability of JKM as well as TTF futures beyond 2024 is limited as a market indicator.

Figure 4: Open Interest for Oil and Gas Futures Markets



Source: ICE, CME and GaffneyCline Analysis

In the context of oil indexation applied to natural gas, the analysis set out below provides some additional insights that help put this report into context:

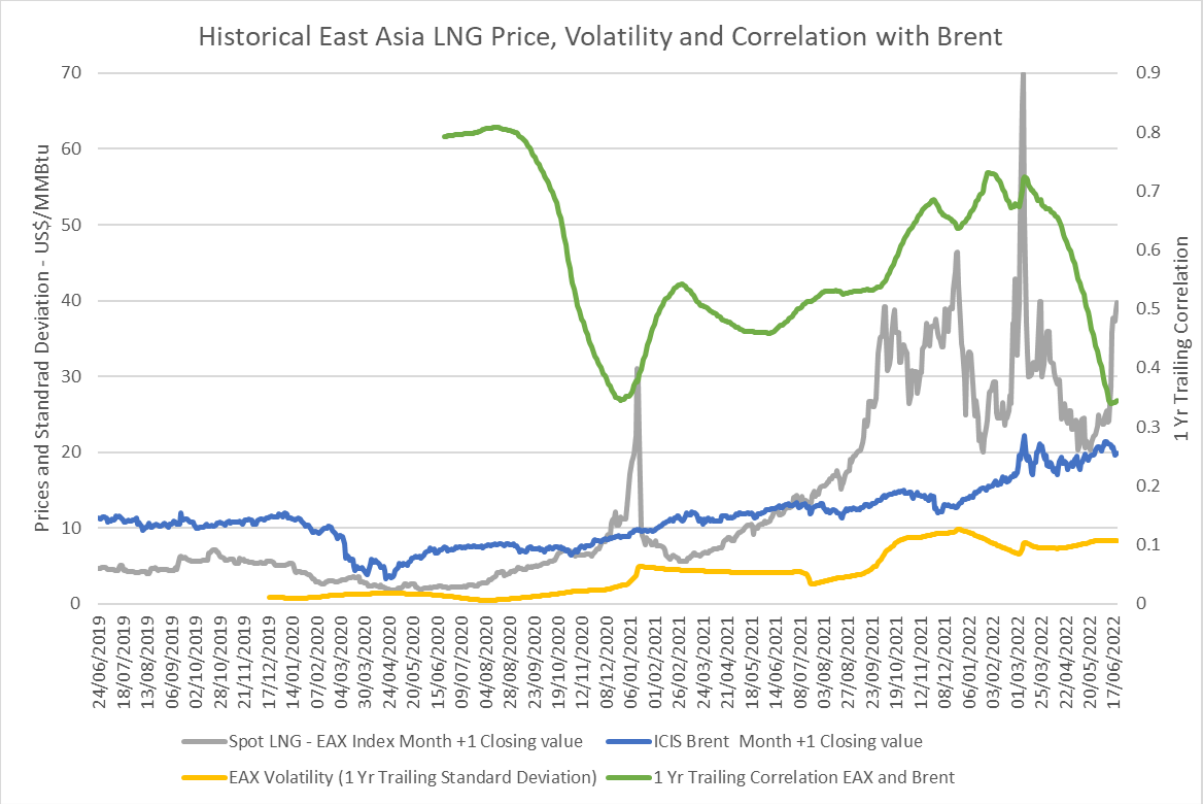
The last three-year data for east Asian LNG prices (EAX), volatility and correlation with Brent crude oil prices are shown in the next chart. In the last two years volatility in LNG prices has consistently risen as shown by the 1 year trailing standard deviation. Volatility has been particularly high over the last nine months. Correlation between Brent and EAX had been trending up from early 2020 to March 2022. However, the last three months have seen a deterioration of the correlation which is likely to have been mainly due to the impact of the Russian Ukraine conflict. Currently Asian gas markets are extremely high volatility and demonstrate a low correlation with crude oil markets.

As noted in the preface, the market features above mean that oil slopes negotiated for individual natural gas purchase agreements could vary considerably depending on the seller,

[2] Open Interest is a way of measuring the level of interest from financial players using the forward market to manage risk. A high open interest indicates a heavily traded market, and suggests a more reliable prediction of future prices. When open interest is low, caution needs to be used in interpreting the forward price levels indicated.

buyer, location and source of the natural gas. It is possible, therefore, that individual gas contracts with virtually identical terms, negotiated within weeks of one another, could vary in price materially depending on prevailing conditions.

Figure 5: Natural Gas Price Correlation and Volatility



Source: ICIS and GaffneyCline Analysis

Figure 5 above demonstrates the somewhat unstable correlation between spot LNG prices and Brent in recent months. This market feature may cause some buyers to place a risk premium on index-priced gas, compared to Brent. This would have the effect of depressing oil slopes slightly, compared to gas supplied under identical terms, but priced against an index such as JKM, and may also encourage some buyers towards oil-indexation until a more stable pricing environment starts to emerge. However, the effect of a tight market on gas prices generally is a bigger influence on prices and slope, which is why we are seeing oil slopes much higher than in previous years.

In conclusion, there are clear signs that for Brent indexed LNG contracts, those of a medium term duration are likely to attract a higher slope, with some industry commentators referring to prices of 15-17%. However, the longer the duration of the contract, the more competitive the slope is likely to become. For example, some market sources suggest that new volumes from Qatar North Field expansion project are being marketed in the range of 12-13% for deliveries starting in 2025, whereas a price of less than 11% might have been anticipated in 2021.

