Energy Products

Seasonality and Storage in Natural Gas

Resource Guide

Paradigm®

CME Group

The storage industry continues to evolve both in capability and it's prominence within the delivery chain. What once was a seasonal crossover point is now an active warehouse with optionality as the predominant market premium. The use of storage is fundamental to the management of natural gas. This requires a good baseline of fundamental knowledge in the techniques and methods of managing storage. This guide will show and explain in detail the different approaches and trading techniques that underpin storage management. In addition, it will familiarize you with the lexicon unique to storage and its optimization. With the ever-increasing emphasis on storage, the understanding and insight to capture value from storage management remains in high demand.

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The Price Curve

A price curve ("forward curve" or "forward price curve"), as used by energy professionals, is a schedule of the current dealable price of energy based on different future delivery dates. It refers to a projection of market spot prices over time and is used in investment analyses.

Represented graphically, each point on a price curve represents the price at which a buyer or seller could contract today to purchase or sell energy on that future date. Both payment and delivery are made at or following the future date. Prepayment is not required and is generally paid the month following delivery.

A forward price for June natural gas is quoted in March at $6.00/MMBtu. If transacted today, the buyer would receive physical natural gas in June with $6.00 cash settlement in July.

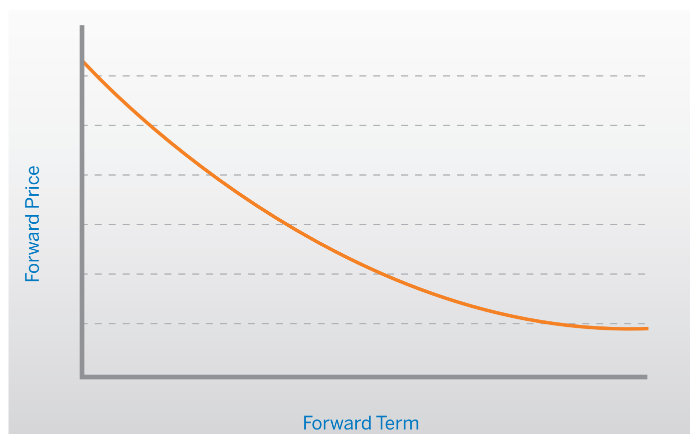
The price curve is not a forecast of future Index prices; rather, it represents the prices at which energy for future delivery is currently being priced and traded.

Shape of the Price Curve: Contango and Backwardated

Forward prices can be more or less expensive than current prices. Factors that influence the curve shape include expectations, interest rates, storage and transportation costs, logistic limitations on physical transport, and supply concerns.

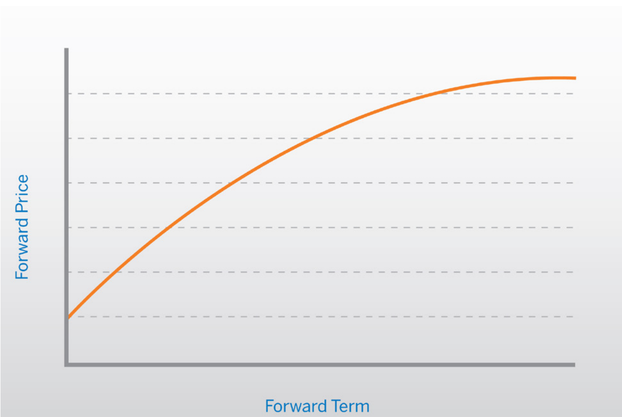
A **contango curve** is a curve where forward prices exceed current prices.

A **backwardated curve** is a curve where forward prices are less than current prices.



Seasonal Price Curves

Certain price curves, such as those for natural gas, follow a seasonal pattern: They rise in fall/winter months and decline in spring/summer months. These seasonality patterns yield short-term contango and backwardated segments.



Long Term Trends in Seasonal Curves

Despite periods of both contango and backwardation in a seasonal price curve, a contango or backwardated long-term shape can emerge, which is assessed by comparing peaks and troughs over a period of time. In the graphic example above, the seasonal curve displays a long-term contango since peak and trough prices increase after each cycle.

