New York Mercantile Exchange

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Crack Spread Handbook

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Crack Spreads

A petroleum refiner, like most manufacturers, is caught between two markets: the raw materials he needs to purchase and the finished products he offers for sale. The prices of crude oil and its principal refined products, heating oil and unleaded gasoline, are often independently subject to variables of supply, demand, production economics, environmental regulations, and other factors. As such, refiners and non-integrated marketers can be at enormous risk when the prices of crude oil rise while the prices of the finished products remain static, or even decline.

Such a situation can severely narrow the crack spread, the margin a refiner realizes when he procures crude oil while simultaneously selling the products into an increasingly competitive market. Because refiners are on both sides of the market at once, their exposure to market risk can be greater than that incurred by companies who simply sell crude oil at the wellhead, or sell products to the wholesale and retail markets.

Market participants have been trading crack spreads — also known as intercommodity spreads — on the New York Mercantile Exchange, Inc., for more than a decade, using heating oil, gasoline, and crude oil futures. The term derives from the refining process which "cracks" crude oil into its constituent products. In recent years, the use of crack spreads has become more widespread in response to dramatic price fluctuations caused by extreme weather conditions or political crises. The impact of extremely cold weather in recent winters, the Persian Gulf crisis of 1990 through 1991, record low prices and depressed margins in 1998 and early 1999, the run-up of prices in 2000, and other world and national events have sometimes generated high margins for refiners and marketers, but at other times severely squeezed their profitability.

Other changes in market conditions and practices can have a more subtle, but still significant impact on prices. The recent controversy over environmental rules governing the formulation of gasoline and the sulfur content of distillate fuels has certainly been felt in the marketplace.

Because a refinery's output varies according to the configuration of the plant, its crude slate, and its need to serve the seasonal product demands of the market, the NYMEX Division energy futures market can provide the flexibility to hedge various ratios of crude and products.

The Exchange facilitates crack spread trading by treating each spread trade as a single transaction for the purpose of determining a market participant's margin requirement.

Each refining company must assess its particular position and develop a crack spread futures market strategy compatible with its specific cash market operation.

Gasoline output is approximately double that of distillate fuel oil, the cut of the barrel that contains heating oil and diesel fuel, products that are almost chemically identical. This ratio has prompted many market participants to concentrate on 3:2:1 crack spreads — three crude oil futures contracts versus two gasoline contracts and one heating oil contract. A refiner running crude oil with a lower yield of gasoline relative to distillate might be more likely to trade other spread combinations such as a 5:3:2 crack, for example.

The NYMEX Division crack spread — a single order comprising the simultaneous purchase and sale of crude oil and petroleum products futures — allows refiners to lock in the differential between refinery input and output prices, and profit from or protect against changes in that value.

The crack spread — the theoretical refining margin — is quoted in dollars per barrel. To obtain it, the combined value of gasoline and heating oil must first be calculated. This value is then compared to the price of crude. Since crude oil is quoted in dollars per barrel and the products are quoted in cents per gallon, heating oil and gasoline prices must be converted to dollars per barrel by multiplying the cents-per-gallon price by 42 (there are 42 gallons in a barrel). If the combined value of the products is higher than the price of the crude, the gross cracking margin is positive. Conversely, if the combined value of the products is less than that of crude, then the gross cracking margin is negative. This sum is then divided by the number of barrels of crude to reduce the spread value to a per-barrel figure.

3:2:1 Crack Spread

Using a ratio of three crude to two gasoline plus one heating oil, the 3:2:1 gross cracking margin is calculated as follows to obtain the 3:2:1 crack spread:

(Assume gasoline is 57.50¢ per gallon, heating oil is 54.50¢ per gallon, and crude is $18.50 per barrel.)

57.50¢ per gallon x 42 = $24.15 per barrel of gasoline x two barrels = $48.30

54.50¢ per gallon x 42 = $22.89 per barrel of heating oil

The sum of the products is: $71.19

Three barrels of crude ($18.50 x 3) = $55.50

Therefore, the gross cracking margin is $71.19 - $55.50 = $15.69

The 3:2:1 crack spread is $15.69/3 barrels = $5.23 per barrel (margin)

First Nearby 3:2:1 Crack Spread
(3 Crude Oil: 2 Gasoline plus 1 Heating Oil, 1/2/96 to 12/29/00)

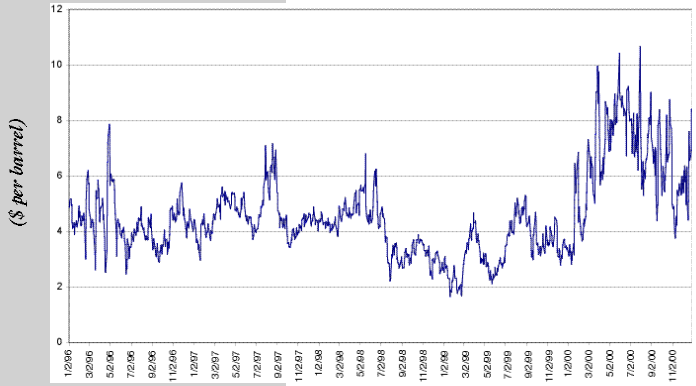

Figure 1

If a refiner expects crude prices to hold steady, or rise somewhat, while products fall (a declining crack spread), the refiner would "sell the crack;" that is, he would buy crude futures and sell gasoline and heating oil futures.

Whether a hedger is selling the crack or buying the crack reflects what is done on the product side of the spread, traditionally, the premium side of the spread.

Once the hedge is in place, the refiner need not worry about movements in absolute futures prices. He need only be concerned with how the combined value of products moves in relation to the price of crude (Figure 1).

The following example shows how a refiner could lock in a margin between crude oil and heating oil (a 1:1 crack spread).

Example 1 — Fixing Refiner Margins Through a Simple 1:1 Crack Spread

In January, a refiner reviews his crude oil acquisition strategy and his potential distillate margins for the spring. He sees that distillate prices are strong, and plans a two-month crude-to-distillate spread strategy that will allow him to lock in his margins.

In January, the spread between April crude ($18 per barrel) and May heating oil (49.25¢ per gallon or $20.69 per barrel) presents what he believes to be a favorable $2.69 per barrel.

The refiner sells the April/May crude-to-heating oil spread, thereby locking in the $2.69/bbl. margin. He does this by buying April crude oil futures at $18/bbl. and selling May heating oil futures at 49.25¢/gal. (or $20.69/bbl.).