2 Summary of LNG Contracts Entered into within the Previous 12 Months

2.1 Medium Term Oil Indexed Contracts

No Medium-Term Oil[3] Indexed Contracts have been entered into that are on public record or in the ICIS database within the last 12 months, other than a non-binding Heads of Agreement (HoA) agreed in early June 2021 and priced at 11.2% Brent that is likely to be re-negotiated should it progress to a binding SPA.

However, there are two data points of interest:

- An international tender which closed on 25 August 2021 that was issued by an Indian buyer for delivery at their terminal in Gujarat. This tender was unusual in that it was for 18 cargoes for delivery between March 2022 and April 2025. The pricing reported for this transaction was just over 14% of Brent, for delivery ex-ship. No adjustment is required, therefore, for price conversion. Furthermore, contract details are insufficient to make any further adjustments for contract terms.
- An international contract was signed on 1 November 2021 with the buyer being a Chinese gas utility. This contract was to supply 1.5 MTPA LNG for nine years starting in 2023, and the seller is a major IOC with the deliveries coming from a portfolio, rather than being terminal specific. The pricing reported for this transaction was just under 13% of Brent, and pricing was also based on delivered LNG.

2.2 Long Term Oil Indexed Contracts in Last 12 Months

A total of 47 long-term LNG deals were agreed in the 12 months from 23 June 2021. Of these, 29 were signed with existing or prospective US sellers. The table below shows the long-term deals signed according to country of origin. The majority of these SPAs and the associated contracted volume originated from United States, followed by Qatar with much smaller number.

Table 1: Recent Long-term Sale and Purchase Agreements (by origin)

Origin	# of Contracts	Contracted Volume (MT)
Russia	1	7
Canada	1	22
Mexico	1	40
United States	29	600
Qatar	6	148
Trinidad & Tobago	3	3
Undeclared	6	32
Total	**47**	**851**

[3] For this analysis, a medium term oil indexed contract is an SPA of less than 7 years duration, with a full or partial oil slope component of the price, for which reliable pricing information is in the public domain or can be derived from the subscription service operated by ICIS

The number of long-term contracts signed is up 34% on the prior 12 months to June 2021 and up 74% on the 12 months ending June 2020, which demonstrates the trend towards buyers wanting to lock in volume given the market tightness and security of supply issues that have evolved since the COVID pandemic.

As shown in table below, the bulk of the contracts destination is China. A large number of contracts did not have declared destinations, but their LNG is mostly originated from the United States. This could be due to buyers maintaining flexibility to divert cargos for best pricing.

Table 2: Recent long-term Sale and Purchase Agreements (by destination)

Destination	# of Contracts	Contracted Volume (MT)
China	24	442
South Korea	3	59
Taiwan, Province of China	1	19
Brazil	1	10
Poland	2	40
Undeclared	16	282
Total	**47**	**851**

The bulk of the contracts signed are indexed to Henry Hub. Only 4 contracts were reported to have been agreed on the basis of an oil slope. Of those, pricing intelligence is available on 3 and the average slope used for LNG pricing was slightly more than 11%.

Table 3: Recent Long-term Sale and Purchase Agreements (by pricing mechanism)

Contract Type	# of Contracts	Contracted Volume (MT)
Henry Hub	25	545
Brent	4	42
Brent & AECO	1	22
Undeclared	17	243
Total	**47**	**851**

2.3 International Tenders

In the 12 months to June 2022 a total of 465 international tenders were issued of which 270 were on the buy side and 195 were on the sell side.

67% of these tenders were for a single cargo, and 20% involved more than 1 and less than 5 cargoes. Only 13% of tenders were for 5 or more cargoes.

In terms of the number of cargos tendered, India is a dominant player on the buy side and accounted for 385 out of a total of 1021 (approximately 38%) of the buy side cargos tendered. Australia is a leading player in the sell side cargos tenders with 57 out of total 345 (approximately 17%) sell side cargos tendered. Whilst China is a dominant importer, it still had high activity in sell side reported tenders, likely due to swap activity.