Time/Calendar Spreads and Storage

A "time" or "calendar" spread is the difference between the prices of the same commodity at different delivery periods.

Calculating a Time Spread

- If the price for July natural gas is $ 4.435 and at the same time, December gas trades at $ 4.916, the July-December time spread would be $ 0.481. The price curve between the two time periods would be in contango at an average spread of $ 0.0962 per month.
- If at the same time January gas was trading at $ 4.398 while next June traded at $ 4.393, the January-June time spread would be $ 0.005 (4.398-4.393). The price curve between the two time periods would be in backwardation at an average spread of $ 0.001 per month. Note that despite backwardation, the spread is considered positive.

Measuring Price Curve Steepness

The difference between prices for different terms is the cost of financially moving an exposure over time. A time spread is a measure of the degree to which the price curve is in contango or backwardation. In either case, the spread is always considered positive.

Seasonal Spreads

Time spreads can also be measured as the difference between the strip's (average) price for one series of months and a second strip price. Often these strips contain months in a particular season: e.g. storage season, winter season, etc.

Buying and Selling Time Spreads

While the time spreads above are the absolute values of the spreads, whether they are considered positive or negative depends upon the quoting conventions being followed, which also determines how the spread is bought or sold.

Dual Quoting Conventions for Trading Time Spreads

The convention for quoting time spreads differs between OTC / NYMEX Floor and electronic trading platforms.

- **OTC/NYMEX Floor:** Time spreads are always considered positive, regardless of whether the forward price curve is in contango or backwardated
- **CME Globex/CME ClearPort:** Time spreads are negative for contango forward curves and positive for backwardated curves.

Transacting Time Spreads on an Electronic Platform

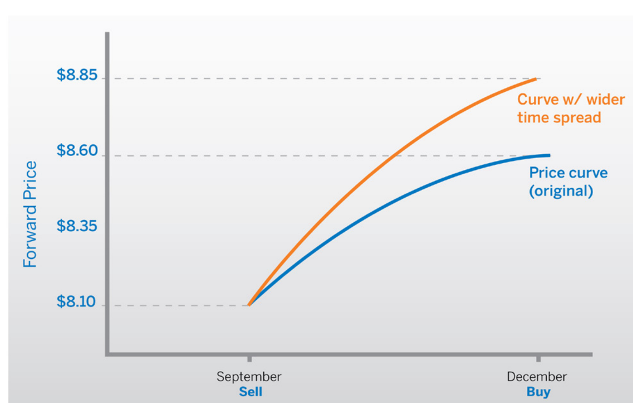
When buying or selling the time spread via an electronic platform the following conventions apply:

- **Buying the Time Spread:** To buy a time spread through electronic trading platforms, a hedger/ speculator would buy the shorter-dated period and sell the longer-term month.
  - **Contango:** If the forward curve is in contango (longer dated month at higher price), the time spread is considered bought at a negative spread. Buying the spread makes the hedger long, who benefits when the negative spread narrows (forward discount declines).
  - **Backwardation:** If the forward curve is in backwardation (nearer term month at higher price), the time spread is considered bought at a positive spread. Buying the spread makes the hedger long, who benefits when the positive spread increases.
- **Selling the Time Spread:** To sell a time spread through electronic trading, a hedger/speculator would sell the shorter-dated month and buy the longer-term month.

A dealer sees the following September and December forward prices in June this year:

September	$ 4.471
December	$ 4.916
Time Spread	$ 0.445

The dealer expects the September-December spread to widen (contango to steepen) as fall approaches.



OTC/NYMEX Floor

In OTC/NYMEX trading, the time spread is considered positive: + 44.5¢. To exploit a widening (increasing positive) spread, the dealer will go long the time spread by buying the spread:

Sell September @ $ 4.471 (Lower Price month); &
Buy December @ $ 4.916 (Higher Price month)

Pay +$ 0.445

Electronic Trading

In electronic trading, the contango time spread is considered negative: - 44.5¢. To exploit a widening (increasing positive) spread, the dealer will go short the time spread by selling the spread:

Sell September @ $ 4.471 (Shorter-dated month); &
Buy December @ $ 4.916 (Longer-dated month)

Earn -$ 0.445 (i.e. earning a negative value).

