THE UNIVERSITY OF QUEENSLAND
AUSTRALIA

UQ Centre for Natural Gas

14 April 2021

Australian Competition & Consumer Commission
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Dear Mr Runciman,

ACCC review of the LNG netback price series – Issues paper (18 March 2021)

Purpose

The purpose of this letter is to provide feedback to the ACCC LNG netback price series. The analyses and comments herein are necessarily illustrative and preliminary, but I would be happy to follow up formally or informally to discuss these matters in greater detail.

Introduction

I am the Director of the Centre for Natural Gas (CNG) at the University of Queensland (UQ). The Centre conducts applied industry research across multiple disciplines and is co-funded by the University, the local gas industry as well as by competitive grants from State and Federal governments (https://natural-gas.centre.uq.edu.au/). I have over 25 years' experience working in the international oil and gas industry and currently teach Masters Students about the economic appraisal of natural gas projects. I am a former non-executive director of National Energy Resources Australia (NERA) and I am a current non-executive director of the Australian Gas Industry Trust (AGIT). This letter represents my personal views and does not purport to represent the views of the University, the UQ CNG member companies or AGIT.

I last corresponded with the Inquiry in detail in March 2018 and refer you to comments on Net Back Price series discussed in that letter as well as the importance of costs of supply (and replacement) which should also inform price comparisons and expectations. I would also refer you to my comments, based on your data at that time, about the possible sensitivity of contracted gas price to gas volume and contract duration.

Comments on the issues paper

The ACCC publishes the LNG netback price (NBP) series as a "... *measure to improve transparency of gas prices in the east coast gas market*" and asserts that this price series "... *represents the price, at Wallumbilla, that a gas supplier would expect to receive for gas if it was converted to LNG and exported*". This is an overly definitive framing of what supplier "would expect" which belies the complexities of the production technology and the various gas markets and gas sales 'types'. It would better to condition this e.g. the NBP is *somewhat representative* of prices for *gas sold on the domestic spot market*, that a supplier might have expected to receive, *in a look-back sense* (*c.p.)*.

An underlying assumption of one-way causality can be read into the NBP series rationale i.e. that "... *LNG spot prices ... influence domestic prices*" [p.9 of the Issues Paper]. The *inference* is that high/low Asia LNG spot prices

cause high/low domestic spot prices, perhaps because suppliers can somehow both *know definitively* and choose the best price at a given time, rather than make guesses of prices achievable in each; and, as if the choice is an unconstrained binary either/or, rather than either/or, neither or both. A more appropriate articulation might be that LNG spot prices and domestic gas spot prices are each influenced by forward estimates (guesses) based on complex market fundamentals and choices are limited by the technologies of gas and LNG production and transportation. Because of the way that LNG eventuates (i.e. LNG that is surplus-to-fixed-delivery-contracts) it may be an error of construction (or at least an over-simplistic one) to assume that a spot market sale of LNG is a contemporaneous, "opportunity cost" for the supply of that same quantity of gas for the domestic spot market at Wallumbilla.

Transparency in the context of the historic NBP, is in essence a "look back" assessment of what has been paid, intended somehow for comparison purposes. A forward NBP series then aspires usefully to inform the broader domestic market about current and future prices. Such a benchmark series has potential utility only if; (i) the products or services benchmarked are similar; (ii) the pathway to markets (LNG spot and domestic spot) are more or less both contemporaneous and similar; and, (iii) if historic prices that have been paid, trends in those prices and price differences, are a useful indicator or 'predictors' for future prices. If these conditions are not met, then price information may be made available but does not necessarily create transparency. In the context of the NBP series, the conditions seem to be not well met. The NBP series is derived from unassured, spot gas sales, whereas the product that the domestic market demands is assured, contracted gas. The mechanics and timing of spot LNG sales are not the same as those for domestic spot sales. And, the forward NBP series do not match well with subsequent calculations of NBP based on observed Asian spot prices. The forecast in particular seems to have little utility (the NBP series seems to be effectively non-stationary[1]).

