GET THE NUMBERS RIGHT

Chris Strickland, Martin Ogden, and Boda Kang, Lacima Group, consider the key drivers of value, risks and rewards in the LNG market, and detail the potential future outlook.

The LNG market and associated LNG trading activity has grown rapidly over the past decade. Figure 1 illustrates that the trading of contracts linked to LNG has grown exponentially, as evidenced by open interest on ICE of JKM futures; increasing from approximately 2000 lots in 2016 - 2017 to over 90 000 lots by early 2020.

Market participants operate highly material businesses. With prices currently just under US$2/million Btu, a single LNG cargo has a value of approximately US$6 million, whilst a train of 60 cargoes a year has a book value of US$360 million/y. A company with 10 trains would then have a book value of US$3.6 billion/y, implying that a number of market participants are managing exposures in excess of US$10 billion/y.

Players in the LNG market cover all the major segments in energy trading and the supply chain: producers, consumers, shipping companies, banks, and trading houses. Although each of these companies has different priorities, and follow different business models, the use of modelling techniques to characterise the uncertainty in future spot and forward prices of natural gas hubs, oil indices, freight rates, fuel costs, and other potential variables, is key and largely the same.

The analytical challenges of operating in the LNG market are complex. As already stated, there are potentially very large risks and rewards to companies operating in this space, and 'getting the numbers right' is often critical to the success and viability of these businesses. This has been particularly true in the past five years as volatility has increased, and price and spread dynamics have all changed substantially. There have been big winners and big losers, with the winners invariably proactive in their analytic analysis, using strategies designed to manage risk, capitalise on volatility, and monetise value.

This article looks at the key drivers of value, risks, and rewards in the LNG market over the past few years, as well as

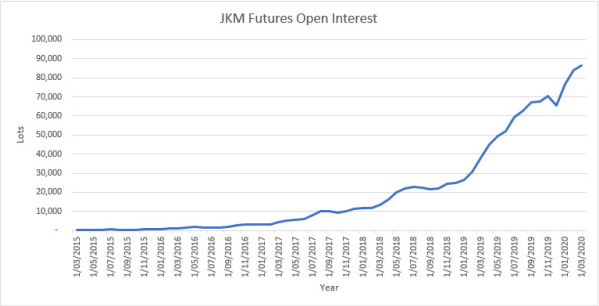

Figure 1. Open interest in ICE JKM futures.

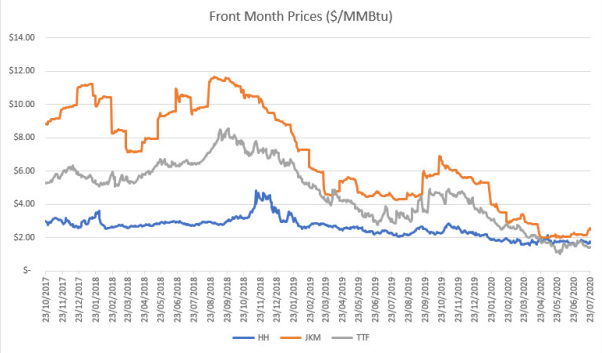

Figure 2. Front month futures prices.

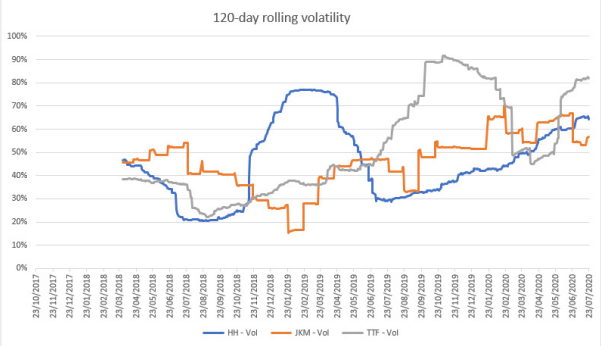

Figure 3. 120 day rolling volatility for gas indices.

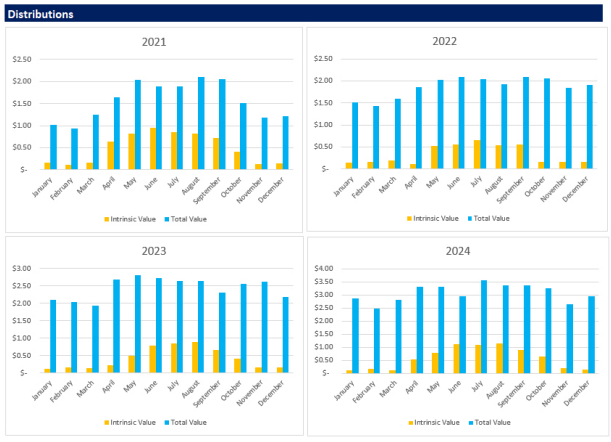

Figure 4. Deal option strip, intrinsic and extrinsic value.

the outlook for the future. Further, the four key areas where LNG companies typically perform analytical analysis, and how they use analytics to build successful businesses by both managing risk and capitalising on the opportunities presented by the market, are reviewed.