Locking in a $0.25 Profit

By late August, the spread has increased:

September $ 4.471
December $ 5.166

Time Spread $ 0.695

OTC/NYMEX Floor

The dealer can now sell back the spread: sell December (high price) and buy September and earn $ 0.695. This will leave the dealer with a $0.25 net profit.

Bought spread for $ 0.445; Sold spread for $ 0.695

CME Globex/CME ClearPort

The dealer can now buy back the spread: buy September (near term) and sell December paying -$ 0.695. This will leave the dealer with a $0.25 net profit.

Sold spread for - $ 0.445; Bought spread for - $ 0.695

Time Spreads in Backwardation

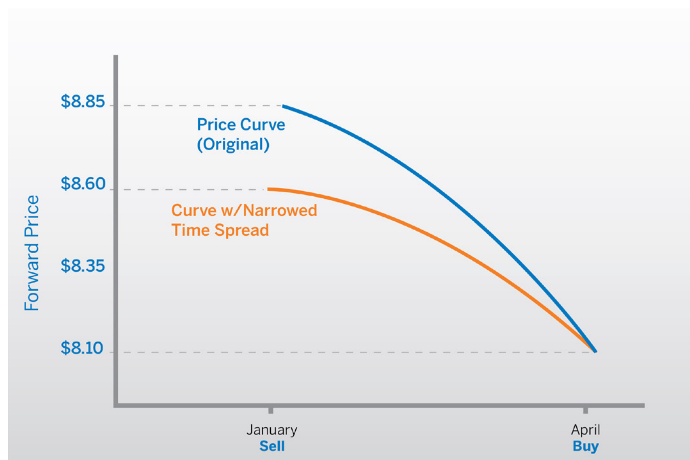
In a contango curve, both quoting conventions result in the purchase of the same positive spread by buying December and selling September [this refers to the example]. However, in backwardation, the conventions result in different characterizations.

A dealer sees the following January and April prices late in the prior year.

January $ 4.398
April $ 4.332

Time Spread +$ 0.066

The dealer expects the January-April spread to narrow (backwardation to flatten) as the New Year approaches.



OTC/NYMEX Floor

In OTC/NYMEX trading, the backwardated time spread is still considered positive: + 6.6¢. To exploit a narrowing (decreasing positive) spread, the dealer will go short the time spread by selling the spread:

Sell January @ $ 4.398 (Higher Price month); &
Buy April @ $ 4.332 (Lower Price month)

Earn +$ 0.066

CME Globex/CME ClearPort

For trades conducted on CME Globex or cleared through CME ClearPort, the backwardated time spread is also considered positive: + 6.6¢. To exploit a narrowing (decreasing positive) spread, the dealer will go short the time spread by selling the spread:

Sell January @ $ 4.398 (Nearer-Term month); &
Buy April @ $ 4.332 (Longer-Term month)

Earn $ 0.066

Note that in backwardation, the two quoting conventions result in the same transaction characterization (e.g. both sell the spread in the example).

Locking in a $ 0.05 Profit

By mid-December, prices have risen to:

April	$ 4.332
January	$ 4.348
Time Spread	$ 0.016

OTC/NYMEX Floor & CME Globex/CME ClearPort

The dealer can now reverse the trade. Using either quoting convention, the reversing trading is considered buying back the spread (paying $ 0.016). This will leave the dealer with a $ 0.05 net profit.

Sold spread for $ 0.066; Bought spread for $ 0.016

Summary: Buying & Selling Time Spreads

- **OTC/NYMEX Floor Time Spreads:** Higher-priced transaction defines the spread transaction.
  - Buy the higher-priced month — Buy/go long the time spread
  - Sell the higher-priced month — Sell/go short the time spread
- **CME Globex/CME ClearPort Time Spreads:** Shorter-dated transaction defines the spread transaction.
  - Buy the shorter-dated month — Buy/go long the time spread
  - Sell the shorter-dated month — Sell/go short the time spread

Managing Price Risk between Time Periods

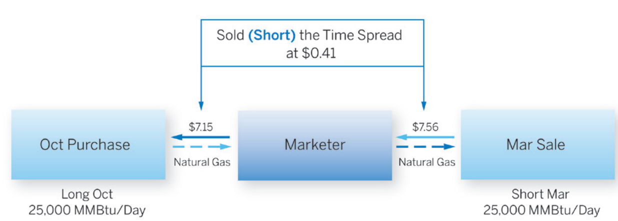
A time spread measures the cost (or earnings) of moving the timing of an exposure position between two points in time.

