Propane Arbitrage Scenario

It is November 2nd.

The arbitrage for propane to Japan is open. Propane is available in Enterprise storage at Mont Belvieu at the OPIS Enterprise (Non-TET) price. For a fee of 12 cts/gal, Enterprise will deliver the propane to a vessel at their terminal in the Houston Ship Channel.

You have a time chartered VLGC vessel that will be available for loading in the US Gulf Coast in early December. The vessel costs $50,000/day. A round-trip voyage to Japan via the Panama Canal will take 60 days. Fuel, canal and port fees for the voyage will cost $1,500,000.

You have done a deal to buy 550,000 barrels of propane, at the OPIS Non-TET Propane price, as a month average during December. The propane will be available for loading December 5-7.

You intend to find a buyer for the cargo in Japan, who will take delivery in early January. Japanese propane buyers use several different pricing mechanisms, including fixed price trades, deals indexed to naphtha prices, or premiums to Middle East contract prices (CP). But the most common pricing in spot trades is a negotiated $/tonne premium or discount to the Argus Far East Index price, calculated as a month average. Buyers are reported to be offering premiums of $5-10/t over FEI for 1H Jan delivery.

Swaps Market Prices

Price Index	Settlement Period	Price
Propane OPIS Mont Belvieu TET vs Argus FEI spread	December	-183 $/tonne
Propane Argus FEI	December	630 $/tonne
Propane Argus FEI	January	620 $/tonne
Propane OPIS Mont Belvieu TET	December	85.750 cts/gal
Propane OPIS Mont Belvieu Non-TET	December	85.750 cts/gal

Notes:

- *Swaps with a December settlement period are settled by payment of the difference between the agreed fixed swap price and the published values of the floating price index, averaged across all pricing days during the month of December.*
- *Mont Belvieu vs Far East Index swaps trade in $/t, using a factor of 521 gal/tonne to convert the Mont Belvieu price. The swap is quoted as a price for the spread Mont Belvieu MINUS FEI, so is always a negative price.*

The MB-FEI spread swap, shown trading at a price of -183 $/tonne above, is the most heavily traded form of US-Asia NGL arbitrage swap. If you used this spread swap to hedge this arbitrage deal, what swap position would you need to take? Would you take a LONG swap position or a SHORT swap position at the current price of -183 $/tonne?

Answer: If using the MB-FEI spread swap, you would need to take a LONG swap position at -183 $/t. That way, if the spread narrows (becomes less negative), and the profit on the physical trade reduces, the hedge position would increase in value. The risk is to the spread between FEI in January and the MB Non-TET price in December.

Is this MB-FEI swap a good hedge for your price exposure? If not, why?

Answer: This instrument doesn't however provide a full hedge, as neither leg of the spread accurately matches the physical deal.

- The Asian pricing is for December FEI instead of the January FEI that your physical buyer will pay. This leaves you exposed to the possibility of a steeper backwardation developing in the market. Worse, the spread swap settles at the end of December, and leaves you fully exposed to any decline in Asian propane prices during the month of January.
- The Mont Belvieu pricing is for TET Propane (in Energy Transfer storage) instead of Non-TET Propane (Enterprise). Currently, these are trading at the same price for December, but they often diverge by a few cents, particularly if infrastructure constraints arise at Mont Belvieu. Differentials of 5 cts/gal (25 $/tonne) are possible.

What combination of the listed swap instruments would accurately hedge your physical price exposure in this arbitrage trade?

Answer: a SHORT position in the Propane Argus FEI January swap would protect against a fall in the FEI price that the buyer will pay. A LONG position in the Propane OPIS Mont Belvieu Non-TET swap would protect against a rise in the price that you will pay to obtain propane.

If a Japanese buyer offered a $5/t premium to the FEI January price, how much profit would you make from the hedged arbitrage trade?

Answer: using swaps, you can lock in an effective buying price of 85.750 cts/gal, or 446.76 $/tonne. The selling price can be fixed at 625 $/tonne (including the premium), giving a gross profit margin of 178.24 $/tonne. The traded volume is 550,000 barrels, or 44,337.8 tonnes. Total gross profit is $7,902,769.47.

