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for a fixed price over a specified period of time.”<sup>5</sup> (In the case of natural gas swaps, they are actually referred to as “Henry Hub look-alikes.”)

Similar to a NYMEX contract, the elements of a swap contract include the commodity, location, date, and price. However, one of the advantages of swaps is the ability to customize the volume to suit the hedger’s needs. (As discussed earlier, NYMEX futures volumes are fixed at 1,000 bbl. for crude, 10,000 MMBtu for natural gas, and 42,000 gallons for gasoline and heating oil. But what if you want to hedge more or less than these amounts? Swaps allow you to do just that.)

When swaps are traded bilaterally, the two parties involved will execute a legal document known as a *confirmation*, which spells out the details of the transaction. These are part of the base ISDA *Master Agreement* for conducting financial trades. (The International Swaps and Derivatives Association [ISDA] is based in New York and provides standardization methods for the trading of financial derivatives.)

We use the phrase *fixed-for-floating swap* to signify the prices agreed to by both parties in the contract. The *fixed price* is always the *current market price*, which is known at the time the contract is executed. The actual exchange of payments will occur when the NYMEX futures contract settlement price is known and is then compared to the fixed price. We refer to the settlement price as the *floating* or *unknown* part of the swap, since it is not known until the contract’s last trading day (settlement). It “floats” as the NYMEX contract trades daily until then. The difference between the two prices represents the amount of payment due one party or the other.

For example, in February, a crude refinery is concerned about oil prices possibly rising as the summer driving season approaches. The June NYMEX WTI price is trading at \$60.50/bbl, and the refiner wishes to fix a price now. So the refiner buys a crude oil swap from a financial counterparty at \$60.50/bbl. In this swap, the refiner’s position is exactly the same as if they traded on NYMEX, that is, the refiner buys the swap since it is short in the physical market. But the refiner is buying *price* protection *only*, and not a commodity-backed contract. The financial institution has sold the swap, just as a NYMEX counterparty would do. Each party has now guaranteed the other a price that will be financially settled upon expiration of the June WTI contract.

In late May, the June NYMEX WTI contract reaches a final settlement price of \$60.75/bbl, so the floating part of the swap has now been determined, which represents the financial counterparty’s swap price. The difference between the refiner’s \$60.50/bbl and \$60.75/bbl is the amount exchanged between the two based upon their respective buy/sell positions. Each has to close out their positions *with one another* and not an exchange. However, the mechanics of this type of hedge are the same as if the counterparties had used NYMEX contracts.

In this case, the refiner bought the \$60.50/bbl swap and now sells it back to the counterparty at \$60.75. The counterparty pays the refiner a settlement of \$0.25/bbl. The refiner had a *financial* gain of \$0.25/bbl, but as with a NYMEX fixed-price hedge, prices rose in the physical market to \$60.75/bbl, making the refiner's actual physical crude purchase price \$0.25/bbl higher. So the refiner has a zero net monetary position with this hedge, just as if the transaction took place on NYMEX. But only the price was exchanged and not the underlying commodity.

If, however, the NYMEX settlement was \$60.25/bbl, the refiner would have to pay the counterparty the \$0.25/bbl difference and take a loss on the financial transaction. Once again, if NYMEX went down \$0.25/bbl, so did the cash market, which saved the refiner that amount on the physical crude purchase. Again, the refiner has a zero net monetary position with this hedge approach.

Table 7-1 shows the standard, fixed-price, hedge for crude oil using NYMEX futures contracts. The calculations for this Swap transaction are the same as those shown in table 7-1. But, in Table 7-2, we substitute the word, "Swap" for "NYMEX" to signify the change in financial instrument we are using. As you will note, the prices don't change. We are still relying on NYMEX for the pricing of both the "fixed" and, "floating" pieces of our Swap. But, the outcome is the same...a fixed-price hedge.