Using Financial Methods

This cost can be measured by the differential between the cost of buying physical for a forward date and the earnings from selling physical at another forward date.

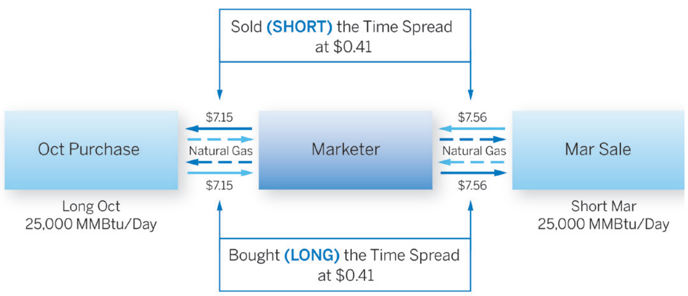
A gas marketer has sold 25,000 MMBtu/day for March 13 delivery at a fixed price. The marketer also has agreed to buy 25,000 MMBtu/day, also at a fixed price, for October 12 delivery.

The marketer is: Long October gas, and
Short March gas



To balance the risk exposure, the marketer must move its October long position forward five months. This can be done financially by buying the time spread: selling October gas and concurrently buying March gas. At these forward prices:

Sell October gas	Earn $ 4.506 (Short October)
Buy March gas	(Pay $ 4.954) (Long March)
Net cost	($ 0.448)



The cost of moving the exposure ahead five months will be $ 0.448, the time spread between October and March gas prices.

Long the Spread

By buying at a higher-priced month and selling at a lower-priced month, the marketer benefits from a spread increase. [reference preceding example]

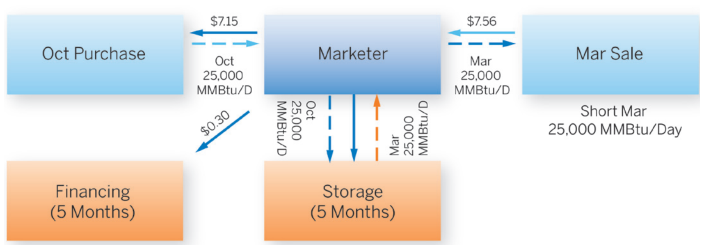
Using Storage Assets

Another way to move price risk exposure over time is to use storage. The costs of this method include storage charges and the cost of financing the stored inventory.

Alternately, to balance the risk exposure between October and March, the marketer may move its October long position forward five months using physical storage for five months.

5 months of storage: ($0.20)	
5 months financing cost of $7.15 ($ 0.19)[1]	
Total cost ($ 0.39)	

[1] $ 4.506 x 10%p.a. x 5/12 = 0.19



Note: The finance cost is based on the current October price, not the historic fixed contract price. This is the cash amount not earned by choosing storage over selling and buying forward.

Storage Creates a Long Spread Position

By owning storage capacity between October and March at $ 0.39, the marketer is positioned to benefit from an increase in the spread. Owning storage also makes the marketer long the October-March time spread.

Choosing Between Physical & Financial Storage

Although the storage alternative appears more costly, it offers benefits unavailable in the purely financial structure. Among them:

- Greater certainty of supply
- Ability to exploit arbitrages from favorable shifts in the price curve (optionality)

Storage as an Option on Time Spreads

Storage allows the owner to take advantage of favorable shifts in the time spread to synthetically store gas at a cost lower than with straight storage.

The decision to store gas in the ground vs. synthetically will be based on the time spread.

Embedded Put in Storage

When time spreads narrow to a level below the recoverable cost of physically storing gas, the storage owner has the ability to sell spot and buy forward (store synthetically), thereby lowering the storage cost.

The storage owner owns an effective put on the time spread and will benefit from a spread below the recoverable cost.