Based on this, in my view the historic and forward NBP series should not serve as any sort of anchoring point for current, or especially future, price expectations in domestic gas markets (especially the non-spot markets).

Conceptual questions for the NPB and useful transparency

There are two main conceptual issues for discussion with the ACCC NPB in terms of transparency and producing useful information on past or present prices in the domestic market.

The first and main one is that, in addition to mechanical and timing differences between the two markets, the NBP series is not grounded in the *type* of gas that is sought most commonly in Australia (and it represents a very small proportion of Queensland LNG sales). The benchmark (i.e. Asian spot gas) is not the gas that is in demand here i.e. assured, contracted gas. In theory, prices for assured, contracted gas should account for some form of delivery/assurance premium (otherwise why contract) as well as some form of volume and duration dependent price factors (premiums or discounts) and should somehow reflect the price outlooks (guesses) of buyers and suppliers *at the time*. Furthermore, the opportunity cost assumption that there is a contemporaneous dual, either/or choice between supplying Asian spot or domestic spot market is probably over-simplistic.

A second factor which limits insights is that the NBP series does not provide any information to the market about the costs of supply and its replacement. Such information might reasonably, over the medium term, inform price expectations. For example, if the market requires continued supply availability for the medium to long term, then the *expectation*, over the medium term, would not rationally be for prices (for the majority of gas traded) to

[1] For example, (in Fig 1) the rolling 12-month average monthly NBP has a min value of $4.20/GJ and a max of $10.88/GJ and for these same 12 months series, the standard deviation varies from a maximum of $4.65/GJ to a minimum of $0.87/GJ.

remain on aggregate lower than costs of supply and replacement. Suitable information may already be available. While details are not clear, costs of supply (and possibly *some* replacement) seem to be the basis for 'gas price assumptions' (or 'requirements for commerciality') that were reported for "uncontracted reserves" in the ACCC's January 2021 Interim Report (Appendix A; Box A.1). These price assumptions ($7.56/GJ to $7.73/GJ) are presumably congruent with reserves estimations. Interestingly, gas price forecasts (GSOO 2021, supporting materials[2]), used in a "Central Scenario", seem to adopt a price outlook also somewhat in line with costs of supply (typically ~A$7.50/GJ) as estimated (by others). Historically, GSOO has also included estimates of "Full lifecycle Cost" (*in* supporting material[3]) for different production areas for both 2P Reserves and for Contingent Resources including Appraisal, Acquisition and Exploration Costs (see Section 6.1 and 6.2 of that report).

The Behaviour of the ACCC Net Back Price Series?

The following simplistic analyses aims only to explore and illustrate the behaviour and hence potentially utility to date of the NBP series.

Observation 1: Differences between the ACCC NBP and WGSH-VWA prices: Figure 1, shows a comparison of monthly historic NBP[4] (red) and actual, observed Wallumbilla Gas Supply Volume Weighted Average, WGSH-VWA[5] prices (brown) *for the period April 2016 to Dec 2020*.