**Table 7-1.** Simple, fixed-price oil hedge using NYMEX futures contracts.

- 1) Refiner buys (30) June NYMEX futures contracts on 02/15/19 @ \$60.50
- 2) June contract expires on 05/21/19 - Refiner closes-out position (sells back)
- 3) Refiner buys physical crude oil at "market" (ARGUS posting) for June

Scenario 1

June NYMEX Crude Oil Contract settles @ \$60.75

- 1) Refiner has to sell back NYMEX contracts @ \$60.75 for a gain of +\$0.25 per Bbl.
- 2) Cash market (ARGUS posting) is now \$60.75 also. Physical loss of (\$0.25 per Bbl.

<b>Refiner</b>							
Buy	Sell June			Buy June	June		
June	NYMEX	Financial		Physical	Physical		Net
NYMEX	Settlement (1)	Gain/Loss		Market	Gain/Loss		Gain/Loss
\$60.50	\$60.75	\$0.25		\$60.75	(\$0.25)		\$0.00

Scenario 2

June NYMEX Crude Oil Contract settles @ \$60.25

- 1) Refiner has to sell back NYMEX contracts @ \$60.25 for a loss of (\$0.25) per Bbl.
- 2) Cash market (ARGUS posting) is now \$60.25 also. Physical gain of +\$0.25 per Bbl.

<b>Refiner</b>							
Buy		Sell June			Buy June	June	
June		NYMEX	Financial		Physical	Physical	Net
<u>NYMEX</u>		<u>Settlement (1)</u>	<u>Gain/Loss</u>		<u>Market</u>	<u>Gain/Loss</u>	<u>Gain/Loss</u>
\$60.50		\$60.75	\$0.25		\$60.75	(\$0.25)	\$0.00
(1) Closing-out position on Last Day of NYMEX trading							

**Table 7-2.** Simple, fixed-price oil hedge using Swaps

- 1) Refiner buys (30) June crude oil Swap contracts on 02/15/19 @ \$60.50
- 2) June NYMEX contract expires on 05/21/19 - Refiner closes-out position (sells back the Swap)
- 3) Refiner buys physical crude oil at “market” (ARGUS posting) for June

Scenario 1

June NYMEX Crude Oil Contract settles @ \$60.75

- 1) Refiner has to sell back Swap contracts @ \$60.75 for a gain of +\$0.25 per Bbl.
- 2) Cash market (ARGUS posting) is now \$60.75 also. Physical loss of (\$0.25) per Bbl.

<b>Refiner</b>							
Buy		Sell June			Buy June	June	
June		NYMEX	Financial		Physical	Physical	Net
<u>Swap</u>		<u>Settlement (1)</u>	<u>Gain/Loss</u>		<u>Market</u>	<u>Gain/Loss</u>	<u>Gain/Loss</u>
\$60.50		\$60.75	\$0.25		\$60.75	(\$0.25)	\$0.00
(1) Closing-out position on Last Day of NYMEX trading							

Scenario 2

June NYMEX Crude Oil Contract settles @ \$60.25

- 1) Refiner has to sell back NYMEX contracts @ \$60.25 for a loss of (\$0.25) per Bbl.
- 2) Cash market (ARGUS posting) is now \$60.25 also. Physical gain of +\$0.25 per Bbl.

<b>Refiner</b>							
Buy		Sell June		Buy June	June		
June		NYMEX	Financial	Physical	Physical		Net
<u>Swap</u>		<u>Settlement (1)</u>	<u>Gain/Loss</u>	<u>Market</u>	<u>Gain/Loss</u>		<u>Gain/Loss</u>
\$60.50		\$60.75	\$0.25	\$60.75	(\$0.25)		\$0.00
(1) Closing-out position on Last Day of NYMEX trading							

The advantage of using swaps for hedging is that you can achieve the same price protection without actually having to buy or sell NYMEX contracts. The refiner in the NYMEX example would have had to pay for the June WTI futures contracts almost immediately. Additionally, you can work with brokers either by phone (“voice” brokers) or through an electronic trading platform such as the ICE.<sup>6</sup> Swaps also can be customized to fit volumetric needs that vary from the standard contract specifications of NYMEX.