Figure 6: Buy Side Cargos Tender by Country

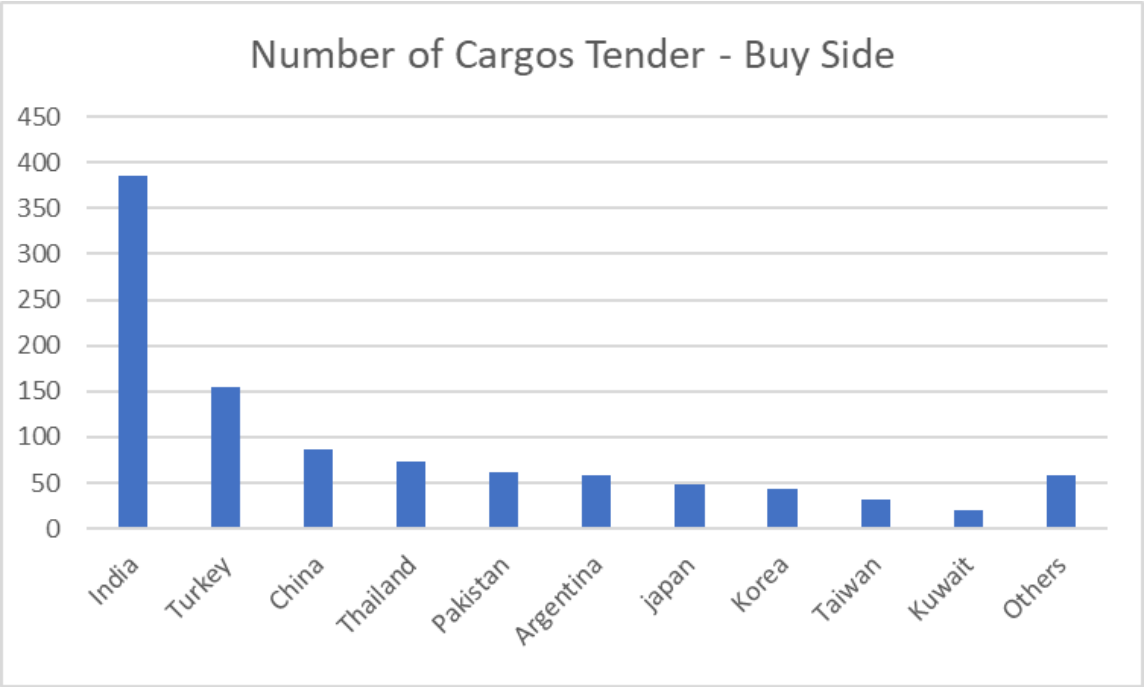


Figure 7: Sell Side Cargos Tender by Country

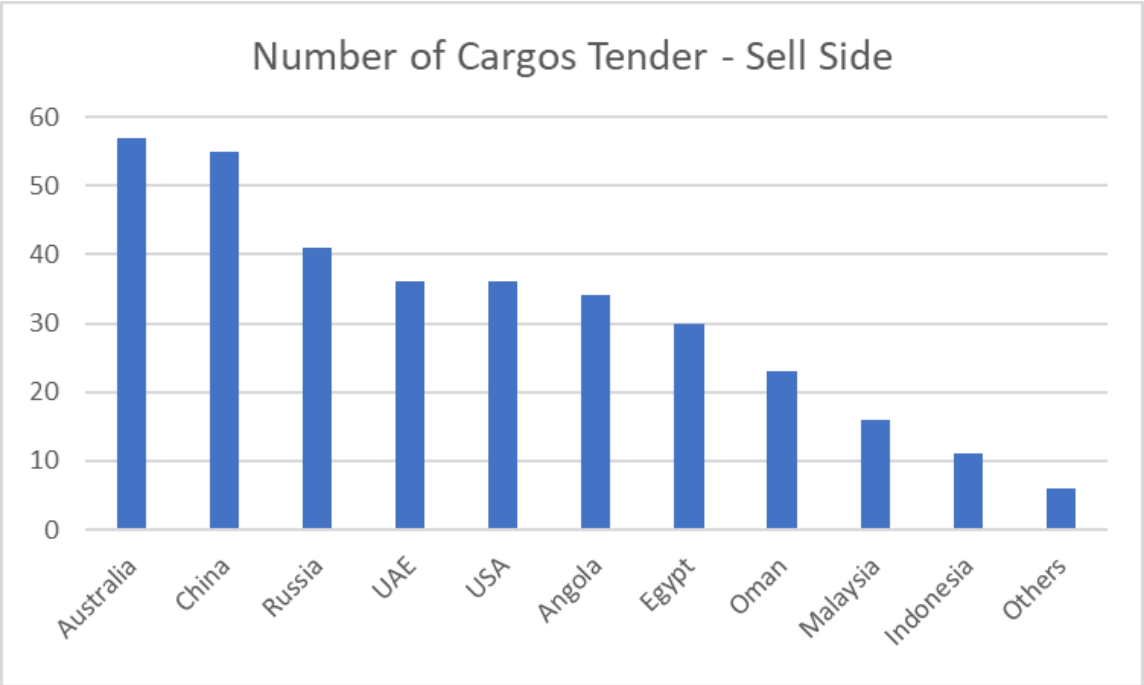


Figure 6 shows that the international tender data can be used as a good reference for Asia deliveries (ultimately netted back to Australia using ACCC methodology). Seven of the top 10 players in the international tender markets are Asian buyers, with European buyers typically relying on other market mechanisms.

Equally, as illustrated in Figure 7, Australia is very well represented on the sell side, suggesting a reasonable link between short term tender pricing data used in the methodology, and the pricing environment relevant to gas buyers in Eastern Australia.