In March, he purchases the crude oil at $19/bbl in the cash market for refining into products. He also sells heating oil from his existing stock in the cash market for 49.50¢/gal. or $20.79/bbl. His net gain in the cash market is therefore $1.79/bbl. ($20.79/bbl. less $19/bbl.).

Since the futures market reflects the cash market, crude oil futures are also selling at $19.00/bbl. in March – $1 more than when he purchased them. May heating oil futures are also trading higher. They are 49.50¢/gal. ($20.79 per barrel), or 0.25¢/gal. higher than the original heating oil futures price.

To complete the spread transaction, the refiner buys back the crack spread by first repurchasing the heating oil futures he sold in January. Since they now trade at $20.79/bbl. (49.50¢/gal.), they cost him 10¢/bbl. more than he sold them for. But he also sells back the crude oil futures he purchased in January. Since crude oil futures are trading at $19.00/bbl., they earn him $1.00/bbl. more than he paid for them.

His gain on the spread is therefore 90¢ (the $1.00 gain on crude oil futures minus the 10¢ loss on heating oil futures). Had the refiner been unhedged, his margin would have been limited to the $1.79 gain he had in the cash market. Instead, combined with that gain, his final net margin with the hedge is $2.69 – the favorable margin he originally sought in January.

	Cash	Futures	Financial Effect Cash	Financial Effect Futures ($/bbl.)
Jan	——	Sell crack spread: Buy April crude	—-	($18.00)
		Sell May heating oil at 49.25¢/gal.		$20.69
		Gain/(loss)		$2.69
March	Buy crude at $19		($19.00)	
	Sell heating oil at 49.50¢/gal.		$20.79	
	Net gain/(loss)		$ 1.79	
		Buy crack spread: Sell April crude		$19.00
		Buy May heating oil at 49.50¢/gal.		($20.79)
		Gain/(loss)		($1.79)
		Net futures gain/(loss)		$.90
	Cash refining margin without hedge		$1.79	
	Final net margin with hedge		$2.69	

In real world operations, however, refiners continuously produce a slate of products and buy crude month-by-month. The next example shows how a crack spread can be calculated on more than one product.

Example 2 — Refiner with a Diversified Slate, 3:2:1 Crack Spread

An independent refiner who is exposed to the risk of increasing crude oil costs and falling refined product prices runs the risk that his refining margin will be less than anticipated.

On September 15, the refiner incurs an obligation in the cash market to buy 30,000 barrels of crude oil on October 16 at prevailing cash market prices. He is also obliged to sell 420,000 gallons (10,000 barrels) of heating oil and 840,000 gallons (20,000 barrels) of gasoline on November 28 at prevailing cash market prices.

That same day, September 15, the refiner initiates a long hedge in crude oil and short hedges in heating oil and gasoline to fix a substantial portion of his refining margin through a 3:2:1 crack spread. He does this by *purchasing* 30 November crude oil futures contracts while *selling* 20 December gasoline futures contracts and 10 December heating oil contracts.

The $3.63/bbl. crack spread has ensured that refining crude oil will be at least as profitable in November as it was in September, regardless of whether the actual cash margin narrows or widens. Note that there is also a 45¢ net basis differential between N.Y. Harbor and Gulf Coast gasoline. A decline in the cash margin is offset by a gain in the futures market; conversely, any gain in the cash market is offset by a loss in the futures market. This table reflects the refiner's 3:2:1 crack spread of three crude, two gasoline, one heating oil.

Date	Cash Prices	Action	Futures Market
Sept 15	Light, sweet crude oil: @ $18.90/bbl.	Agrees to buy at prevailing prices: 30,000 bbl. light, sweet crude on Oct 16	Buys 30 Nov light, sweet crude contracts at $18.45/bbl.
	Gasoline: Gulf Coast @ 54.50¢/gal. ($22.89/bbl.) NY Harbor @ 58.50¢/gal. ($24.57/bbl.)	Commits to sell at prevailing cash market prices: 840,000 gal. (20,000 bbl.) NY Harbor gasoline on Nov. 28	Sells 20 Dec NY Harbor gasoline contracts @ 52.57¢/gal. ($22.08/bbl.)
	Heating oil: Gulf Coast @ 48.74¢/gal. ($20.47/bbl.) NY Harbor, 51.24¢/gal. ($21.52/bbl.)	Commits to sell at prevailing cash market prices: 420,000 gal. (10,000 bbl.) NY Harbor heating oil on Nov. 28	Sells 10 Dec NY Harbor heating oil contracts @ 52.55¢/gal. ($22.07/bbl.)

Results

Futures crack spread on Sept. 15: { [(20 x $22.08) + (10 x $22.07)] - (30 x $18.45) } /30 = $3.63/bbl.

Gulf Coast cash market margin: { [(20 x $22.89) + (10 x $20.47)] - (30 x $18.90) } /30 = $3.18/bbl.

NY Harbor cash market margin { [(20 x 24.57) + (10 x 21.52)] - (30 x 18.90) } /30 = $4.65

Gulf Coast cash basis minus NY Harbor futures: $3.18 - $3.63 = - $0.45

Timing risk and basis risk can be quantified and are usually less than the absolute price risk to which the refiner is subjected.

The example assumes fixed points in time of the obligation to buy and sell in the cash market. In practice, these may not be entirely known or fixed.

Purchasing a Crack Spread

The purchase of a crack spread is the opposite of the crack spread hedge or selling the crack spread. It entails selling crude oil and buying products. Refiners are naturally long the crack spread as they continuously buy crude and sell products. At times, however, refiners do the opposite, they buy products and sell crude and thus find purchasing a crack spread a useful strategy.

When refiners are forced to shut down for repairs or seasonal turnaround, they often have to enter the crude oil and product markets to honor existing purchase and supply contracts. Unable to produce enough products to meet term supply obligations, the refiner must buy products at spot prices for resale to his term customers. Furthermore, lacking adequate storage space for incoming supplies of crude oil, the refiner must sell the excess on the spot market.

If the refiner’s supply and sales commitments are substantial and if it is forced to make an unplanned entry into the spot market, it is possible that prices might move against it. To protect itself from increasing product prices and decreasing crude oil prices, the refinery uses a short hedge against crude and a long hedge against products which is the same as purchasing the crack spread.