Costs are:

- 12 cts/gal terminal fee = $2,772,000.00
- Vessel time charter cost $50,000/day x 60 days = $3,000,000.00
- Vessel fuel, canal and port fees = $1,500,000.00

Total costs are $7,272,000.00

Arbitrage Profit = $630,769.47

N-butane storage scenario

Stage 1: It is June. A refinery is offering normal butane for sale during July at a 0.5 cts/gal discount to the OPIS Mont Belvieu TET price, as a month average. You have access to storage capacity and pipeline capacity that links it to refineries. You want to profit from the contango structure in the market. You are certain of being able to sell the n-butane during the winter when refiners buy it for gasoline blending. Refiners typically pay a month-average price.

TET N-butane Swaps Prices:

- July 92.000 cts/gal
- August 92.250 cts/gal
- September 93.000 cts/gal
- October 94.000 cts/gal
- November 95.000 cts/gal
- December 95.500 cts/gal
- January 95.250 cts/gal
- February 94.500 cts/gal
- March 93.000 cts/gal

Note: July swaps settle at the end of July, with a payment equal to the difference between the agreed fixed price, as shown above, and the average of published TET N-butane spot prices for all business days during July. As a hedging instrument, they can be used to effectively fix the price paid or received for physical material purchased or sold on a month-average price basis, at the above prices.

If storage capacity is a sunk cost, and you don't need it for any other purpose, what trades could you make today to create the maximum risk-free profit?

Answer: agree the physical deal; enter a long position in July swaps at 92.000 cts/gal, and a short position in December swaps at 95.500 cts/gal. The July swap and the physical deal together guarantee acquisition of n-butane in July at a fixed price of 92.000 cts/gal. The December swap position locks in a selling price of 95.500 cts/gal (a profit of 3.5 cts/gal), as long as a physical buyer can be found who will pay a December month average TET n-butane price for in-storage butane in December.

Stage 2: It is now the beginning of August. During July, you received delivery of normal butane into storage, which you bought from a refiner at a 0.5 cts/gal discount to the month average of OPIS TET N-butane prices. You took a long position in July butane swaps at 92.000 cts/gal.

Prices have risen, and the July month average of OPIS TET N-butane prices was 97.500 cts/gal.

- What price did you pay the refiner for the physical barrels?
- How many cts/gal did you gain or lose when the July swap settled?
- What was your effective buying price, taking the swap settlement into account?

Answer: The physical barrels were bought at a price of 97.500 - 0.500 = 97.000 cts/gal. Because the TET n-butane price has risen to 97.500 cts/gal since you entered a long swap position at 92.000 cts/gal, the swap settlement results in a payment to you of 5.500 cts/gal. Your effective buying price is the 97.000 cts/gal that you paid to the refiner, less the 5.500 cts/gal gain from the hedge, which is **91.500 cts/gal**.

Stage 3: It is now September. You have n-butane in storage for which you paid an effective price of 91.500 cts/gal. You are holding a short position in December swaps, entered at 95.500 cts/gal. Butane prices have fallen since August. The swaps market now looks like this:

TET N-butane Swaps Prices:

- September 90.000 cts/gal
- October 90.250 cts/gal
- November 91.000 cts/gal
- December 91.500 cts/gal
- January 92.250 cts/gal
- February 92.500 cts/gal
- March 95.000 cts/gal
- April 92.000 cts/gal

What trades could you make to increase the risk-free profit of your n-butane storage trade?

Answer: Back in June when you established your hedge positions, December was the highest priced month. Now, the March price is highest, so you could benefit from holding the n-butane in storage until March. So you could close the existing short December swap position, or take an offsetting long position in December swaps, at 91.500 cts/gal, and open a short position in March swaps at 95.000 cts/gal.

If the swaps were traded as cleared OTC instruments (submitted to an exchange), the existing short December swap position, entered at 95.500 cts/gal, will have already resulted in a series of daily margin payments with a cumulative gain to you of 4.000 cts/gal. To be precise, the gain will be equal to the difference between the 95.500 cts/gal price at which the short swap position was opened and yesterday's settlement price. A final settlement payment covers the difference between yesterday's settlement price and the 91.500 cts/gal price at which the swap position is closed.