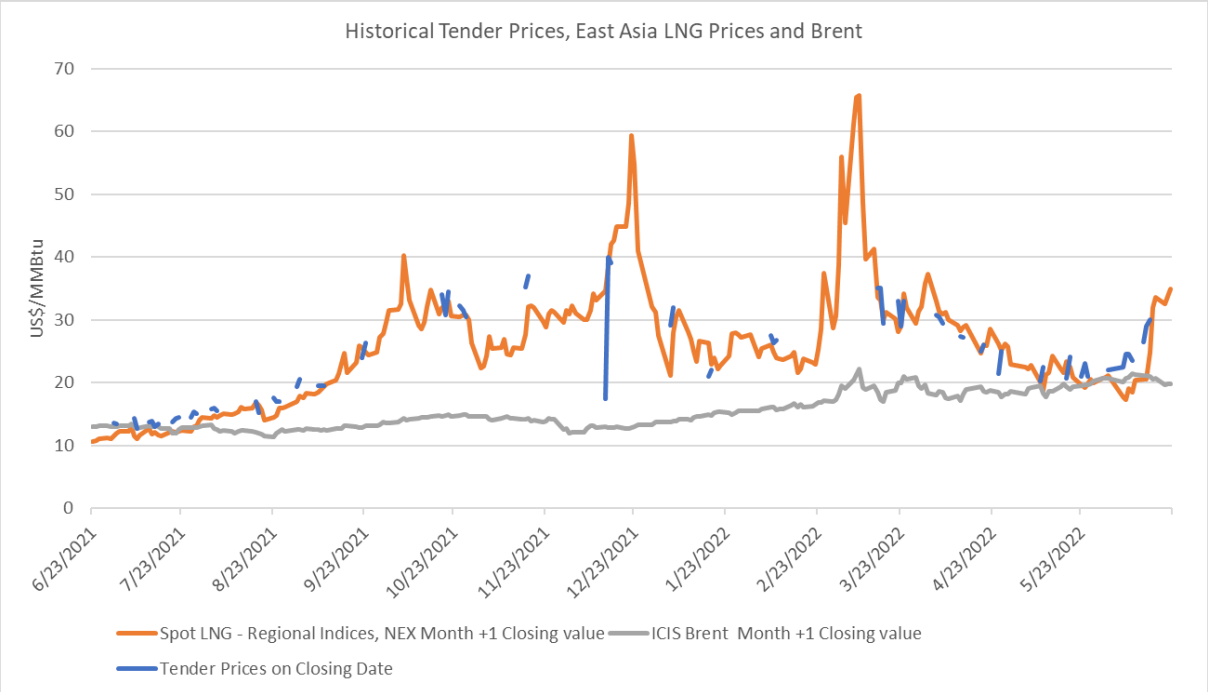
In terms of contract pricing, limited information is available. Based on available information the majority of the cargos were tendered at a fixed price. TTF and NE Asian markers were second and third preferred choices.

Table 4: Recent Tenders (by pricing mechanism)

Contract Pricing Type	Buy Side	Sell Side	Total
Fixed Price	219	62	281
TTF linked	141	16	157
NE Asian Marker linked	27	24	51
HH linked	21	7	28
Slope	20	6	26
Unknown	593	230	823
Total	**1021**	**345**	**1366**

In terms of pricing, available tender prices closely follow East Asian spot LNG indices. This is not surprising as tenders cater for the short-term markets. During extreme spot price movements, tender price information is sparsely available.

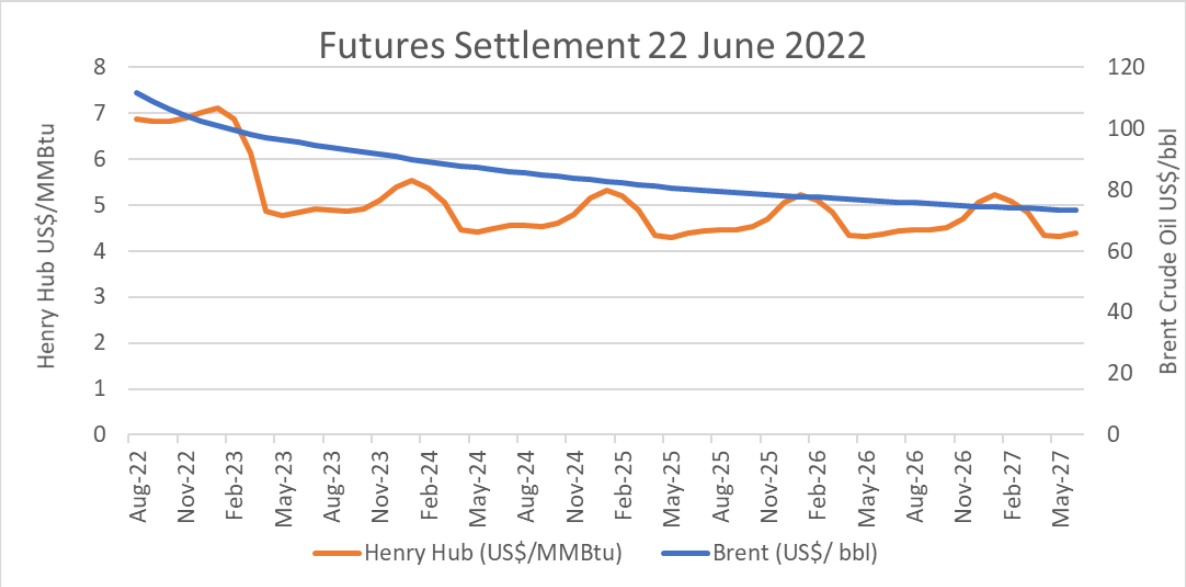
Figure 8: Historical Tender Prices



2.4 Estimation of US LRMC

Based on the analysis of Henry Hub forward prices, delivered gas into a Gulf Coast US LNG terminal would be expected to attract a price of 4.7 US$/MMBtu on average over the medium term period corresponding to the focus of this report (July 2024 to June 2027), and it is assumed this would attract a surcharge of 15% to address basis differential, fuel and other charges, reflecting typical LNG tolling terms.