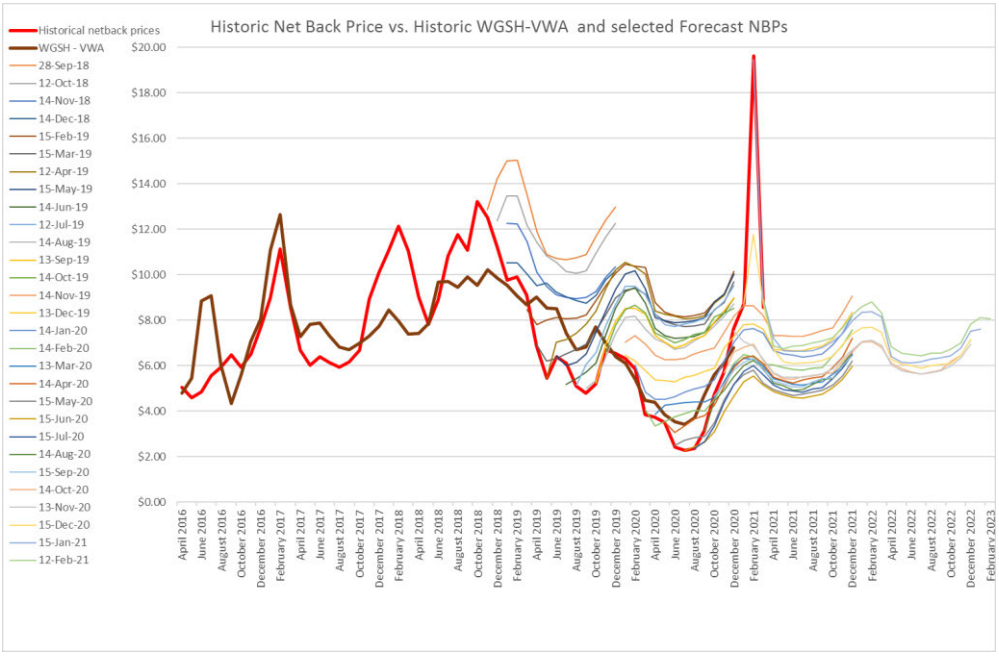

Figure 1: Monthly historic NBP (red) vs. observed monthly WGSH-VWA (brown), and selected forward NPB series (09/18 to 02/21).

[2] 2021 GSOO Gas Price Forecasts https://aemo.com.au/en/energy-systems/gas/gas-forecasting-and-planning/gas-statement-of-opportunities-gsoo

[3] Example: Gas Reserves and Resources, Costs | Eastern & Northern Australia, NT. Core Energy and Resources Nov 2019. https://www.aemo.com.au/-/media/files/gas/national_planning_and_forecasting/gsoo/2020/final_reserves_contracts_cost_report.pdf?la=en

[4] LNG netback price series chart data (ACCC). https://www.accc.gov.au/regulated-infrastructure/energy/gas-inquiry-2017-2025/lng-netback-price-series

[5] Wallumbilla Gas Supply Hub - trade volume and VWA prices by pipeline (AER). This is the only domestic price series examined at this time (for reasons of limited time) https://www.aer.gov.au/wholesale-markets/wholesale-statistics/wallumbilla-gas-supply-hub-trade-volume-and-vwa-prices-by-pipeline

Figure 2, shows a simple cross plot between the two observed price series (Apr 2016 to Dec 2020). The following observations can be made.

- The observed price series are *somewhat* positively correlated
- The average, over the period, of each series is almost the same ($7.17/GJ vs. $7.34/GJ). This is similar to the cost of supply associated (by others) with 2P reserves as well as to assumptions used by AEMO for longer term outlooks.
- The historic, observed monthly NBP (calculations) are more variable than monthly observed WGSH-VWA (st. dev. +/-$2.73/GJ for the NBP vs. +/-$1.99/GJ for the WGSH-VWA[6]).
- Examining a simple, least squares, best-fit, straight-line relationship, gives the following the outcome: - WGSH-VWA = 0.57 x NBP + $3.28/GJ
    - A $1/GJ increment in NPB has corresponded to a $0.57/GJ increment in WGSH-VWA price - the coefficient of determination between the two variables (R^2) is 0.61.
    - Observed levels and relatively larger changes in NBP have not been good predictors of levels and relatively smaller changes in WGSH-VWA price.
- In the 57-month period illustrated (Figure 1), there were 35 months in which the monthly WGSH-VWA price was higher than the monthly NBP, and 22 months when it was lower – but, this ratio is highly dependent on the time period examined.
    - For example, in the period Nov 2017 to Oct 2018 the observed Wallumbilla price was lower than the observed NBP for 10 out of the 12 months; and from Nov 2018 to Oct 2019, it was lower for just 5 out of the 12 months