Example 2 – Case A: Rising Crude, Falling Product, Stable Basis, Refiner Buys the Spread

Date	Cash Market Prices	Cash Market Action	Futures Market Action
Oct 16	Light, sweet crude oil: Cushing @ $19/bbl.	Buys 30,000 bbl. light, sweet crude oil @ $19/bbl.	Sells 30 Nov light, sweet crude oil contracts @ $19/bbl.
Nov 28	Gasoline: Gulf Coast @ 46.24¢/gal. ($19.42/bbl.) NY Harbor @ 48.74¢/gal ($20.47/bbl.)	Sells 840,000 gal. (20,000 bbl.) NY Harbor gasoline @ 48.74¢/gal.($20.47/bbl.)	Buys 20 Dec NY Harbor gasoline contracts @ 49.36¢/gal. ($20.73/bbl.)
	Heating oil: Gulf Coast @ 46¢/gal. ($19.32/bbl.) NY Harbor @ 48.50¢/gal. ($20.37/bbl.)	Sells 420,000 gal. (10,000 bbl.) NY Harbor heating oil @ 48.50¢/gal.($20.37/bbl.)	Buys 10 Dec heating oil contracts @ 49.42¢/gal. ($20.76/bbl.)

Results

Futures crack spread: { (30 x $19) - [(20 x $20.73) + (10 x $20.76)] } /30 = -$1.74.

New York Harbor cash crack spread: { [(20 x $20.47) + (10 x $20.37)] - (30 x $19) } /30 = $1.44/bbl.

Futures profit: $3.63 (Sept 15 crack spread) - $1.74 (Oct 16 crack spread) = $1.89/bbl.

Realized margin: cash margin + futures profit = $3.33/bbl. ($1.44/bbl. + $1.89/bbl. = $3.33/bbl.)

Example 2 – Case B: Falling Crude, Rising Product Prices, Stable Basis, Refiner Buys the Spread

Date	Cash Market Prices	Cash Market Action	Futures Market Action
Oct 16	Light, sweet crude oil: Cushing @ $17.50/bbl.	Buys 30,000 bbl. light, sweet crude oil @ $17.50/bbl.	Sells 30 Nov light, sweet crude oil contracts @ $17.50/bbl.
Nov 28	Gasoline: Gulf Coast @ 56¢/gal. ($23.52/bbl.) NY Harbor @ 60¢/gal ($25.20/bbl.)	Sells 840,000 gal. (20,000 bbl.) NY Harbor gasoline @ 60¢/gal.($25.20/bbl.)	Buys 20 Dec NY Harbor gasoline contracts @ 59.50¢/gal. ($24.99/bbl.)
	Heating oil: Gulf Coast @ 56¢/gal. ($23.52/bbl.) NY Harbor @ 52.50¢/gal. ($22.05/bbl.)	Sells 420,000 gal. (10,000 bbl.) NY Harbor heating oil @ 52.50¢/gal.($22.05/bbl.)	Buys 10 Dec heating oil contracts @ 52¢/gal. ($21.84/bbl.)

Results

Futures crack: { (30 x $17.50) - [(20 x $24.99) + (10 x $21.84)] } /30 = - $6.44/bbl.

New York Harbor cash crack spread: { [(20 x $25.20) + (10 x $22.05)] - (30 x $17.50) } /30 = $6.65/bbl.

Futures loss is $3.63 (Sept 15 crack spread) - $6.44 (Oct 16 crack spread) = - $2.81 bbl.

Realized margin: cash margin + futures loss = $3.84 ($6.65/bbl. - $2.81/bbl. = $3.84/bbl.)

Example 3 — Refiner's Reverse Crack Spread

A large refining company experiences mechanical failures at its plant in February, shutting down production. The company has ongoing obligations to purchase crude, which it now lacks the capacity to process. The company also has an entire month of term sales commitments for refined products, but only a 20-day inventory.

The company also has several cargoes of crude oil in transit which it will have to sell on the spot market, even though it is concerned that the quantity of crude offered for sale over a relatively short time period in one location could weaken prices. It therefore decides to sell the crude oil on the futures markets to reduce its risk of falling prices.

At the same time, the refining company needs to purchase heating oil and gasoline in order to meet sales obligations. It fears that a late February cold snap could drive up heating oil prices and that an early inventory drawdown could boost gasoline prices. The company also wants to protect against its open market purchases of products causing a strengthening of prices. Given this scenario, what can it do?

On February 1, the company realized the refinery would have to be shut down and, on February 8, the company confirms the plant will be shut down for a minimum of three, and possibly as long as six, weeks.

On February 1, the refining company simultaneously sold April crude oil futures and purchased gasoline and heating oil futures using the NYMEX Division crack spread. Since gasoline season was approaching, it bought a 3:2:1 crack spread (three barrels of crude, two barrels of gasoline, one barrel of heating oil) at $3.12 per barrel. The breakdown of the spread was $19 per barrel for crude, 54¢ per gallon for gasoline ($22.68/bbl.), and 50¢ per gallon for heating oil ($21/bbl.). { ($19 x 3) - [($22.68 x 2) + ($21 x 1)] }/3 = - $3.12.

News of the refinery's problems had not yet leaked. Having completed the futures market transaction, the company entered the cash market in order to arrange time trades for both crude and products. After the first few deals were struck, news that the refiner was in the market in a big way began to spread. Crude prices softened to $18.54/bbl. and the price for gasoline firmed at 55¢ per gallon ($23.10/bbl.). By February 8, when the shutdown was confirmed, the crack spread had widened to $3.86. { ($18.54 x 3) - [($23.10 x 2) + ($21 x 1)] } /3 = - $3.86.

On February 26, the company had to enter the spot market to dispose of the next shipment of crude. The best deal the company was able to negotiate in the cash market was $18.40, after purchasing the crude in the cash market on February 15 at $18.75. Simultaneously, the refiner liquidated the crude oil leg of its crack spread position, buying back April crude oil futures contracts for $18.75.

The refiner thus had a 25¢ per barrel profit on the crude oil futures position, offsetting most of the 35¢ loss on the crude oil cash market transaction.

On March 15, the refiner had to purchase cash market gasoline and heating oil in a ratio of approximately 2:1. February was mild so heating oil was abundant. The refiner was able to purchase its heating oil requirements at the cash market price of 50.50¢ per gallon. Gasoline, however, was in tight supply, and the best deal was 58¢ per gallon. The refinery then delivered the products to a reseller at the contractual price of the spot market quotation plus one-half cent, or 51¢ per gallon for heating oil and 58.5¢ per gallon for gasoline.

Also on March 15, the refining company liquidated its long product futures positions by selling them. Heating oil futures for April delivery was trading at 51¢ per gallon, 1¢ higher than the original purchase price. April gasoline futures had risen by 3¢ to 57¢ per gallon. The net result, as the chart below indicates, was a gain of $1.23 per bbl. in the futures market.