Figure 9: Brent Crude Oil and Henry Hub Gas Forward Curve



The methodology includes an assumed $2/MMBtu tolling charge for use of the liquefaction facilities, and it is noted that in the last 12 months, two tolling style contracts were agreed, with a rate of just over $2/MMBtu. For this report, no change is proposed to the $2/MMBtu tolling assumption but this will be kept under review for future reports.

Based on an average delivery distance of 10,000 nautical miles (approximate average for Japan, China and Taiwan) and a round trip fee through the Panama Canal, US Gulf Coast exporters would be expected to have to meet a freight cost estimated at $2.3 per MMBtu for delivery to Asian markets, though this may not fully reflect LNG vessel charter rates and single voyage charters which could be more or less than this figure which is cost-reflective of a new vessel.

Table 5: Summary of Total LRMC Estimates for July 2024 to June 2027

Components	US$/ MMBtu	Description
Average Henry Hub Futures during period of interest	4.7	Average of July 2024 to June 2027
Liquefaction Surcharge	0.7	15% for fuel and other charges
Liquefaction Tolling Fee	2.0	
Shipping Charges	2.3	All-inclusive shipping charges
LRMC Estimate	**9.7**	

Based on the analysis of Brent forward prices, 78.5 US$/bbl is the average forward market price for the period July 2024 to June 2027. By back calculating the average delivered cost and the average price of oil, the calculated % slope for LRMC in terms of Brent is 12.4%.

3 Price Derivation

Based on the pricing methodology (set out in Appendix III) the estimation of a medium term oil indexed price for delivery to Asia will follow the process set out below:

3.1 Medium Term Contract History and Data

As noted in the discussion above, GaffneyCline's proprietary access to market activity and the ICIS database of LNG contracts has not identified any documented oil indexed contracts of up to 6 years duration.

However, in consideration of the close match in market parameters (date signed and duration) there are two datapoints that GaffneyCline consider to be sufficiently aligned with the criteria, to be of value in this analysis.

The two examples described in section 2.1 generate a volume weighted average of 12.9% for delivered LNG to an Asian destination (in this case India and China).

Given the lack of data from actual medium term examples, the following additional data will be used to estimate the oil related slope:

3.2 International Tenders

An analysis of oil linked international tenders over the last 12 months has turned up 7 examples, one of which was FOB from a Middle East export terminal[4], the others being DES to Asian destinations.

Table 6: Oil Slope pricing – International Tenders

Buy/Sell	Cargoes	Tender Close	Cargoes	Estimated Slope
Sell	6	11-Aug-21	6	16.9%
Buy	6	30-Sep-21	6	20.0%
Buy	18	25-Aug-21	18	14.1%
Buy[5]	2	19-Aug-21	1	34.7%
		19-Aug-21	1	24.5%
Buy	1	4-Aug-21	1	22.1%
			Weighted Average	**16.9%**

3.3 US LRMC

From section 2.4 above, the estimate of US LRMC over the relevant period renders a delivered price to Asia of $9.7 MMBtu which is calculated to be the equivalent of a slope of 12.4%.

[4] Price adjusted in the table above to account for freight charge from Middle East terminal to Asian destination
[5] Two differently priced cargoes under the same tender

3.4 Long Term SPAs

An analysis of oil linked international long term contracts over the last 12 months has turned up 3 examples, all are DES to Asian destinations. As set out in the methodology, GaffneyCline has estimated that a 5% surcharge would be applied.

Table 7: Oil Slope Pricing for Long-Term SPAs

Date Signed	Contract Start	Contract End	Annual Contract - MTPA	Total Volume - MT	Reported Slope
11-Jan-22	2023	2032	1.5	14	12.8%
8-Dec-21	2022	2037	1	15	10.0%
6-Dec-21	2024	2033	1	10	10.5%
				Weighted Average	**11.1%**

3.5 Oil Slope Final Calculation

The starting point for the estimated oil slope is the analysis of medium term contracts. As noted above, there are two examples which although not strictly falling within the criteria could be used as a reference. These generate an average slope of 12.9%. Since these do not sufficiently conform with the definition set out in the methodology (even with some discretionary flexibility applied), they are not included, but adopted as a "sense check" on the slope range emerging from the secondary analysis carried out.

Moving to the secondary analysis from which to draw, taking a combination (that depends on the degree of market volatility) of international tenders, US LRMC and long term SPAs. Based on the methodology set out, in a volatile market such as the one that exists today, it is proposed to place a weighting on the various input parameters in the proportion of 1:2:3:

- Least weighting on international tenders (on the basis they reflect short term market pressures)
- Medium weighting on US LRMC
- Most weighting on Long Term SPAs

By applying the process to the data and calculations set out above, the following oil slope estimation is calculated (without reference to the non-conforming but illustrative data points from the assessment of medium term contracts):

Contract Type	Weights	Slope	Section
Volume weighted international tenders	1	16.9%	3.2
LRMC US exports converted to slope	2	12.4%	3.3
Volume weighted long term deals*	3	11.7%	3.4
Published Slope Estimate		**12.8%**	
*Long term slope of 11.1% is adjusted +5% for financing benefits			

While the methodology is considered robust and appropriate, it should be noted that the disruption to global supplies over the last several months has introduced a level of

unpredictability and unprecedented price volatility which makes any attempt to forecast price levels exceptionally hard.

Given the global gas market disruption, and the potential for major European supply interruptions during the second half of 2022 and into 2023, the prices derived from the analysis set out in this report may be impacted by rapidly changing market conditions and this should be taken into consideration in the context of any natural gas pricing negotiations in the coming months. This will be revisited in the next Report #2 prepared for end 2022 / early 2023.