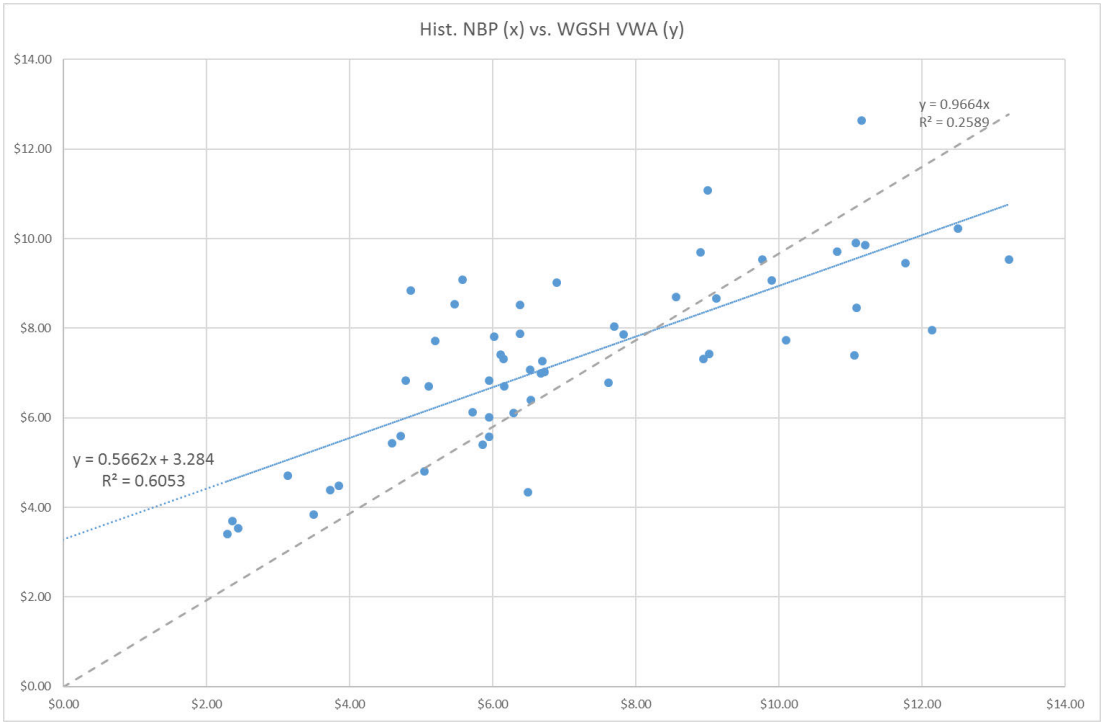

Figure 2: Correlation between monthly historic, observed NPB and observed monthly WGSH-VWA for the period April 2016 to Dec 2020.

[6] The reason for this difference and degree to which this difference in variability is influenced by volume weighting is not determinable from the available data. The difference is typically less than the st. dev. of the NBP series is not obviously systemic.

Observation 2: Performance of forecast NPB vs. observed NPB.

Figure 1, also shows a number of forecast NBPs (fainter lines on the chart) compared to the actual, observed or historic NPBs (red).

- The variability (st. dev.) of the forward NBP series (typically around +/- $1.00/GJ) is significantly lower than that of the historic NBP series. The forward series does not reflect the dynamics of the actuals.
- The forecast NBP prices diverge significantly from actuals – they are a poor predictor
    - The difference between forecast and actual, 1-2 months after forecasting date, is on average over this sub-set of data +2%, though the range is -15% to +26%.
    - The difference between forecast and actual, 7-8 months after forecasting date, is typically +50%, with a range from -70% to +176%.

Summary of observations

These analyses are not extensive and only *indicate* rather than properly quantify issues with the historic and forward NBP series and their contribution to transparency. Furthermore, the analysis is correlative and should not be inferred as causal.