Stage 4: It is now April.

Last July, you took delivery of n-butane into storage, for which you paid an effective price, after hedging with swaps, of 91.500 cts/gal. At the same time, you opened a short December swap position at 95.500 cts/gal.

In September, you rolled your hedge, closing the short December swaps at a price of 91.500 cts/gal, for a 4.000 cts/gal gain, and opening a short March swap position, at a price of 95.000 cts/gal.

In February, you negotiated the sale of the stored n-butane to a local refiner during March. The refiner agreed to pay the OPIS TET n-butane month average price during March, with no premium or discount. Oil prices have fallen a lot in the last six months, and the month average of OPIS TET n-butane price during March was 75.000 cts/gal.

- At what price did you sell the physical barrels?
- What was your hedging gain or loss on the March swaps?
- What was your total hedging gain or loss including the gain from rolling the hedge in September?
- What was your effective selling price, taking the hedging gain or loss into account?
- What gross profit did you make on the trade?
- What costs would this profit need to cover?

Answer: the physical barrels were sold at the month average price of OPIS TET n-butane, 75.000 cts/gal. The short March swaps position was originally entered at 95.000 cts/gal and has settled at 75.000 cts/gal, for a 20.000 cts/gal gain. The total hedging gain, including the 4.000 cts/gal gain from rolling December to March swaps in September, was 24.000 cts/gal. The effective selling price was the 75.000 physical price plus the 24.000 hedging gain = 99.000 cts/gal. Your gross profit is 99.000 (effective selling price) minus 91.500 (effective buying price) = 7.500 cts/gal.

This profit would have to cover the cost of storage, the cost of any pipeline transport required, the cost of financing ownership of the n-butane for six months, plus any exchange and clearing fees and broker commissions required for the physical and hedging transactions.

Propane Cargo Pricing Exercise

Today's date: 2nd November

A trading company has acquired 280,000 barrels of propane (22,500 tonnes) in storage in Texas. The company wishes to sell the propane and must choose between the following alternatives.

A) A European chemical company will pay 85% of NWE CIF Naphtha price for a cargo delivered to their plant in Antwerp, November 21-25, pricing as a month average during November.
B) A trading company will pay a 50:50 fixed/floating price for a cargo delivered to Flushing November 21-25. Half the cargo volume would be at a fixed price of $550/t, and the remaining volume at CIF ARA Propane plus $5/t, as a 5-day average after delivery.
C) A Chinese buyer will pay FEI December plus $14/t for a cargo of Propane delivered Ningbo 1H December.
D) A Japanese chemical company will pay a $15/t discount to Japan CFR Naphtha price for a cargo delivered Yokohama 1H December, pricing as a month average during December.
E) The propane could be sold FOB for loading in Houston 10-25 days from now, priced at a 12.5 cts/gal premium to the Mont Belvieu TET Propane price, as an average of prices published in the five days following completion of loading.

Today's Market Prices

Spot Prices	
Naphtha CIF NWE (Platts)	$667/tonne
Naphtha C&F Japan (Platts)	$677/tonne
Propane Mont Belvieu TET (OPIS)	$0.84625/gal
Propane CIF ARA (Argus)	$552/tonne
Propane Far East Index (Argus)	$619/tonne
Swaps Market Prices	
Naphtha CIF NWE November	$650/tonne
Naphtha CIF NWE December	$645/tonne
Naphtha C&F Japan November	$670/tonne
Naphtha C&F Japan December	$664/tonne
Propane Mont Belvieu TET November	$0.83750/gal
Propane CIF ARA November	$551/tonne
Propane CIF ARA December	$551/tonne
Propane FEI November	$622/tonne
Propane FEI December	$621/tonne
Spot charter rates for refrigerated gas carriers	
Houston to ARA (includes Antwerp or Flushing)	$64/tonne
Houston to Ningbo	$105/tonne
Houston to Japan	$117/tonne

Notes:

- *1 tonne of propane = 521 gallons*
- *A November swap is settled by payment of the difference between the agreed fixed swap price and the published value of the floating price, calculated as an average of all publication dates in the month of November. December swaps settle against the average difference between the agreed fixed price and the published floating price for all pricing days in December.*

To enable comparison between the five alternatives, the trader will need to assess the value of the propane on a consistent basis. We are going to ask you to calculate the netback value of the propane at Houston (ready for loading), for each alternative. This involves working out the selling price that could be achieved by hedging the trade, then subtracting any shipping costs to calculate a FOB Houston value.