The refinery's use of the futures market allowed it to realize a profit of 81¢ per barrel for the period, rather than the 42¢ loss it would have incurred unhedged. ($1.23 futures gain minus the 42¢ cash market loss equals 81¢.) The transaction summary appears below:

Date	**Cash Mkt. Action**	**$ Finc'l Effect 3:2:1 crack**	**Futures Mkt. Action**	**$ Finc'l Effect 3:2:1 crack**
2/1	Realizes refinery will shut down		Buy April 3:2:1 crack	($3.12)
			Sell three April crude futures contracts @ $19/bbl. =	$57.00
			Buy two April gasoline futures contracts @ 54¢/gal.= $22.68/bbl. X 2 =	$45.36
			Buy one Apr heating oil futures contract @ 50¢/gal.= $21/bbl.	$21.00
			[57-($45.36+$21)] /3 =	($3.12)
2/15	Buy 3,000 bbl. of crude at $18.75/bbl.	$18.75	Sell April 3:2:1 crack by leg	
2/26	Sell 3,000 bbl. of crude at $18.40/bbl.	$18.40	Buy three Apr crude futures contracts @ $18.75/bbl.	$56.25
	Crude gain/loss)/bbl. = ($0.35) bbl. X 3 =	($1.05)		
3/15	Buy 2,000 bbl. of gasoline @ 58¢/gal. = $24.36/bbl. X 2 =	$48.72	Sell two Apr gasoline futures contracts @ 57¢/gal. $23.94/bbl. X 2 =	$47.88
	Sell 2,000 bbl. of gasoline @ 58.5¢/gal. = $24.57/bbl. X 2 =	$49.14	Sell one Apr heating oil futures contracts @ 51¢/gal. $21.42/bbl. =	$21.42
	Gasoline gain/bbl.	$0.42	$47.88+$21.42-$56.25/3 =	$4.35
	Buy 1,000 bbl. of heating oil @ 50.50¢/gal. $21.21/bbl.	$21.21		
	Sell 1,000 bbl. of heating oil @ 51¢/gal. $21.42/bbl.	$21.42		
	Heating oil gain /bbl.	$0.21		
	Net gain/(loss) in cash market - $1.05 + $0.42 + $0.21 =	($0.42)		

Final futures gain/(loss)	$1.23
Cash position excluding hedge	($0.42)
Final crack spread realized	$0.81

Crack Spread Options

Crack spread options complement the futures by allowing the refiner to hedge its operating margin at a known up-front cost while simultaneously allowing it to participate in any future widening of refining margins. The options give added flexibility to those trying to manage their risk in increasingly fickle physical markets.

While crude-to-product ratios of futures crack spreads are tailored by traders to best fit their needs, crack spread options contracts are standardized Exchange instruments which reflect a one-to-one ratio.

Crack spread options are puts and calls on the one-to-one ratio between the New York Harbor heating oil futures or New York Harbor unleaded gasoline futures contract and the Exchange's light, sweet crude oil futures contract. The underlying spread and options price is expressed as dollars and cents per barrel. For example, if June gasoline is priced at 60.30¢ per gallon ($25.33 per barrel), and June crude is priced at $19.66 per barrel, the June gasoline crack spread is $5.67 ($25.33 minus $19.66). The equation is the same for heating oil.

The one-to-one ratio of the options meets the needs of many refiners, because it reflects the refiner's exposure related to the manufacture of gasoline and heating oil throughout the year.

Types of Options

There are two types of options: calls and puts. A call gives the holder of the option the right, but not the obligation, to buy the underlying futures contract. Conversely, a put option gives the holder the right, but not the obligation, to sell the underlying futures contract.

The price at which the underlying futures contract may be bought or sold is the exercise price, also called the strike price. An options contract affords the right to buy or sell for only a limited period of time; each options contract has an expiration date.

On the opposite side, a seller, or writer of an options contract incurs an obligation to perform, should the option be exercised by the purchaser. Therefore, the writer of a call incurs an obligation to sell a futures contract and the writer of a put has an obligation to buy a futures contract.

Because trading on the New York Mercantile Exchange is done with anonymous counterparties, when an options contract is exercised, the Exchange randomly assigns an options writer to fulfill the obligation.

Options Rights and Obligations

***Call* Buyer**	Has the right to buy a futures contract at a predetermined price on or before a defined date. ***Expectation:*** Rising prices
Seller	Grants right to buyer, and therefore has an obligation to sell futures at a predetermined price at buyer's sole discretion. ***Expectation:*** Neutral or falling prices
***Put* Buyer**	Has right to sell a futures contract at a predetermined price on or before a defined date. ***Expectation:*** Falling prices
Seller	Grants right to buyer, and therefore has an obligation to buy futures at a predetermined price at buyer's sole discretion. ***Expectation:*** Neutral or rising prices

Crack spread options offer a number of benefits:

- Refiners, blenders, and marketers have a flexible hedge against variable refining margins in heating oil and gasoline.
- Puts give refiners an instrument for locking in crude oil cost and product margins without penalty to further market gains.
- Calls afford product marketers protection during unstable spread increases.
- Crack spread options in general furnish traders with an efficient mechanism for hedging the changing relationship between crude and products.
- They allow refiners to generate income by writing options.
- A refiner's margin could be hedged by utilizing the appropriate futures contracts, but maintaining the hedge essentially locks him into a predetermined margin. Options give him the right, but not the obligation, to obtain that margin.
- Marketers and distributors selling branded and unbranded gasoline can use options to help maintain their competitive positions in the marketplace. Branded distributors who are also refiners can use options to help protect their margins during periods of market instability. Unbranded marketers normally must sell at a discount to the majors. They can find themselves at tremendous risk when the crack spread is severely squeezed in the face of higher crude costs. Their wholesale prices may climb much more rapidly than they can raise retail prices because they generally do not have the same flexibility as a refiner who is selling a wide slate of products. If the refiner chooses, he can hold his gasoline prices relatively steady and pass some of the increased costs through on the prices of other

products. Unbranded marketers, however, must continue to buy gasoline on the wholesale market where prices will likely reflect higher crude costs, thus narrowing their retail margins.

Example 4: Replicating a Refiner's 3:2:1 Crack Spread With Crack Spread Options

Underlying crack spread options are ratios of one heating oil or gasoline futures contract to one crude oil contract. By using multiple options contracts, refiner's hedges can be replicated, such as the 3:2:1 spread (three crude oil futures, two gasoline futures, one heating oil future) which is indicative of many refinery runs.

two gasoline crack spread options = two gasoline futures and 2 crude oil futures

one heating oil crack spread option = one heating oil future and 1 crude oil future.