## Basis Swaps

*Basis* is “the difference between the spot price of an asset and its futures price.”<sup>7</sup> As we have stated, futures contracts have set delivery locations. Yet these same commodities change hands at hundreds of locations throughout North America. In addition, products like crude oil vary greatly in their quality and composition. The specific gravity, sulfur content, and Reid vapor pressure (RVP)<sup>8</sup> can all be different depending on the actual source of the crude oil.

These variations from the standard financial contract, in quality and/or location in physical commodities, are known as *basis* and represent a form of financial risk exposure for counterparties when these differences do exist. If delivery is to take place at a point other than the designated futures contract location, transportation costs may have to be considered. Or where the quality is different from the contract specifications, adjustments to the price may be warranted. From a price perspective:

$$\text{Basis} = \text{Spot (cash/physical) price} - \text{NYMEX (futures)}$$

Crude oil markets handle this by providing “deducts” and “adders” for the variances from WTI in their bilateral sales contracts. These can take many forms and will spell out what price adjustments will be made for API<sup>9</sup> gravity, RVP, and sulfur, among other possibilities. There may also be a transportation component, such as “WTI less transport,” which would represent the actual cost to deliver the oil to Cushing, OK, the NYMEX futures contract delivery point.



In the natural gas market, since there is a uniform pipeline quality standard, the only real risk posed is the delivery location vs. Henry Hub, the so-called basis differential. Once known as the “geographical location basis differential,” it is now more commonly known simply as the *basis*. A financial instrument called a *basis swap* can mitigate this risk. While it operates in a similar fashion as a regular swap, its settlement is very different. This is another form of a *fixed-for-floating* swap, where the fixed portion is the current market value and the floating portion has to be determined at settlement.

As we saw above, swaps settle by comparing the initial NYMEX price at the time of execution to the final settlement price for that NYMEX futures contract. For natural gas, that sets the price equivalent at Henry Hub in southern Louisiana. However, for other delivery points, other financial instruments will be needed in order to hedge the risk.

Take for example a producer with natural gas in Oklahoma who wishes to hedge the price in a future month. A NYMEX swap can get the producer a fixed price at Henry Hub, but that does not represent the price for the producer in Oklahoma. So the producer must look to the basis swaps market for the actual differential in price between the two points. Otherwise, as the price differences between Henry Hub and Oklahoma vary, the producer is exposed to what is known as *basis risk*.

The value of a basis swap is determined based on several factors but is closely tied to the market’s perception of the value of gas in each location for which a basis market exists. (These are usually most, but not all, of the physical pricing points found in the industry publications.) One would think that this differential would simply be the transportation cost to get the gas from Oklahoma to the Henry Hub. While this makes perfect sense, there are two main factors that prevent this from being the case.

- *Capacity*. There would have to be enough pipeline capacity to get *all* of the natural gas from Oklahoma to southern Louisiana for the transportation cost to be the only variable, which is not the case.
- *“Domestic” demand*. Oklahoma produces more gas than it consumes and is thus a net exporter of natural gas. However, at high periods of demand, there is less natural gas available to be sent out of state. Out-of-state markets will have to pay the prevailing prices if they wish to purchase natural gas from Oklahoma. Competition between these groups raises the price in Oklahoma. This tends to make the value of natural gas closer to that of Henry Hub, eliminating the idea of a purely transportation-based differential.<sup>10</sup>

In general, natural gas prices are higher in consuming areas and lower in the producing regions, since that is the normal direction of the flow of gas. As a result, prices are less in producing areas than in market areas. That means there is *normally* a price discount from the Henry Hub price for production zones and some type of adder to that same price for consuming zones. Since basis swap values reflect these

price differences, they are generally negative for cash market producing locations and positive for cash market consuming locations.