Put + Fixed = Call

The embedded put combines with a fixed storage cost to create an effective call option (applying Put-Call Parity). It results in a maximum price with the ability to benefit from declining spreads for time spreads below the recoverable cost level (i.e. the strike price on the put).

Extrinsic Value

Because owning storage has this embedded option, storage affords “extrinsic value” or option time value. The buy-sell (synthetic storage) structure does not offer this optionality and has no extrinsic value. The value of storage therefore should be greater than the value of synthetic storage.

A marketer from the earlier example has taken delivery of the October gas deliveries and has injected it in storage to meet its March obligation. The total cost of storage, including financing, from October to March is $0. 39/ MMBtu.

If the storage is not used, the utility still must pay a fixed demand fee of $0.15 (i.e. recoverable cost is $0. 24).

Ability to Sell from Storage

Should monthly or daily prices spike during the storage period, the marketer can exploit those higher prices by selling gas out of storage. In that event it not only earns a high price for the gas, but also reduces storage costs and eliminates financing costs going forward.

Need to Replace Gas for March

However, high spot/index pricing in and of itself would not precipitate withdrawal of gas for sale. If sold, the gas would have to be replaced to meet the March commitment. If spot pricing rose by the same amount as March prices, there would be no advantage to selling the stored gas.

Put Option on the Time Spread

Advantage only results when spot prices rise significantly more than March prices, i.e. the time spread between the current month (selling) price and the March (repurchase) price narrow. The storage owner owns put options on time spreads.

Complex Optionality

The optionality is not as simple as a single put option. It is a complex web of interrelated options wherein the exercise of one eliminates (AKA "knocks out") the ability to exercise the other. These include puts on:

- Oct-Mar Time Spread
- Nov-Mar Time Spread
- Dec-Mar Time Spread
- Jan-Mar Time Spread
- Feb-Mar Time Spread
- Oct-Feb Time Spread
- Nov-Feb Time Spread
- Dec-Feb Time Spread
- Jan-Feb Time Spread
- Oct-Jan Time Spread
- Etc.

Also:

- Gas Daily Index-Mar Time Spread
- Gas-Daily Index-Feb Time Spread
- Etc.

Variable Strike

Storage optionality is further complicated by a strike that is a variable, determined by:

1) Recoverable storage costs
2) Loss of future optionality (remaining options are knocked out)
3) Loss of supply security

Value Is Determined by Type of Storage

The amount of optionality, and therefore the value of storage options, will vary by type of storage facility. Salt dome storage, because it allows quick cycling of gas, offers greater option value than slower-cycling aquifer and depleted field storage. Optionality is further defined by contractual limits on withdrawal rates.

Storage Arbitrage

Theoretical Arbitrage-Free Forward Price

In theory, the time spread for a commodity should be directly related to the cost of storage and financing. The premium for forward delivery of that commodity should then reflect the cost of storage and financing:

If: Prompt month (Sept.) gas:	$ 4.471
Storage for 4 months:	0.21
Cost of financing	$ 4.471
payment for 4 months:	0.24
Then: Synthetic forward price:	$ 4.921

Arbitrage: Forward Price > $ 4.921

If the three-month forward price is greater than $ 4.921, arbitrage profits would be possible by selling at the higher forward price and buying spot, storing and financing.

These risk-free profits would attract forward sales and spot purchases, driving back down the forward price to the arbitrage-free levels.

Arbitrage: Forward Price < $ 4.921

If the three-month forward price is less than $4.94, arbitrage profits would be possible by buying at the lower forward price and selling spot, saving storage costs and finance charges:

If: Sell spot gas:	$ 4.471
Save storage cost:	0.21
Saved financing cost:	0.24
Then: Synthetic Forward Sale Price:	$ 4.921

These risk-free profits would attract spot sales and forward purchases, driving up the forward price to the arbitrage-free levels.

Theoretical Pricing Formula

Forward Price = Spot + Financing + Storage

Necessity of Non-Operating Inventories

The second arbitrage described above [references example] begins by selling spot. In order to sell spot, it assumes market players own inventory (gas in storage) that are deemed unnecessary to support the business operations.