Q1 At today's market prices, what value could be captured for the propane at Houston, if it were sold to the European chemical company at 85% of NWE CIF Naphtha price, as a month average during November (option A)?

Answer: The Naphtha CIF ARA price for November can be fixed at $650/tonne using the November swap. 85% of this is $552.50/tonne. Shipping to Europe costs $64/tonne, so the value FOB Houston is **$488.50/tonne.** Note: to hedge this price exposure, the trader would need a short swap position in only 85% of the cargo volume, or 19,125 tonnes.

Q2 At today's market prices, what value could be captured for the propane at Houston, if it were sold to the trading company at a 50:50 fixed/floating price with half the cargo volume at $550/t and half at CIF ARA Propane plus $5/t, as a 5-day average after delivery (Option B)?

Answer: The CIF ARA Propane price, as a 5-day average after discharge Nov 21-25 can't be exactly hedged using a simple calendar month swap. The pricing will fall right at the end of November, possibly into December. Propane CIF ARA swaps for both months are trading at $551/tonne, indicating a flat forward curve. So 50% of the cargo is fixed at $550/t and the other 50% can be valued at $556/tonne (swap price plus $5 premium). That's an average of $553/t. Shipping to Europe costs $64/tonne, so the value FOB Houston is **$489/t.**

Q3 At today's market prices, what value could be captured for the propane at Houston, if it were sold to the Chinese buyer at FEI December plus $14/t (Option C)?

Answer: FEI December is trading at $621/t, so the selling price in China can be fixed at $621 + $14 = $635/tonne. Shipping to China costs $105/t so the value FOB Houston is **$530/t.**

Q4 At today's market prices, what value could be captured for the propane at Houston, if it were sold to the Japanese chemical company at $15/t discount to Japan CFR Naphtha price as a month average during December (Option D)?

Answer: Japan CFR Naphtha is trading at $664/tonne for December, so the selling price in Japan can be fixed at $664 - $15 = $649/tonne. Shipping to Japan costs $117/t, so the value FOB Houston is **$532/t.**

Q5 At today's market prices, what value could be captured for the propane at Houston, if it were sold FOB Houston, at a 12.5 cts/gal premium to the Mont Belvieu TET Propane price, as an average of prices published in the five days following completion of loading (Option E)?

Answer: The TET propane price as an average of five days after loading cannot be exactly hedged using a calendar month swap. It will be a late November price. November swaps are currently trading at $0.83750/gal. With the 12.5 cts/gal premium, the FOB Houston price offered is $0.9625/gal, or **$501.46/t.**

Q6 Which is the most attractive deal?

Answer: The highest value, $532/t, is provided by the sale to a Japanese chemical company (Option D). The sale to the Chinese buyer, at $530/t, is almost as good.

Q7 Are there any additional costs or risks that need to be considered in choosing between these options?

Answer: all alternatives except Option E would expose the trader to costs and risks of international shipping. The issue of who pays to insure the cargo is unclear from the information provided. Are these "delivered" deals on a CFR basis, DES or CIF? If DES or CIF, then the cost of insurance would differ with the length of voyage. The Asian trades involve a long voyage and a Panama canal transit (or an even longer Cape route), so there could be risk of delays. How does the contract handle the risk of failing to deliver within 1H December? Is there a high risk of demurrage payments arising due to delays in discharging at the any of the destination ports?

Another risk that could differ from one choice to another is credit risk. What is the creditworthiness of each of these buyers? What contractual arrangements will they agree to manage credit risk (letter of credit, etc.)?

Two of the choices, B and E, involve five-day pricing windows which cannot be accurately hedged using the standard monthly swap contracts that are commonly traded. The trader would either have to accept some residual unhedged risk or negotiate a custom approach to hedging.