The financial markets provide basis swap values, so commercial parties wishing to hedge their locational risk can readily find quotes. Those who provide basis swaps markets run complex models to establish the market values. NYMEX's *ClearPort* electronic platform and *ICE* each trade basis swaps, as do the traditional voice brokers at financial institutions.

So our Oklahoma producer, wishing to set a fixed price, will utilize both a NYMEX swap to establish a Henry Hub price and a basis swap to hedge the price differential for Oklahoma. As with any hedge, the commercial entity will always take a position in the financial market that is the opposite of its physical position. In this case, the producer would sell both the NYMEX swap and the basis swap.

Since basis swaps are tied to the cash market, the settlement price is tied to the indexes for the respective locations as published each month. The majority of basis swaps for natural gas settle against the location's index as reported in *Platts Gas Market Report*, a natural gas market publication described in the chapter on cash markets.

For our example, we will use a pricing point known as "Panhandle Eastern Pipe Line Co. for Texas, Oklahoma (mainline)." This is an interstate natural gas pipeline that runs through Oklahoma on its way to market areas in Kansas, Missouri, and the upper Midwest region. Because a large volume is transported on Panhandle Eastern Pipe Line Co. (PEPL), it functions as a "liquid" point for trading basis swaps in Oklahoma.

At the time the hedge is executed, the fixed-price swap is priced at the current NYMEX price and the basis swap is priced at the current value in the marketplace for the desired location. The producer would sell both the NYMEX swap and the PEPL basis swap to a financial counterparty. Using our producer example, let's assume NYMEX was at \$3.50/MMBtu and the PEPL basis swap, based on the current market quotes, was Henry Hub less \$0.25/MMBtu. The price for the producer is now set at \$3.25/MMBtu as follows:

$$\text{NYMEX} + \text{Basis} = \text{Locational fixed price}$$

When the *Platts Gas Market Report* is published for that month, the PEPL index price is compared with the NYMEX final settlement for that same month. (The index price is subtracted from the NYMEX settlement price.) The difference is the "actual" basis swap value for that month and represents what was the floating part of the swap and is now the settlement for the basis swap. That is then compared to the basis swap value set previously, the \$0.25 fixed portion of the swap. The producer settles with the counterparty in the same fashion as with a normal swap agreement. Table 7-2 illustrates how the settlement of a basis swap works.

**Table 7–3.** NYMEX Basis Swap for Natural Gas

<i>Basis Example 1</i>					
1/15/2019	«Fixed»		<i>Platt's</i>	NYMEX	Actual
		PEPL Basis	February	Settlement	Basis
	Feb-19	(\$0.200)	\$2.530	\$2.750	(\$0.220)
		Sells	Buys	Pays	
Seller (Producer)	Feb-19	(\$0.200)	(\$0.220)	\$0.020	
		Buys	Sells	Receives	
Buyer (Broker)	Feb-19	(\$0.200)	(\$0.220)	(\$0.020)	
<i>Basis Example 2</i>					
1/15/2019	«Fixed»		<i>Platt's</i>	NYMEX	Actual
		PEPL Basis	February	Settlement	Basis
	Feb-19	(\$0.200)	\$2.530	\$2.780	(\$0.250)
		Sells	Buys	Receives	
Seller (Producer)	Feb-19	(\$0.200)	(\$0.250)	\$0.050	
		Buys	Sells	Pays	
Buyer (Broker)	Feb-19	(\$0.200)	(\$0.250)	(\$0.050)	

In order to fully comprehend how the settlement process for basis swaps works, we need to cover the addition and subtraction of negative numbers. For the purposes of simplicity, picture a number line where Henry Hub is the zero point. Generally, as you move along to locations north and east of Henry (to the right on the number line), you are in consuming areas where the value of gas increases, and thus prices are generally Henry “plus.” That would make the basis

swap values more “positive” than Henry Hub along the number line. Conversely, supply areas generally have lower prices than Henry, and their basis swap values are more “negative.” (The exceptions here are prices for the large consuming regions in the Southwest and West. As gas moves west out of Texas, for example, demand exceeds supply and prices start to increase, which increases the basis swap values.)