Gaffney Cline

Appendix I
Glossary of Terms

List of Standard Oil Industry Terms and Abbreviations

ACQ	Annual Contract Quantity
A$	Australian Dollars
Bbl	Barrels
/Bbl	per barrel
BBbl	Billion Barrels
Bscf or Bcf	Billion standard cubic feet
Bscfd or Bcfd	Billion standard cubic feet per day
Bm^3	Billion cubic metres
boe	Barrels of oil equivalent @ xxx mcf/Bbl
boepd	Barrels of oil equivalent per day @ xxx mcf/Bbl
BTU	British Thermal Units
CAPEX	Capital Expenditure
DAT	Delivered At Terminal
DCQ	Daily Contract Quantity
DES	Delivered Ex Ship
FDP	Field Development Plan
FEED	Front End Engineering and Design
FID	Final Investment Decision
FOB	Free on Board
GBP	Pounds Sterling
HH	Henry Hub (US gas hub price)
ICIS	International Commodity Intelligence Services
JKM	Platts Japan Korea Marker (TM)
LNG	Liquefied Natural Gas
m^3	Cubic metres
Mcf or Mscf	Thousand standard cubic feet
MMcf or MMscf	Million standard cubic feet
m^3d	Cubic metres per day
Mm^3	Thousand Cubic metres
Mm^3d	Thousand Cubic metres per day
MM	Million
MMBbl	Millions of barrels
MMBTU	Millions of British Thermal Units
Mscfd	Thousand standard cubic feet per day
MMscfd	Million standard cubic feet per day
MMtpa	Million tonnes per annum
NBP	National Balancing Point (UK gas hub price)
p.a.	Per annum
cfd or scfd	Standard Cubic Feet per day
scf/ton	Standard cubic foot per ton

SL	Straight line (for depreciation)
SPE	Society of Petroleum Engineers
SPEE	Society of Petroleum Evaluation Engineers
ss	Subsea
T	Tonnes
TD	Total Depth
Te	Tonnes equivalent
THP	Tubing Head Pressure
TJ	Terajoules (10^{12} Joules)
Tscf or Tcf	Trillion standard cubic feet
TTF	Title Transfer Facility (NL gas hub)
TOP	Take or Pay
US$	United States Dollar

Gaffney Cline

Appendix II
Methodology for Normalising Contract Terms

The negotiation of a major Sale and Purchase Agreement between an LNG seller and buyer will typically be examined on a sophisticated basis, with each side taking advantage of a support group whose role it would be to quantify the financial implications of various terms and conditions contained in the contract.

A firm LNG offtake by an FOB buyer would be priced according to the following features and variables:

- ACQ. Base project economics would be based on an expectation that the buyer would undertake to purchase a quantity of gas equal to the ACQ. This would then be inputted into the master project economic model, which would generate a project return, which may be further subdivided into an equity return, based on the fixed portion of debt that may be present, and the cost that had been negotiated.
- The starting point for the model would most likely be an approach that contains some reasonable degree of contract flexibility, coupled with what might be considered a "market price" for LNG at the time. Variations from these typical flexibility terms would be evaluated to determine whether a lower or higher indexation level would be appropriate.
- The considerations that the seller would bear in mind are set out below, and a basic assessment of the order of magnitude of each feature, in terms of changes to the price and oil indexation needed to generate similar economic returns, is set out at the bottom of the discussion.

With this base case in mind, the sellers would examine the various features of the contract and may assign a change in the project returns, which could be translated into a pricing discussion to be had with the counterparty.

The methodology involved in assessing a price change resulting from a number of the key contract parameters could be viewed as follows:

- FOB versus DES. The seller may take the view that using an FOB sales basis would preclude the sellers from organizing their shipping fleet to take advantage of operational synergies, fast or slow steaming, or other mechanism that could either save on the cost of freight or result in a slightly higher average cost of gas sold.
- Lack of diversion rights/profit sharing clause. An FOB offtaker who is in the business of LNG aggregation and trading would not typically agree to any restrictions on LNG destination or sales price, as might have been the case with a utility buyer (FOB or DES). As such, the seller would not benefit from periodic sales of LNG on a spot basis at prices higher than the contract price. This represents an opportunity cost, therefore. The basis for assessing this opportunity cost might be an assumption that a small portion of LNG sales could be redirected, and that the seller might share any net profits under a 50/50 arrangement.
- Downward Flexibility Quantity (DFQ). If the buyer is offered the option to reduce the ACQ by a DFQ, the seller would typically make an assumption around the frequency and amount by which the ACQ might be reduced and rerun their project model based on that lower sales volume. This could then be translated into an equivalent higher base price, to keep the seller's economics "whole". Some allowance may be made for being able to insert a spot cargo into the ADS, to partially compensate for the lack of cashflow as a result of the buyer using their DFQ, but the assumption would be for a

lower price, given the short term nature of the cargo, which might, for example, be sold through a tender.