LNG market context: Historic and future outlook

The past few years have seen major changes to both LNG price levels and associated volatility, with 2016 and 2017 initially experiencing a period of gradually rising LNG prices and low volatility. Figure 2 plots the front month futures prices for the major global hubs: US (Henry Hub: HH), Asia (Japan Korea Marker: JKM), and Europe (Title Transfer Facility: TTF).

Throughout 2018, volatility and prices across the energy market complex began to increase rapidly. In 2019, prices fell sharply, but volatility remained high. 2020 has seen this trend continue, with price declines and sustained volatility. Figure 3 illustrates this last point by plotting the 120 day rolling volatility of the price variables illustrated in Figure 2.

These rapid price moves, high volatility, and major market shifts have been driven by a number of factors including: weather and major climate events; LNG supply and demand fundamentals; oil prices; global macroeconomic and geopolitical events; and low investment in flexible assets.

The risk factors outlined are likely to continue having a major impact on energy prices. Extreme results are predicted to increase in frequency. LNG fundamentals can change very rapidly in the short-term to long-term. The coronavirus pandemic could last anywhere from six months to multiple years. Europe has to resolve Brexit. In the US, 2020 is a Presidential election year and there is continued uncertainty driven by rapid policy changes from the White House, trade tensions, and the risk of sanctions. In summary, the LNG market has never experienced as many major factors which can affect price and volatility. It can also be observed that the market expects significant ongoing uncertainty, as evidenced by high implied volatility in option markets.

Key areas of energy analytics

The market context presents significant opportunities as well as risks for LNG market participants. Over the past few years, successful LNG companies have used analytics to deliver value and monetise opportunities presented by changing market dynamics, while actively managing and mitigating risk. There are four key areas where analytics are typically implemented and which are outlined in this section: individual deal analysis; portfolio analysis; portfolio optimisation; and risk management.

Deal analysis

Individual deal analysis involves capturing the deal payoff, exercise and nomination conditions, and any associated constraints, and then modelling the uncertainty of the key variables driving the exercise conditions through time. Within LNG companies, the roles typically for this type of analysis are structurers, originators, quantitative analysts, and portfolio optimisers. Deals can be analysed either on a standalone basis and as part of a portfolio.

A typical trade might look like the following: a company evaluates a deal to buy a strip of 12 US cargoes with the

option to pay either HH or a percentage of Brent for each of the cargoes, and with an option to cancel one Summer and one Winter cargo from the strip, with the cancellation to be nominated 90 days before cargo loading.

Analysis of a trade of this type would involve being able to model both HH and Brent prices using a forward price model. The user would simulate forward prices of both HH and Brent up to the nomination date of each individual option, with the maturity of the relevant forward being the delivery month of the cargo which can be cancelled. For each simulated price path, the user computes the payoff of the option in terms of the simulated forward prices from the buyer's perspective, with the total value of the option computed as the discounted average of those payoffs, over a large number of simulations.

Depending on the nature of the individual deal, the key outputs that enable detailed analysis typically include: total, intrinsic and extrinsic value; physical flows; probabilities of events (such as of options being exercised or of cargoes delivering to different locations); and distributions of value. Figure 4 shows intrinsic vs extrinsic value for a strip of cargoes, allowing the user to determine the true value of the strip. Figure 5 shows probabilities of various price outcomes, as well as the value and distribution of value for the same strip of cargoes.

In addition, the effects of scenarios and 'what if' cases – such as adding or removing optionality, including an asset, or an option to deliver gas to another terminal – can also be analysed. Users also look at the effectiveness of introducing a hedging strategy, or the effect of a price shock, or the breakdown in correlation between hubs, etc., which can further extend the understanding of the risks associated with a deal.

Performing accurate deal analysis can be highly material, especially for deals with embedded optionality. Deals which are currently deeply out of the money, for example, can still have very high total value, even if, in this case, the intrinsic value is zero. High volatility and low correlation can create situations where the deal can move into the money, especially if there is a long time to option expiry. Having the right tools to value these options correctly and the right strategy to monetise these options can be highly material and can be worth over US$100 million for a strip of cargoes.