Result: three crude, two gasoline, one heating oil.

A futures crack spread executed on the Exchange is treated as a single transaction for the purpose of determining a market participant's margin requirement. Specifically, the minimum margin requirement takes into account that the risk on one side of the spread is generally reduced by the other leg of spread. Similarly, crack spread options allow the hedge to be accomplished with the payment of one options premium instead of two. Crack spread options also offer the inherent advantages of outright options on futures which allow market participants with commercial exposure to tailor their hedge to their price risk without giving up the ability to participate in favorable market moves.

Trading Units of Crack Spread Options

A long crack call (buying a crack call option), or a short crack put (selling a crack put option), is defined as the assignment of futures positions which, at exercise, involves buying one underlying heating oil or gasoline futures contract and selling one underlying crude oil contract.

A long crack put (buying a crack put option), or a short crack call (selling a crack call option), is defined as the assignment of futures positions which, at exercise, involve selling one underlying heating oil or gasoline futures contract and buying one underlying crude oil futures contract.

Example 5 — Setting a Floor with Crack Spread Options

Locking in a positive crack spread by itself doesn't necessarily guarantee a profitable refining margin if it doesn't meet the fixed and operating costs of running the plant.

A refiner who is buying crude oil for $25 per barrel and selling heating oil at 73¢ ($30.66 per barrel) has a crack spread of $5.66 per barrel. Of that, $2 may be fixed and operating costs, leaving a net refining margin of $3.66.

As long as the products/crude differential remains above $2, the refiner can justify operations. When demand for product is good or crude prices are low, there should be ample opportunity to lock in profits. The lower a refiner can keep the break-even point, the more aggressively it can hedge its profit margin.

A refiner may pay to guarantee covering its costs, yet may be in a position to profit from a favorable move in the market. When refining margins are low, it is difficult to convince management to hedge the entire future production and lock in a break-even price, incurring the risk of an opportunity cost if product prices move higher.

Conversely, the decision becomes an easy one when a participant can lock in strong margins with a single trade. Crack spread options afford the greatest flexibility in seeking to hedge (or capture) these refining margins. With a single trade and a single price, two independent areas of risk can be hedged.

Let's take another look at the refiner who has a $2 break-even point and a heating oil crack spread trading at $5.66 per barrel. The question is, how it can best lock in the $3.66 profit margin, and to what extent is it comfortable with that level of profitability?

By buying 50 December heating oil crack spread puts with a strike price of $5 a barrel for a premium of 30¢ a barrel, the refiner has effectively hedged the cost of purchasing 50,000 barrels of crude oil and the revenue from the sale of 50,000 barrels of heating oil. (The futures contracts that underlie each crack spread options contract represent 1,000 barrels of crude and 42,000 gallons — 1,000 barrels — of products).

If taken to expiration and exercised, the refiner will sell heating oil for $5 per barrel over crude oil. The hedge cost $15,000 to implement and guarantees that neither a rise in crude oil prices nor a fall in heating oil prices can eat away at the refining margins below $5. For that $15,000, a profit margin of $3 has been locked in for 50,000 barrels of output. In this case, $135,000 is a guaranteed cracking margin ($3/bbl. x 50,000 barrels = $150,000 - $15,000 options premium = $135,000).

A less aggressive strategy might be to buy the $4 puts at a price of 10¢. This time, only $5,000 was spent but the strategy also only ensures a $2 per barrel or $95,000 cracking margin ($2/bbl. x 50,000 barrels =$100,000 - $5,000 options premium = $95,000).

Example 6 — Refiner Uses a Collar to Hedge the Crack Spread at an Affordable Cost

Sometimes, the cost of buying an option can be more expensive than a company's balance sheet requires. One solution to this is a collar strategy. It allows a hedger to lower the cost of the hedge by using the proceeds from the sale of one type of options contract to help defray the premium for purchasing an opposite options position. Collars involve the purchase of a call and the sale of a put or, conversely, the sale of a call and the purchase of a put. The call and put both have out-of-the-money strike prices and expire in the same month.

Assume the crack spread is trading at $3/bbl. A refiner may not be ready to lock in that margin, hoping it will go higher, but he does want to protect against it falling to less than $2.50. To accomplish this, the refiner sells a call with a strike price of $3.50, and uses the premium from the sale to offset the cost of simultaneously purchasing a $2.50 put. Such an arrangement allows the refiner to participate in a favorable move up to $3.50, and protects it if the market falls below $2.50.

If the refiner has hedged 100% of its market exposure, it gives up the opportunity to participate in a market rally above $3.50 because the call options it has sold will surely be exercised by the purchasers. If the refiner chose not to hedge all of its market exposure, however, the potential exists to benefit from the remaining unhedged position. In a case such as this, the refiner would identify the percentage of its refinery margin it wants to hedge at certain economics and then increase the percentage of hedged volume as crack spread values increase.

In this example, the refiner is selling its product and needs to buy crude oil. Refiners as hedgers typically sell the spread because they are continually buying crude and selling products. In this case, if the crack spread widens to more than $3.50, the refiner will give up any profit above $3.50 for the portion of its market exposure that it hedged. The refiner is willing to do that, however, because if the spread narrows to less than $2.50, it is protected.

Example 7 — Writing a Crack Spread Call

Selling, or writing, a crack spread call can also be a refiner's strategy. The buyer of the call has purchased the right to sell crude and buy products. If the buyer exercises the call, the refiner is obligated to "sell the spread," that is, buy crude oil and sell products. Selling a crack spread call enhances returns on refining margins since the premium income is used to offset the risk of declines in the product market outpacing a decline in crude oil costs, and squeezing refining margins.

Refiners are natural writers of crack spread calls. If the crack spread widens — that is, refining margins increase — a refiner could be at risk because the option could be exercised against it. However, a refiner's position will be enhanced by the amount of premium it collects.

An integrated refining company with a substantial marketing network, however, is not as concerned about finding a home for its products as in protecting its margin. Many refiners are in a position where their market demand is greater than their refinery production. To make up this deficit, they often must purchase products for resale. That places the company on both sides of the products market, as a buyer and as a seller.