- Upward Flexibility Quantity (UFQ). The opportunity cost for the UFQ is more complex to address as the existence of the UFQ means that up until the ADS is agreed, the seller would need to put aside sufficient capacity to be able to offer UFQ in the first place, unless the obligation to make it available is on a reasonable endeavours basis only. Typically, a reasonable endeavours obligation to supply gas would be classed as excess gas. As with the DFQ, some assumption might be made that if the buyer does not exercise their UFQ, then that same quantity of gas could be offered for sale on a short term/spot basis.
- Excess Gas. Most LNG facilities are capable of operating beyond their nameplate capacity, especially after one or two years of operation, and so buyers have the opportunity to take excess gas. Where excess gas is priced at the contract price, it represents a boost to project economics, as its marginal cost of production is less, and typically excess gas would only be marketed on a short term/spot basis as the seller would typically be uncomfortable selling it on a long term/committed basis (especially prior to any formal debottlenecking process).
- Other factors that may influence price include whether the project is in development phase, or whether LNG is being re-marketed following the end of a previous contract, geopolitical risk and security considerations, and whether the buyer has equity participation in the project.

Table AII.1: Summary of Contract Term Reconciliation Process

Scenario	*Assumption (based on 14.8% JCC with typical levels of flexibility)*	*Price implication $/MMBtu*	*Price implication %JCC*	*Price implication %JCC*	*Resulting indexation*	*Resulting indexation*
			$50 oil	*$80 oil*	*$50 oil*	*$80 oil*
Base price inexation with no flexibility by seller and control by the buyer over shipping efficiencies	13.75		$ 7.40	$ 11.84		
FOB basis for sale compated to DES	A 5% saving in freight costs by being able to control shipping logistics	$ 0.09	0.17	0.31	13.92	14.06
Lack of diversion rights	Assumes that 1 in 20 cargoes could be sold for an additional $1/MMBtu	$ 0.03	0.05	0.09	13.80	13.84
Downward flexibility quantity	A 10% buyers option to reduce the ACQ with no mitigation from spot sales with no price or volume mitigation	$ 0.17	0.31	0.57	14.06	14.32
Upward flexibility quantity	A 10% buyers option for a firm commitment to deliver 10% more than the ACQ with the potential to mitigate by selling the equivalent on a short term basis at a $1/MMBtu discount	$ 0.10	0.19	0.35	13.94	14.10
Excess gas	An average of 5% in addition to the ACQ sold at the contract price	$ (0.08)	-0.14	-0.26	13.61	13.49
Median pricing assuming 10% DFQ, Excess Gas, FOB, no diversion, $80 oil				1.05		14.80

Gaffney Cline

Appendix III
Pricing Methodology

Based on the analysis set out in the report on methodology, three main sources of insight can be applied to understanding contemporary LNG contract pricing, in addition to reported contracts of the duration of interest (3-6 years). These are:

4. Short term international tenders
5. Long run cost of US LNG Exports
6. Long term contract signings

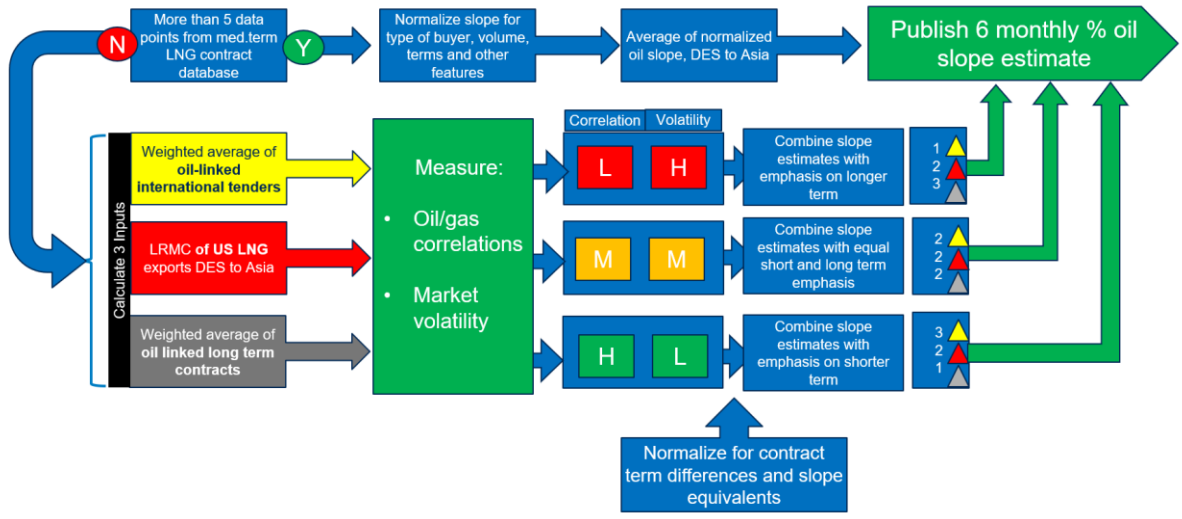
The discussion in the sections above demonstrates that the relationship between these three sources of insight varies, based on the market conditions prevailing. For example, when there is considerable volatility in the market, shorter term/international tender prices can depart substantially from longer term market fundamentals, and are less helpful in signalling an oil slope up to 5 years out.

Conversely, when the market is very well correlated, and volatility is low, tender prices are a much better signal for a 5 year look ahead and deserve greater emphasis in the approximation process.

When average levels of correlation / price volatility apply, a 5 year look ahead is likely to be equally affected by shorter term, longer term, and calculated long run costs of LNG delivered from the US.