Portfolio analysis

Portfolio analysis takes the individual deal analysis up a level, looking at the effect of the deal on the wider portfolio. This type of analysis similarly looks at modelling all the relevant variables that drive the value of the deal and captures the deal payoff, exercise and nomination conditions, and any associated constraints. Roles within an organisation that typically implement this analysis are portfolio managers and optimisers, shipping, structurers, and strategists. Major strategic questions are typically considered, such as, what is the effect of selling different amounts of a new production train on a spot basis, or under a long-term contract? What is the effect of investing in a new train, or additional regasification capacity? What is the effect of buying storage capacity in Singapore? What is the effect of acquiring two vessels on long-term leases on the overall portfolio value?

The key outputs for this type of analysis are similar to the individual deal analysis, with a focus on 'what if' cases. The analysis typically addresses questions as to the effect of changing an element of the portfolio on the total value, the distributions of those values and potential revenues, as well as probabilities of events and overall portfolio risk. Figure 6 shows these types of outputs, comparing a portfolio base (case 1) and evaluating the effect of adding an option (case 2), a hedging strategy (case 3), and the effect of adding a deal to a portfolio (case 4).

Portfolio analysis is used extensively for making major strategic business and investment decisions, which are often highly material and can have value in excess of US$10 billion. It is also used as part of deal analysis to assess the effect of adding a deal to a portfolio and used in trading strategy analysis and risk management strategies – for example assessing the effect of implementing a hedging or trading strategy.

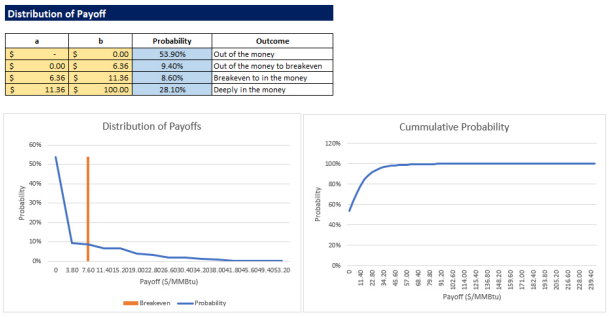

Figure 5. Probability of deal payoff at different price levels.

Table 1. P&L of the top four optimal results

Solution	P&L
1	21 279 479
2	21 264 479
3	21 143 163
4	13 987 997

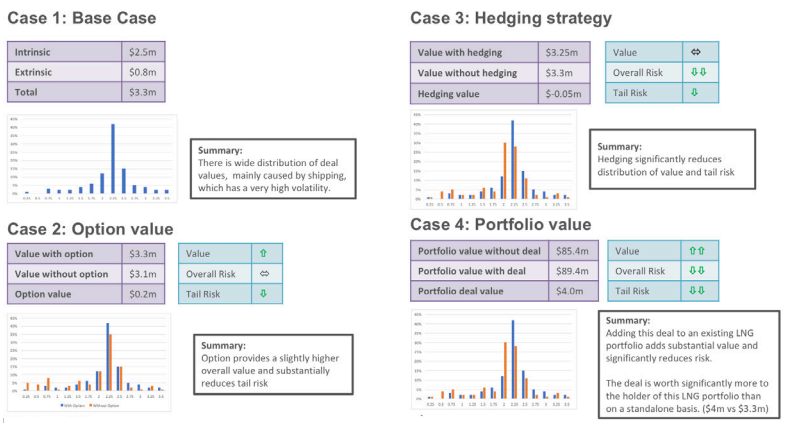

Figure 6. Typical portfolio analysis. Base case and three 'what-if' cases.

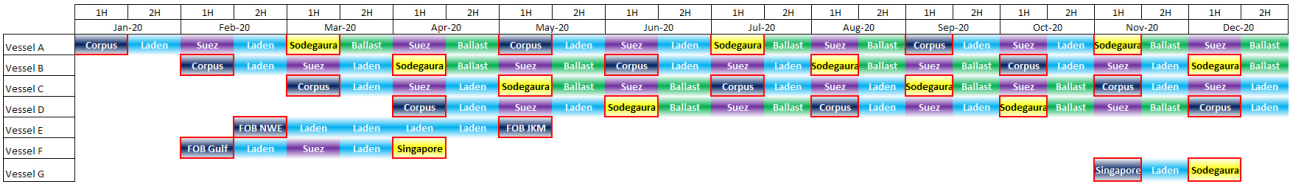

Figure 7. Shipping schedule, monthly view.