Futures Settlement Crack Spread $/bbl	Exercise Long Put	Long Put Gross Revenues	Return on Physical Market Spread Sale	Bid Premium		Profit vs. (Cost or Loss)		Futures Position	Total Position
				Long Put	Short Call	Long Put	Short Call		
$0.50	Yes	$2,500	$500	($200)	$200	$1,800	$200	$2,000	$2,500
$1.50	Yes	$2,500	$1,500	($200)	$200	$800	$200	$1,000	$2,500
$2.50	No	0	$2,500	($200)	$200	($200)	$200	--	$2,500
$3.50	No	0	$3,500	($200)	$200	($200)	$200	--	$3,500
$4.50	No	0	$4,500	($200)	$200	($200)	($800)	($1,000)	$3,500
$5.50	No	0	$5,500	($200)	$200	($200)	($1,800)	($2,000)	$3,500
$6.50	No	0	$6,500	($200)	$200	($200)	($2,800)	($3,000)	$3,500
$7.50	No	0	$7,500	($200)	$200	($200)	($3,800)	($4,000)	$3,500
$8.50	No	0	$8,500	($200)	$200	($200)	($4,800)	($5,000)	$3,500

A company in that position also has to be concerned about the crack spread increasing too rapidly for the volume of products that are purchased for resale from outside sources.

In such a case, the refiner has to be careful not to sell the crack spread. Selling the spread (buying the crude and selling the products), effectively locks in a margin, something that is not desirable when the seller depends on outside sources for supply. If product prices should suddenly strengthen, the purchaser-reseller would likely be at a great disadvantage. For various reasons, he or she may not be able to pass the higher wholesale prices on to his or her retail distribution network for weeks or more. If he or she did sell the crack spread, however, he or she would have to liquidate the position and buy it back when the products were transferred to the retail group, an unnecessary step.

A company in that position would likely be better off buying a crack spread put, allowing the hedger to protect the refining margin in the event prices fall.

That is a key advantage of the crack spread options. They allow a hedger to manage both sides of the overall risk. A refiner in that position does not want the crack spread to go down too far — it loses money on its production of refined products, nor does it want the spread to go up too much — it loses on his purchase of products for resale.

Example 8 — Creating a Fence with Crack Spread Options

The following table shows that the refiner's purchase of a $2.50 crack spread put and its sale of a $3.50 crack spread call assures that it will realize a margin of between $2.50 and $3.50 per barrel. The strategy ensures that its margin will not fall below $2.50. If the crack spread drops below $2.50, the refiner's crack spread put position will be exercised, offsetting a loss in the physical market.

Should prices rally above $3.50, however, it is likely that the short call option will be exercised. Since the refiner also sells the physical product, the increased margin realized in the cash market would offset its loss on the options position, preserving the $3.50/bbl. margin.

In this example, based on 1,000 barrels or one contract, the premium of both options is 20¢ per barrel, so the refiner's cost of the long put is $200 and its premium income on the short call is $200. The refiner also has a 1,000-barrel exposure in the cash market.

Other Types of Intercommodity Energy Spreads

Spark Spreads

Similar to the crack spread, the "spark spread" has developed in the electricity markets as an intermarket spread for electricity and natural gas. The spark spread involves the simultaneous purchase and sale of electricity and natural gas futures contracts. This allows traders to take advantage of the generic conversions of natural gas to power to help price the forward electric power curve using natural gas-fired generation operating efficiencies and prices.

The regions with the most transparent short-term natural gas to power price correlation typically have been the northwestern and southwestern United States and Texas. These areas coincide with the Palo Verde, California-Oregon border, and Entergy electric power futures contracts trading on the Exchange.

The gas-to-power correlation is not as good in other parts of the country where coal, oil, or nuclear energy are predominantly used as the marginal fuels.

The spark spread, expressed in dollars per megawatt-hour ($/Mwh), is the difference between the value of electricity in $/Mwh and the fuel used to generate that electricity, also calculated in $/Mwh. The type of fuel itself is irrelevant. It can be coal, gas, oil, or even enriched uranium. In this case, the spark spread is the difference between the value of the electricity and the value of natural gas used in the generating unit (spark spread = [value of electricity less the cost of natural gas]/Mwh). Since gas is sold by the British thermal unit (Btu), not the megawatt hour, the cost of gas in Btus must be converted to its equivalent in megawatt hours in order to calculate the spark spread.

To make the conversion, it is necessary to know the heat rate for the specific generating unit in question. The heat rate is a measure of the efficiency of the generating unit calculated in the number of Btus required to generate one kilowatt of electricity.

If a generator has a heat rate of 10,000 Btus per kilowatt-hour, it means that the generator requires 10,000 Btus of fuel to produce one kilowatt hour of electricity. Since commercial power production is measured in megawatt hours, it takes 10 mmBtus to make one megawatt hour of electricity (1,000 Kwhs equal 1 Mwh, and 1,000,000 Btu equal 1 mmBtu). So the formula reads this way:

$$\frac{10{,}000 \text{ Btus}}{1 \text{ Kwh}} \times \frac{1{,}000}{1{,}000} = \frac{10 \text{ million (or MM)Btus}}{1 \text{ Mwh}}$$

Assume the operator of a power generating plant knows that the efficiency of his generators, as measured by the heat rate, is 10,000 Btus per kilowatt hour. He also knows that his net cost for natural gas is $1.58/mmBtu. He is now in a position to calculate his generating cost, which works out to be $15.80/Mwh. Here is the calculation:

$$\frac{10{,}000\ \text{Btus}}{1\ \text{Kwh}} \times \frac{1{,}000}{1{,}000} = \frac{10\ \text{mmBtus}}{1\ \text{Mwh}} \times \frac{\$1.58}{\text{mmBtu}} = \$15.80/\text{Mwh}.$$

The accuracy of the spread evaluation is dependent on the market price for power, which takes into account operating unit efficiencies. The market price reflects the relationship of the supply and demand for power. Generally, in an over-supplied power market, natural gas may not be the best marginal cost energy source. Conversely, in a high-demand period, the cost of natural gas as a generating fuel could be lower than the cost of oil aggregated, or even than the cost of imported power, particularly if all baseload generating capacity is already in use.

Other costs affecting the price of power include gas transportation, power transmission, plant operations and maintenance, and fixed costs. In addition, when power demand is rising, the utility's ability to dispatch the next lowest cost generation in an economic manner can have a considerable impact on operating costs. For instance, oil might be less costly as a marginal generating fuel than natural gas, but the utility may still find it far easier and faster to bring natural gas-fired generators on line in time to meet rising demand.