Areas on the positive side of the number line traditionally have included regions such as the Northeast,<sup>11</sup> Southeast, upper Midwest, Southwest, and West. On the negative side are mainly the supply regions of the Mid-continent, Rocky Mountains, West Texas/New Mexico, and the Pacific Northwest.

As basis swap values become more negative relative to Henry, we refer to this as *widening*, i.e., the distance away from the zero point is increasing. If the opposite is true and values are getting closer to Henry, we refer to this as *tightening*, i.e., the distance away from the zero point is decreasing. Keep in mind that these basis swap fluctuations represent an increase or decrease in the fixed price for each location since they are added to the NYMEX price to establish the locational price. Widening basis swap values mean higher prices on the positive side of the number line but lower prices on the negative end. Conversely, tightening basis swap values represent lower prices on the positive side of the number line but higher prices on the negative end (the negative values are decreasing, leading to prices that are closer to those at the Henry Hub). Table 7–4 illustrates this concept using basis swap values and a NYMEX Henry Hub price to establish the locational fixed prices.

**Table 7–3.** Basis swap values at Henry Hub

Basis Swap	(\$0.25)	(\$0.20)	(\$0.15)	(\$0.10)	\$0.00	\$0.10	\$0.15	\$0.20	\$0.25
Fixed-price	\$3.25	\$3.30	\$3.35	\$3.40	\$3.50	\$3.60	\$3.75	\$3.70	\$3.75

Now, going back to our example above, the producer first *sold* the basis swap at  $-\$0.25$ . When the actual basis value was calculated, it was a  $-\$0.20$ , which is a greater value on the number line as it represents a lower discount to Henry. In this case, then, the producer *bought* the basis swap back at higher value and thus lost money:  $-\$0.25 - (-\$0.20) = -\$0.05$ . On the other side of this transaction, the broker *bought* the basis swap from the producer at  $-\$0.25$  and *sold* it back at  $-\$0.20$ , making  $\$0.05$ :  $-\$0.20 - (-\$0.25) = \$0.05$ .

Figure 7–1 shows actual North American natural gas basis swap quotes from CME’s ClearPort electronic over-the-counter platform.

Description +	Prev Close
Feb 19 NYMEX CIG Rockies Natural Gas (Platts IFERC) Basis Futures Clearport	-0.2200
Feb 19 NYMEX Columbia Gas Transmission Corp. Appalachia (TCO) Basis (Platts IFERC) Futures Clearport	-0.2240
Feb 19 NYMEX Demarc Natural Gas (Platts IFERC) Basis Futures Clearport	-0.0900
Feb 19 NYMEX Dominion South Point Natural Gas (Platts IFERC) Basis Futures Clearport	-0.2440
Feb 19 NYMEX Houston Ship Channel Natural Gas (Platts IFERC) Basis Futures Clearport	0.0570
Feb 19 NYMEX MichCon Natural Gas (Platts IFERC) Basis Futures Clearport	-0.0880
Feb 19 NYMEX Panhandle Natural Gas (Platts IFERC) Basis Futures Clearport	-0.2510
Feb 19 NYMEX Permian Natural Gas (Platts IFERC) Basis Futures Clearport	-1.1850
Feb 19 NYMEX Surmas Natural Gas (Platts IFERC) Basis Futures Clearport	0.4040
Feb 19 NYMEX Transco Zone 6 Natural Gas (Platts IFERC) Basis Futures Clearport	5.8220
Feb 19 NYMEX Waha Natural Gas (Platts IFERC) Basis Futures Clearport	-1.4730

Fig. 7–1. Natural gas Basis Swaps quotes, NYMEX *ClearPort*

Note the description. The month is shown followed by the exchange (NYMEX). Then the physical pricing point is listed, along with the published settlement index reference. (ClearPort is still using the traditional name associated with *Platts Inside FERC* index publication, now known as *Platts Monthly Price Guide*.) The financial instrument, “Basis Futures,” and the “sub-exchange,” ClearPort, is shown. The “Previous Close” column represents the latest trading day’s settlement value for the basis swap at the given location.