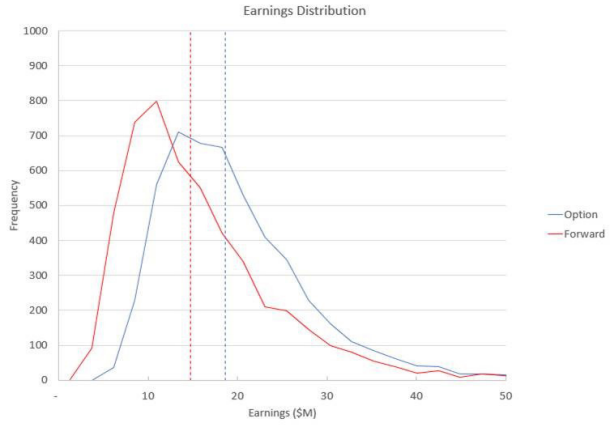

Figure 8. Earnings at risk distributions.

Portfolio optimisation

Portfolio optimisation looks to take a description of the full physical detail of an LNG portfolio and finds the optimal value, shipping schedule, and physical dispatch of the portfolio. The physical details of the portfolio should look to include as many of the major physical features and constraints as possible. For example, users would typically look to include: sales and purchase contacts – and their associated lifts and deliveries; vessels and associated properties, such as speed, fuel use rates, boil-off rates, charter rates and insurance costs; port and market properties, such as loading and discharge fees and time to load/discharge; canals and associated time and costs; routes between ports and waypoints between ports. Additional physical elements which can affect portfolio optimisation also need to be captured and included in the calculations where possible. The goal of the optimisation routine is to provide the optimal portfolio decisions that deliver the most value, while meeting all the constraints of the portfolio.

Portfolio optimisation is a critical activity and is used in three areas: short-term optimisation, which is usually focused on physical delivery and optimisation of shipping (less than 12 months ahead); long-term portfolio and shipping optimisation (one year to 30 years ahead); and annual delivery programme (ADP) planning. Having access to a comprehensive and accurate portfolio optimisation tool, able to capture the full physicality of an LNG portfolio, has considerable value and is business-critical to many LNG trading teams.

Table 1 and Figure 7 show typical outputs from this type of optimisation analysis. Table 1 shows the P&L of the top four optimal solutions, ranked by value. Trading teams can then analyse the shipping schedules, dispatch, and nomination decisions of each of these solutions to understand the differences between them. Figure 7 shows the shipping schedule from the optimal solution, Solution 1, in a compact monthly view.

Risk

Risk management groups in the LNG space need to be able to report on the joint risks to the business across both the physical and financial aspects of the portfolio. Whilst many pure trading shops tend to focus on value based metrics like value at risk (VaR), this metric gives little insight into the uncertainty of earnings that accrue to the physical side of the business. Thus, for many organisations, cash flow based metrics like earnings at risk (EaR) or revenue at risk (RaR) are more applicable as they can be constructed to take into account equity positions; cargo sales and purchases; flexible sources and delivery points; volumetric uncertainty; and other aspects that are highly relevant to LNG portfolios, but are impossible to represent accurately in VaR metrics.

Similar to the discussion for the previous key uses of energy analytics, the calculation of portfolio level at-risk metrics involves modelling (simulating) the uncertainty of the relevant price and other variables forward through time, and based on these simulated outcomes calculating potential distributions of earnings implied by the contractual commitments across the physical and financial portfolio. Figure 8 shows an earnings-based analysis for a simple comparison for two LNG contracts – one which is purchased forward (Forward) for a particular delivery point, and an option which allows delivery to the same point or to a different point at the spot price (Option). The dotted lines represent the mean of the distribution, i.e. the value of the two trades, but the value-based analysis gives the structurer little insight into the upside of the trade, how the downside can be limited, or how the risks can be hedged.

This simple example shows how these so-called 'enterprise wide' cash flow based risk metrics have a number of advantages over VaR and other techniques such as stress tests:

- They allow a better understanding of all the drivers that affect a particular earnings stream and how they react to market forces.
- Can be used to better communicate corporate goals and strategies to the investment community and rating agencies.
- Enables more informed hedging strategy decisions.
- Provides a distribution of outcomes, given a certain confidence level, rather than a point estimate that may never actually occur.

In this article, discussion has focused on the areas where analytics has been applied by successful businesses to manage risk and capitalise on trading opportunities presented by the LNG market. LNG