The following example of a spark spread calculation shows the basic elements of pricing power using natural gas in the southeastern United States:

Capacity charge per Mwh	$2.50
Transmission charge into Entergy transmission system per Mwh	1.50
Subtotal capacity and transmission charges per Mwh	$4.00
Natural gas price (Henry Hub) per mmBtu	$1.45
Natural gas transmission (burnertip add-on) per mmBtu.	0.18
Subtotal price per mmBtu	$1.63
Heat rate: 10,000 Btu/Kwh	
[($1.45+$0.18) x 10] = $16.30 per Mwh	
Subtotal burner tip price of natural gas per Mwh	$16.30
Total power cost per Mwh $4 + $16.30 =	$20.30

In turn, once the fuel cost is known, it is possible to find the spark spread simply by subtracting the generating cost from the market price of electricity. If the current market price is $20/Mwh — and the company's gas generating cost is $16.30/Mwh — then the spark spread is $3.70.

Market price of electricity	=	$20.00/Mwh
Generating cost in Megawatt hours	=	- $16.30/Mwh
Spark spread	=	$3.70

Using the above values for natural gas at a 10,000-Btu-per-Kwh heat rate, the burner-tip gas price equals [($1.45 + $.18) x 10] = $16.30 per Mwh. With the additional $4.00 per Mwh for capacity and transmission charges, the total cost to generate power under this scenario is $20.30 per Mwh. (NOTE: This may not represent the market price.)

Because of the different units of measure in electricity and natural gas futures contracts, it is necessary to know the heat rate of a power plant in order to determine the hedge ratio of electricity to natural gas. The Entergy electricity futures contract calls for delivery of 736 Mwh compared to the natural gas contract unit of 10,000 mmBtus. Using the (10,000 Btu/Kwh) heat rate method of converting Mwhs to mmBtus, one power contract will equate to 7,360 mmBtus or 0.736 natural gas contracts — roughly a comparison of four power contracts to three natural gas contracts. At an 8,000 heat rate, the spread goes to a five-to-three relationship and, at a 13,500 heat rate, the spread is close to a one-to-one relationship.

Heat Rate Btu/Kwh	Hedge Ratio*	Electricity/Natural Gas Contracts
8,000	0.59	5 to 3
10,000	0.74	4 to 3
12,000	0.88	9 to 8
13,500	0.99	1 to 1

** The hedge ratio is determined by dividing the heat rate by 1,000, multiplying it by 736 (the size of the electricity contract in Mwh) and dividing it by 10,000 (the size of the natural gas contract in million Btus). Therefore, 8 x 736 = 5,888/10,000 = 0.59, gives it a ratio of five to three.*

Example 9 — Independent Power Producer Uses Spark Spread to Protect Margin

In April, an independent power producer (IPP) in the Southwest reviews his natural gas acquisition prospects and his potential electricity sales for the summer. He sees that while electricity prices are strong, natural gas is an economical buy. He believes that gas prices are likely to increase as the summer progresses, which could erode his profit margin for electricity. The IPP plans a spread strategy that will allow him to lock a profit margin for his product.

On April 25, the price of July Henry Hub natural gas futures is $1.45 per million Btus and July Entergy electricity futures is $20 per megawatt hour (Mwh). He executes a spark spread to lock in a margin.

The heat rate of the generating unit is approximately 8,000, meaning it requires 8,000 Btus to generate one kilowatt hour of electric power. Because the natural gas and electricity contracts differ in size, the appropriate hedge ratio must be determined to capture the profit margin successfully. The hedge ratio depends upon the heat rate of the generator.

The hedge ratio is determined by dividing the heat rate by 1,000, multiplying it by 736 (the size of the electricity contract in Mwh) and dividing it by 10,000 (the size of the natural gas contract in million Btus). Therefore, 8 x 736 = 5,888/10,000 = 0.59, gives it a ratio of five to three.

By executing the following hedge, the electricity producer locks in a margin:

Spark Spread = [Electricity total value - natural gas cost/Mwh]

Independent power producer places hedge on April 25, sells the spread:

Apr 25

Futures Transaction
Sell five July Entergy electricity futures at $20/Mwh
Buy three July Henry Hub natural gas futures at $1.45/mmBtu
[(5 x 736 Mwh x $20/Mwh = $73,600) - (3x10,000 mmBtu x $1.45/mmBtu = $43,500)]/(5 x 736 Mwh = 3,680) =
Spark spread of $8.18/Mwh

Independent power producer lifts the hedge on June 26, by buying the spread:

June 26

Futures Transaction
Buy five July Entergy electricity futures at $16/Mwh
Sell three July Henry Hub natural gas at $1.60/mmBtu
[(3 x 10,000 mmBtu x $1.60/mmBtu = $48,000) - (5 x 736 Mwh x $16/Mwh = $58,880)]/5 x 736 Mwh = 3,680
Spark spread of – $2.96/Mwh

Result of hedge: $8.18-$2.96 = $5.22/Mwh, net profit
$5.22/Mwh x (5 x 736 Mwh) = $19,210

By buying natural gas futures at a relatively low price and selling electricity futures at a relatively high price, the independent producer sold the spread, hedging his profit margin for a physical sale. To lift the hedge, the opposite will be true, that is, buying the spread (buying electricity futures and selling natural gas).

The producer also did better by instituting a hedge on the spread rather than simply on the price of electricity itself. If he had hedged electricity only, selling futures at $20/Mwh and buying them back at $16/Mwh, he would have earned a profit of $4/Mwh versus the $5.22/Mwh earned on the spread.

In the cash market, the cost of gas transportation, electricity capacity, and transmission charges also must be factored in when determining the delivered price of electricity.

The natural gas cash market in April looked like this:

Price of natural gas at Henry Hub based on Henry Hub natural gas futures:	$1.45 per mmBtu
Current cost of gas transmission to power plant:	<u>$0.18 per mmBtu</u>
Total projected cost of gas	$1.63 per mmBtu

$1.63 x 8 (heat rate in mmBtu per Mwh)	= $13.04, Mwh equiv. gas price
Present electric capacity charge	$2.50 per Mwh
Present electric transmission to Entergy	$1.50 per Mwh
Total power cost at Entergy	$17.04 per Mwh

In July, the power producer must take delivery of physical gas and sell his electricity at the current cash market prices, while incurring the current transportation charges for gas and the capacity and transmission charges for electricity.

By this time, market conditions have dramatically changed. Gas prices began spiking up, as electricity prices were tumbling because of a prolonged cool spell.

When the power producer bought natural gas futures and sold electricity futures in April, he locked in a margin of $8.18 per Mwh. In June, he must offset his positions by selling back on the Exchange the natural gas futures that he purchased and by buying back the electricity futures that he sold. Because natural gas prices increased and electricity fell, the absolute margin, the differential between the two, also fell to $2.96 per Mwh.