The NBP is more variable than the domestic price benchmark examined here (WGSH-VWA). From a simple statistical basis, incremental changes in $/GJ of the NBP, do not correspond to similar sized increments in WGSH-VWA price. There are real and unpredictable differences in market dynamics.

As a forecast indicator, the forward NBP series performs poorly with major errors growing significantly over time. These errors are not randomly distributed. The series almost always over-predicted price in a declining NBP price environment (e.g. northern hemisphere winter to northern hemisphere summer, NHW to NHS). Forward NBP series tended to under-predict in a rising NBP price environment (e.g. NHS to NHW). A better predictive performance *may* be achievable by super-imposing larger and growing seasonal trends (based on Northern hemisphere demand patterns) onto current NBP forecasting methods. However, for such a possibly non-stationary series, any such refinement, needs a deeper analysis to confirm its utility. Instead of this, better information might also be provided to the local market, if relationships between contract volume, duration and price can be determined from historic contract data and if these relationships hold in rising and falling demand (seasonal) demand markets.

In essence, reference to a non-stationary price series and forecasts thereof, for a different product in a dissimilar market seems to produce little useful transparency (could even be a disservice to buyers in terms of any expectation setting or anchoring). Given representativeness, uncertainties and system dynamics, it is unreasonable to expect to be able conclude simplistically, based on these price comparisons that domestic prices were too high (or too low) – if that were the aim.

<u>Response to Questions</u>

The length of the forward LNG netback price series

Notwithstanding previous comments,

1. ***Whether there would be merit in the ACCC publishing a longer-term LNG netback price series?*** No, not if the series proves to be non-stationary. The LNG netback price forward series has little utility. Better transparency *might* be gained through (i) incorporating better seasonal trends; and (ii) account for the higher volatility in

the historic NBP compared to the forecast NBP e.g. by constructing forecast price *ranges* which increase with forecasting time (based on historic analysis of actual vs forecast).

2. ***The most appropriate period, or periods, over which to publish forward LNG netback prices, based on market trends in LNG markets and the east coast gas market?*** Assuming predictive performance can be improved, there is likely to be little value in extending the outlook beyond a year (4 seasons) as the uncertainty 'range' or window, must necessarily grow significantly over time.

3. ***Whether the ACCC should publish multiple forward LNG netback prices, based on different periods (to inform pricing for different GSA terms).*** No, the forward series perform increasingly poorly with longer periods. It would not be sound to base terms for contracted, assured gas on such forward series.

4. ***How important it is that the length of the forward LNG netback price series is consistent with the duration of domestic GSAs.*** See answer above. The forward LNG netback series has little information utility for either spot or contract prices beyond a month or two.

5. ***Whether there are relevant market benchmarks for a longer forward LNG netback price series, or methods/approaches to deriving such market benchmarks*****.** In my view, there are no sound 'benchmarks' per se for a longer LNG netback price series. Though buyers would be served (in terms of their own risk assessment) by examining a number of medium-term supply and demand forecasts for Asia LNG. As an alternative, some statistical analysis of actual contract (not spot) prices might provide some insights into the relationships (price premiums or discounts) between contract price, duration and volume. It would necessarily be historic and so should be communicated with some reference to the overall price outlook *at the time*, as well as uncertainty ranges.

   The Issues Paper discusses US, LNG projects and the Henry Hub and price point. The Henry Hub (HH) is connected to a very large developed, volume and very high rate-potential of natural gas (2 orders of magnitude larger than Australian markets), 25 times the transmission pipeline kilometres, very large numbers of suppliers, very large numbers of buyers, low short-term delivery risk for large volumes, and very large gas storage with the ability to rapidly swing – it is a highly liquid market with minimal supply risk for large buyers. HH prices reflect costs of supply. They are currently low, relative to the rest of the world, because the Hub is currently connected to very large volumes of low-cost natural gas i.e. gas associated with the massive increase in unconventional, onshore liquids (oil, NGLs, condensates) production. Until the recent growth in US LNG exports, since around 2010, the HH was almost a "gas disposal route"[7]. It is important to note that the Henry Hub per se is not the root cause of low (or high) price gas in the USA. For example, prior to major quantities of unconventional, liquids-associated gas coming on stream, in the period 2004 to the GFC in 2008, the HH spot price averaged around US$7.50/mmbtu, (~A$9.35/GJ).