Several key basis swaps locations were chosen to give the reader an idea of the variances in differentials from the NYMEX natural gas contract delivery point at the Henry Hub in southern Louisiana. Some represent mainly supply areas, while others are large consuming regions.

- *CIG Rockies*. This point represents the physical prices for natural gas that originates in the Rocky Mountain region and is transported via Colorado Interstate Gas Company. Gas from this region can move East, West, SE and, NW. The area is a net exporter of natural gas.
- *Columbia Gas Transmission*. This is a mainline transmission pipeline that serves portions of the Northeast and runs through the Marcellus Shale.
- *Demarc*. This is a “line of demarcation” on Northern Natural Gas Company’s main transmission line running through Kansas. It delineates the Supply area from the Market area in the rate matrix.
- *Dominion South*. This represents a point on Dominion Gas Transmission’s mainline system in SW Pennsylvania/NW West Virginia. It is reflective of gas prices in the Marcellus Shale and is, at times, constrained due to limited takeaway capacity in the region.
- *Houston Ship Channel*. Gas delivered here serves the huge crude and petrochemical refining corridor along the Gulf Coast in eastern TX.
- *MichCon*. MichCon is the abbreviation for Michigan Consolidated Gas, a large Midwest utility. This pricing point reflects market demand in the upper Midwest. The upper Midwest has access to gas supplies coming

from the Gulf Coast, Mid-continent, Rocky Mountains, and from both the Marcellus and Utica Shale basins, thus providing substantial gas-on-gas competition for market share.

- *Panhandle*. Short for Panhandle Eastern Pipeline Company, this interstate pipeline delivers gas to the Midwest and upper Midwest from sources in the Texas Panhandle, Oklahoma, and Kansas. A large enough volume moves through the region on Panhandle that the financial markets found solid liquidity for the basis swaps market using this pipeline. The value reflects the supply area in TX/OK/KS. It is negative since the region is a net exporter of natural gas, even in winter.
- *Sumas*. This “hub” represents the value of natural gas entering the United States from Canada into Northwest Pipeline at the Washington State border. (At +0.40, the market clearly expects cold in northwestern United States.)
- *Permian*. This is an area in West Texas which encompasses the Permian Basin producing area. As of this writing, more natural gas is being produced than pipeline capacity can handle. Thus, the large discount to Henry Hub seen.
- *Waha*. Several pipelines crisscross West Texas near the Midland area. This creates a “hub” for the transfer of gas from one pipeline to another. Prices here reflect the supply/demand dynamics for intrastate TX (west to east), as well as for gas going west into NM, AZ, and CA. A large discount to Henry Hub applies to this area as well for the same reasons as in the Permian Basin.
- *Transco Zone 6*. This delivery area represents a large market area in the Northeast as well as the Marcellus Shale supply basin. As you can see, the price here is also higher than Henry Hub, which would be normal for a winter month. However, vast amounts of the Marcellus Shale gas still cannot get the East Coast to supplement the demand in this area, or the basis value would be less. Again, pipeline projects and “backhaul” arrangements are in the works that should shift this dynamic.

There are also Swaps for crude oil with the most widely-quoted being those that represent differentials between the WTI Cushing, OK, delivery point and, the Permian Basin and, Houston Ship Channel areas.

## Using Basis Swaps to Hedge Transportation

Basis swaps can also be used to hedge the cost of natural gas transportation via pipelines since, in essence, we are looking at the value of one location (receipt) vs. another (delivery). We have addressed the fact that basis swaps are the difference between the price of natural gas at the Henry Hub and other locations. So each