The methodology is illustrated schematically below:

Figure AIII.1: Methodology Flow Diagram



Note: For the purposes of the flow chart above long term contracts for input #3 would be those signed in the previous 12 months, but not necessarily flowing. Medium term contracts are those with a duration of less than 7 years, long term contracts would include those of 7 years or more. This cut off is based on the typical tenor of LNG loans of more than 7 years. A 5% price difference would be applied as a mechanism to convert from a long term LNG SPA to a deemed medium term price, based on an assumption that a prospective seller would not be able to use the credit support from a firm offtake to lower the cost of an LNG debt instrument.

The methodology and derivation of approximate 5-year oil-linked LNG slope is set out in more detail below:

1. If there is sufficient data that can be sourced for medium term LNG contracts (e.g. 5 or more transactions with full or partial reported oil slope within the previous 12 months), then the volume weighted average of these slopes will be used as the primary input derive LNG oil slope estimates.[6]
2. If there is insufficient data from this source, then any price points that can be sourced (if any) pursuant to #(1) above will be modified using the following approach:
   a. Calculate the volume weighted average of internationally tendered cargoes linked to oil
   b. Calculate the long run marginal cost of US LNG exported to Asia
   c. Calculate the volume weighted average of any long-term contracts linked to oil

   These three parameters will be combined following the process set out below to produce a single slope data point, and combined with the slope data derived from #1 using a simple arithmetic average to generate the final six monthly oil slope estimate.
3. In an environment where oil and gas indices have experienced high volatility and have been **less than 40%** correlated within the previous 12 months: Combine the oil slope derived from (1) and the coefficients calculated from 2 (a), (b) and (c) in the proportions 1:2:3, thereby placing more emphasis on longer term deals
4. In an environment where oil and gas indices have experienced average volatility and have been **more than 40% and less than 60%** correlated within the previous 12 months: Combine the oil slope derived from (1) and the coefficients calculated from 2 (a), (b) and (c) in equal proportions to calculate an overall oil slope
5. In an environment where oil and gas indices have experienced low volatility and have been **more than 60%** correlated within the previous 12 months: Combine the oil slope derived from (1) and the coefficients calculated from 2 (a), (b) and (c) in the proportions 3:2:1, thereby placing more emphasis on shorter term deals.
6. In the event of lack of tender related oil pricing, or longer-term SPA pricing, or both, the following amended process will be adopted:
   a. When there is no recent tender related oil pricing data the input otherwise derived from this feature of the analysis would be excluded, and the averages re-calculated with reference to inputs #2 and #3. In this case the greatest emphasis will be placed on actual contract terms entered into by unrelated counterparties (of whatever term) and the US LRMC derived pricing would be applied with lesser emphasis in the ratio 3:2 with the greater weighting on longer term SPAs—regardless of market volatility.
   b. In the unlikely event there are no long-term oil linked contracts from which to derive data, the same logic would apply and the weighting between recent oil-linked tender data and US LRMC would be applied in the ratio 3:2 respectively.

[6] If GaffneyCline considers that there are relevant medium term LNG contracts that were executed outside (but reasonably close to) the 12 month period, then to the extent these can be used to place less reliance on the alternative data sources, GaffneyCline may account for these in the calculation of LNG prices as it considers appropriate.

c. Finally, in the event that no oil-indexed data can be sourced *neither* from the recent international tender activity *nor* longer term signed SPAs the ***previous six-monthly report*** LNG slope will be utlised, and adopted as the current six-monthly price estimate.

Worked examples to illustrate the methodology are included below. ***Example 1*** shows how the oil slope would be derived, based on 6 example contracts for which oil slope data is available:

Table AIII.1: Worked Example 1

Example Contract	*Volume (MMtpa)*	*Slope adjusted for terms and delivery point*
1	***0.5***	***11.0%***
2	***1.25***	***11.5%***
3	***1***	***10.0%***
4	***0.35***	***10.2%***
5	***0.8***	***10.4%***
6	***1***	***12.0%***
Total volume / Weighed average	***4.9***	***11.0%***

In this example, the contracts range between 10% and 12% in indexation (adjusted for contract terms where appropriate) and from 0.35 to 1.25 MTPA in annual quantity. The resulting price slope is 11%.

Example 2 shows a more likely scenario, where only limited contract data has been obtained, in this case from 3 example contracts. Depending on the degree to which oil and gas prices are correlated, there are three different scenarios for deriving the relevant oil slope. The three example scenarios involve an oil/gas correlation of 50% (average), 35% (low) and 65% (high correlation, and therefore each hypothetical scenario places a differing emphasis on short- and long-term contract pricing:

Table AIII.2: Worked Example 2

Example Contract	*Volume (MTPA)*	*Slope adjusted for terms and delivery point*
1	*0.5*	*11.0%*
2	*1.25*	*11.5%*
3	*1*	*10.0%*
Total volume / Weighed average	*2.75*	*10.9%*
Volume weighted international tenders		*13.1%*
Volume weighted long term deals		*10.3%*
LRMC US exports converted to slope		*9.5%*
Oil/index correlation 50%	*Averaged slope*	*10.9%*
Oil/index correlation 35%	*Averaged slope*	*10.7%*
Oil/index correlation 65%	*Averaged slope*	*11.1%*

Depending on how markets have behaved in the 12 months prior to the price determination, the oil slope could be between 10.7% and 11.1%. GaffneyCline will provide its recommended approximate slope, based on our market assessment.

It is envisaged that as LNG markets and the half yearly report evolve over the coming months, the methodology could be revised and simplified.