   Asia spot markets (if they are to be referenced) represent a changing mix of suppliers and costs of supply. Considering HH as an alternate benchmark would problematic. It is important to recognise that as US export LNG volumes grow, this is not a one-way, price-influencing street. Henry Hub players may off-load low cost gas to export LNG markets (including some in Asia) if prices are expected to be higher. This could put downward pressure on Asian markets *and* upward pressures on Henry Hub prices (feedback). US exporters may also choose European destinations. The current market expectation, for example, is for HH prices to rise over 2021 e.g. as LNG demand growth recovers globally and as US gas storage needs to replenish (see answer to questions 7 & 10, below). However, if and while HH source LNG puts downward pressure on Asian spot LNG prices, Asian demand is also growing, so a simple relationship between increasing HH export volumes and movements in the Asian spot LNG price should not be expected.

[7] In 2020, the COVID-related very low HH prices were associated with a significant increase in gas flaring.

6. ***Issues that should be considered in calculating a longer-term LNG netback price series.*** The task in forecasting NBPs over a longer term is challenging. While there *are* regular cyclic drivers (seasons) the strength of these is highly variable (e.g. weather or gas storage levels). Furthermore, there are other non-cyclic drivers (e.g. oil price, LNG supply growth, LNG demand growth, geopolitics ...) which also have a strong or stronger price influence. Information which might better inform forecasts would include a view on long term LNG supply-demand balance and long-term LNG demand and supply growth rates. This may give some hint at whether the price is generally rising or falling over the 1-5 year time frame. Even with this information, significant variability will lead to large differences in the short term at the final price point.

   This discussion is in effect describing how the global oil and gas sector (e.g. through many consultancies) have evolved to create a number of forward outlooks of fundamentals and price outlooks which have a least some utility for contemporary decision making.

LNG price

7. ***The influence of international gas markets on pricing in the east coast gas market*.** That the historic NPB and the WGSH-VWA correlate *to some degree* (showing some degree of seasonality) could be interpreted as some form of direct causal link. However, coupling between the prices is not simple. It is more likely that there is a common underlying causality in both series in terms of (i) variable NH seasonal demand and forward '*guesses*' about this; (ii) stock levels; and (iii) the lagging interference of oil price dynamics and so on.

   On top of these, there is an evolving 'change of supply' dynamic in global LNG. For example, this includes (a) a strong growth in both volume demand *and* in numbers of customer; (b) a rise of US exported LNG *and* other anticipated new entrants; and, there are (c) possible supply shifts from West to East (e.g. if US LNG displaces ME LNG from the European market). Differences in 'cost of supply' of these new entrants along with both country and company market-share aspirations, means that the general market cost-mix is dynamic and therefore the forward price dynamics are highly complex and largely unpredictable.

8. ***The relevance [to the LNG netback price series] of different international LNG and gas price markers for LNG pricing in key LNG export markets and the east coast gas market***. This requires further analysis of other markers and the changing supply mix over time – it would be amenable to forward modelling with superimposed uncertainties and information lag time to investigate (non-linear) price behaviours and thus condition *expectations* and interpretations of domestic and international price differences.