The net profit on the hedge, therefore, was $5.22/Mwh ($8.18/Mwh - $2.96/Mwh = $5.22/Mwh).

Meanwhile, in the July cash market, natural gas and gas transportation increased too:

July Cash Market

Buy gas at	$1.60 per mmBtu
Transportation	$0.20 per mmBtu
$1.80 x eight (heat rate in mmBtu per Mwh) =	$14.40 Mwh equivalent price of gas
Electric capacity and transmission	$4.00 per Mwh
Total power cost on gas basis	$18.40 per Mwh
Entergy cash market electricity	$16.00 per Mwh
Capacity and transmission	$4.00 per Mwh
Total power cost at Entergy	$20.00 per Mwh
Net margin ($20 - $18.40) =	$1.60 per Mwh

The independent power producer was much better off hedging, which enabled him to lock in a net margin of $5.22, after he offset his futures positions vs. the $1.60 margin he'd realize if unhedged.

In the cash market, the favorable natural gas to electricity relationship that existed in April had reversed by July, relative to electricity futures pricing.

Frac Spreads

Natural gas and propane are also likely candidates for a market-related spread since natural gas processing is the major source of propane production.

The natural gas processor can partially hedge the price risk of processing natural gas and extracting propane through the use of a fractionation spread, much the same way refiners use crack spreads to establish margins when refining crude oil into heating oil and gasoline.

Balancing the Frac Spread by Equating Heating Value

The frac spread is quoted in heating value terms, dollars per mmBtu, to equate propane to natural gas. The natural gas futures contract is composed of 10,000 MMBtu, and is quoted in dollars and cents per mmBtu.

Propane futures are quoted in cents per gallon and traded in units of 42,000 gallons (1,000 barrels). One gallon in gaseous form contains approximately 91,500 Btus or 0.0915 mmBtu per gallon. Dividing the price of propane by 0.0915 gives the equivalent price per mmBtu. If propane were trading at 35¢ per gallon, the cost would be $3.825 per mmBtu.

$$\frac{\$0.35}{1 \text{ gallon}} \times \frac{1 \text{ gallon}}{0.0915/\text{mmBtu}}$$

One propane futures contract, 42,000 gallons, represents about 38% of the heating value of one natural gas contract of 10,000 mmBtu. The two most popular ratios used to create a balance heating value position are a 3:1 or 5:2 propane to natural gas spread.

Once the price of propane has been converted into the price per mmBtu, the frac spread can be calculated by subtracting the price of natural gas from the calculated value of propane to yield the gross manufacturing margin. At this point, the fractionator has only paid for the value of natural gas consumed, or reduced, in processing. There are many additional costs including processing, transportation, fractionation, and marketing that must be paid out of the gross manufacturing margin.

Example 10 – Gas Processors Frac Spread with a 5:2 Ratio

Assume propane futures are trading at 47¢ per gallon ($5.137 per mmBtu). If natural gas futures were trading at $3.087 per mmBtu, then the frac spread would have a positive margin of $2.05. From this margin, other operating costs could be covered.

Figure 1: Gas Processor's Frac Spread with a 5:2 Ratio

	Dec 3 Sold PN	Jan 6 Bought NG	Feb 10 Bought PN	Feb 10 Sold NG	Gain (Loss) PN	Gain (Loss) NG
Contract Month	March	March	March	March	March	March
$ per Contract Unit	$0.4700	$3.087	$0.3550	$2.167	$0.115	($0.919)
# of Units per Contract	42,000	10,000	42,000	10,000	42,000	10,000
$ per mmbtu NG=PN/.0915	$5.137*	$3.087	$3.88*	$2.167	$1.26*	($0.919)
Heat Value per Contract (mmBtu)	3,843	10,000	3,843	10,000	3,843	10,000
Spread Ratio	5	2	5	2	5	2
Ratio x Heat Value (mmBtu)	19,215	20,000	19,215	20,000	19,215	20,000
$ Value per Contract	$19,740	$30,870	$14,910	$21,670	$4,830	($9,190)
Ratio x $ Contract Value	$98,700	$61,740	$74,550	$43,340	$24,150	($18,400)
Spread PN-NG (per mmBtu)	$2.05		$1.71		$0.34	
Net Futures					$6,533	

* propane price divided by 0.0915

Profit per mmbtu = $0.34

PN = propane

NG = natural gas

The 34¢ profit per mmbtu is calculated this way:

$$\frac{\$0.34}{\text{mmBtu}} \times 3{,}843 \text{ mmbtu} \times 5 = \$6{,}533.$$

The most frequent application of frac spreads is found among gas processors. In the preceding example, a processor wishes to lock in the $2.05 per mmBtu spread between the two products for the March contract. He enters into the market on December 3, and liquidates the position on February 10, several days before the March contract ceases trading.

A profit of 34¢ per mmBtu on 19,215 mmBtu is realized in the futures market. In March, the gas processor can no longer realize the high margin he received in December for fractionating propane and "dry" natural gas out of wet gas. The 34¢-per-mmBtu futures gain is used to supplement, or offset, the reduced processing margin received in the cash market. The net effect on the processor's balance sheet is a maintained margin.

If the frac spread had increased beyond $2.05 instead of decreasing, the processor would have lost an opportunity for further gain but, as a hedger, he was content in locking in the $2.05 per mmBtu margin. He was willing to forego a potentially higher margin in exchange for eliminating the chance of a lower margin.

Conclusion

The simple strategies outlined in this book are designed to illustrate the flexibility of the New York Mercantile Exchange intercommodity energy spreads. Commercial hedgers may adapt any particular strategy to reflect their particular market circumstance or conditions particular to the markets for the underlying commodities.

Margin Requirements

The New York Mercantile Exchange requires its market participants to post and maintain in their accounts a certain minimum amount of funds for each open position. These funds are known as margin and represent a good faith deposit or performance bond that serves to provide protection against losses in the market. The clearinghouse collects margin directly from each of its clearing members who, in turn, are responsible for the collection of funds from their clients. Margins are required for open futures and short options positions. The margin requirement for an options purchaser is included in the cost of the premium.

Margin requirements and contract specifications are subject to change; please contact the Exchange clearinghouse or your broker for current information.

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Price histories for all Exchange contracts are available on diskette, including crude oil; heating oil; New York Harbor unleaded gasoline; natural gas; electricity; propane; options on the heating oil-crude oil and New York Harbor unleaded gasoline-crude oil crack spread; gold; silver; platinum; palladium; copper; aluminum; and futures and options on the FTSE Eurotop 100® index and on the FTSE Eurotop 300® futures index. To order, contact (212) 299-2318.

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