9. ***Whether the relevance of different LNG and gas price markers is different for short-term versus long-term LNG netback price*?** Long term demand, long term supply and long-term supply-demand balance has most relevance to long term trends in Asia Pacific spot prices and therefore the LNG NBP series (the utility of which has been questioned previously). The influence ($/GJ) of short-medium term variation e.g. in weather or oil price may be significantly larger as illustrated in Dec 2020 (Figure 1). While it is well recognised that LNG contract prices are often oil-price linked, it is less often discussed that there is also *some* correlation[8] between Asian *spot* LNG prices (e.g. METI) vs. oil prices (which are also non-stationary). It is important to note, in this period of analysis (Figure 3[9]), there was a common causal, exogenous factor in 2020 (COVID-

[8] Example: comparing METI spot prices LNG monthly historic statistics with monthly average oil prices
[9] Source for oil price data (www.indexmundi.com/commodities/?commodity=crude-oil&months=60). Source for METI Spot price data (www.meti.go.jp/english/statistics/sho/slng/index.html).

related demand destruction) which influences the measure of apparent correlation over time[10] (see answer 10, below)

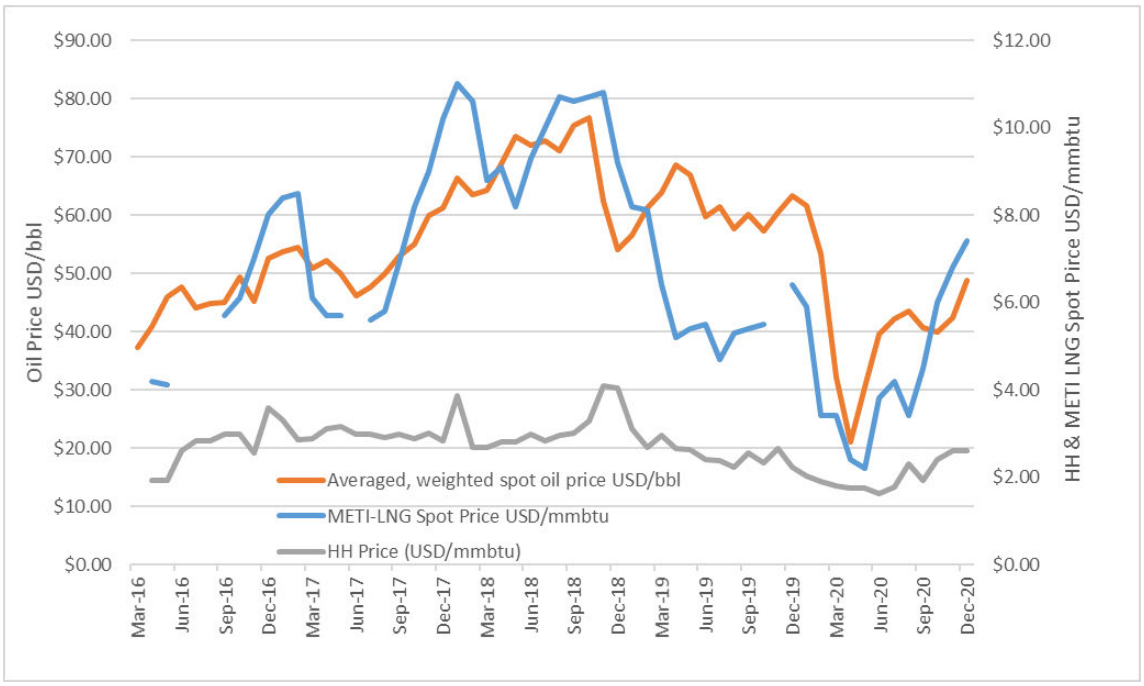

Figure 3: Comparison of monthly average HH and METI-LNG spot prices and monthly average oil prices

10. ***Whether the relevance of different LNG and gas price markers, for the LNG netback price series, is likely to change over time***. Over time, the following changes are likely in the LNG markets which will influence any price markets: (i) annualised LNG demand is forecast to grow significantly in the Asia Pacific region; (ii) the number and mix of suppliers and costs (to market) of each different source of supply; (iii) the mix and numbers of buyers and their domestic gas-growth aspirations; and (iv) oil prices. It should be noted, especially with reference to US, Henry Hub sourced LNG, that as those volumes become material, prices achievable through LNG will have complex a feedback effect (upward pressure) on HH prices. Similarly, if oil prices rise again, volumes of associated gas will rise in the US with a downward pressure on HH prices. Figure 3, also shows monthly Henry Hub prices and major differences in variability compared to METI Spot LNG prices (e.g. st. dev. for the HH series is $0.54 USD/mmbtu vs. $2.35 USD/mmbtu for METI data, with *differences* between the two benchmarks varying from a maximum of $7.93/mmbtu to a minimum of $0.45/mmbtu). It is possible that HH prices are having an increasing influence on Asian spot prices, as HH supply to the region increases – but this is not a smooth, simple or consistent relationship and feedback loops will apply.
11. ***Whether the ACCC should consider additional methodological approaches, such as averaging, to account for the impact of price volatility of price markers on calculated LNG netback prices*.** Averaging is not indicated to account for volatility in a non-stationary series. The ACCC may serve the sector better with information on the underlying fundamentals in the Australia sector (e.g. costs of supply, levels of upstream investment) rather than only prices in international LNG markets, as discussed above.

[10] Example ... data from March 2016 to Sept 2018 (R^2 = 0.73); from March 2016 to Dec 2019 (R^2 = 0.35); from March 2016 to Dec 2020, whole chart (R^2 = 0.52).

12. ***Any other issues that should be considered when determining which LNG and gas reference price should be used for the ACCC LNG netback price series***. The purpose of any LNG netback series needs to be articulated at a deeper level than simple "transparency", since historic prices and price differences have little bearing on current and future expectations. The series, if any, should refer to, or enable a correction to, the product actually traded in the market (assured, contracted gas); and, any price series should include ranges of uncertainty which naturally grow with the forecast time.

In summary, perhaps the most useful information is much simpler than historic or forward NBPs. Notwithstanding that the Australian buyers prefer contract rather than spot gas, more fundamental information on factors causing underlying price dynamics in Asian LNG prices may have more utility. There is other information and forward outlooks for (i) LNG supply vs. demand in the region over a one year and several-year; (ii) expectations of changes in market share from vs. cost of supply; and (iii) overall demand growth ... i.e. whether the market is tightening (expectations of prices rising) or not. Is supply short? And, are greater quantities of cheaper gas coming to the Asian spot market? In addition, two other types of information might be informative. The first relates to historic relationships between price, duration and volumes. The second relates to estimates of range of cost of supply (e.g. already referred to in other AEMO and ACCC reports), with some consideration of cost of replacement, would be useful to make more widely known.

Questions not addressed

LNG freight costs & Conversion to $AUD/GJ & LNG plant costs: I have not considered freight, foreign exchange or LNG plant costs at this time. The former costs are likely significantly less volatile than the other factors influencing the NBP. Forex *may be* similarly volatile (correlating as it does to some degree with oil price). Factor analysis might indicate what degree of NBP variability can be explained by variability in these assumptions. With respect to plant costs, this is more complex. It would seem that the assumption of contemporaneous choice between supplying the Asian spot market or the Australian spot market requires some deeper exploration.

Pipeline transportation costs: while I have not examined this in detail, I consider, based on knowledge of personal knowledge of engineering lay-out and operations, that the following assumption may be unsound "*... short-run LNG netback price at the wellhead can effectively be regarded as the LNG netback price at Wallumbilla*". I accept that it may be 'negligible', but it is not cost free to transport gas from well-head to Wallumbilla. It will clearly vary depending on distance, pressures, any intermediate compression, the need for water management, or perhaps solids management etc. but there will always be a positive cost (even on a short run basis). Furthermore, as fields mature and pressures decline, these costs may increase.

Yours sincerely

Professor Andrew Garnett
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