Applicability to Pricing Financial Products

The arbitrage-free forward pricing theory has wide profit applications for equities, gold, and currencies. These commodities are commonly held (stored) in investor and band portfolios and vaults, with large volumes available for arbitrage if forward prices diverge from the theoretical level.

Natural Gas Not Held in Portfolios

Energy commodities, including natural gas, are not kept idle in portfolios and thus are unavailable for arbitrage.

For those holding inventory for the sole purpose of exploiting arbitrage, hesitation to harvest the arbitrage out of fear of mistiming the execution of the arbitrage strategy allows the arbitrage to persist.

Inapplicability to Natural Gas Products

Because of this lack of non-operating inventories, the theoretical relationship ("cost of carry" model for forward prices) does not tend to hold up in energy commodities. Divergences between actual forward prices and the theoretical are common among energy commodities, for reasons that include:

- Supply risk fears encourage hoarding energy inventories
- Lack of non-operating inventory
- Utility regulations do not reward cost savings
- Individual incentives and shareholder value can diverge
- A material extrinsic value exists in owning storage

Arbitraging Storage

The divergence between actual market forward prices and theoretical forward prices produce arbitrage opportunities both to synthesize low-cost forward gas and/or to synthetically create low cost storage.

Storage Pricing Implicit in the Forward Price

The same forward formula implies that the forward price for natural gas (which does not conform to the formula) suggests a market value for storage. By rearranging the pricing formula, storage can be isolated.

Synthetic Storage

Storage can be synthesized by buying the time spread (selling spot and buying forward). The cost is the time spread less the unspent financing cost.

- Forward = Spot + Storage + Finance Cost
- Storage = (- Spot + Forward) - Finance Cost
- Storage = Time Spread – Finance Cost

A utility buys natural gas in late summer for winter needs. September gas prices are $ 4.471/MMBtu. Four-month storage between September and January costs $0.21/MMBtu. The utility pays 9% per annum for its short-term borrowings. Forward natural gas for January delivery is currently priced at $ 5.046.

How can the utility minimize its cost for January gas?

Storage cost: ($0.21)

If the utility created storage synthetically, it would sell September gas and buy firm forward gas for January. It would pay the difference between January and September natural gas prices, pay no storage and save the financing cost:

Sell September gas:	$ 4.471
Buy forward:	($ 5.046)
Save finance cost:	$0.13 ($ 4.471x9%x4/12)
Synthetic storage cost:	($ 0.445)

Packaged Synthetic Storage

Instead of the end-user executing the component transactions, the synthetic storage structure can be packaged by a marketer and provided in a single synthetic storage contract.

In the example above, the utility as a whole would recognize savings from the spot sale/forward purchase/financing savings over keeping the surplus storage volumes in the ground. Nevertheless, the utility may reject the structure. Four reasons are cited:

1) The forward purchase would be subject to scrutiny by utility regulators: A gain on the forward would be passed on to ratepayers, while a loss would be born by shareholders.

2) The fuels and storage manager's business unit would not realize the full benefit of the cost saving. The majority of the $0.18 in savings comes from saved finance costs. Financing costs do not show up on the unit's accounts.

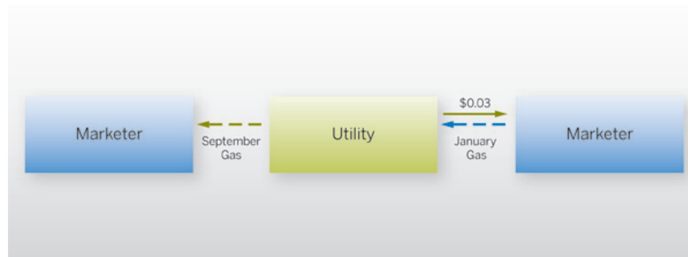
3) Loss of storage optionality

4) Increased physical supply risk

The bottom line to the manager is not a visible savings, but a loss of $0.06, $0.21 vs. $0.27 (sell spot @$ 4.471, buy forward @$ 5.046) for which it loses optionality, exposes itself to regulatory risk, and increases its exposure to supply risk. It loses much of its appeal.

Packaging Synthetic Storage

To remedy the manager's concerns, the marketer creates a single contract: A Synthetic Storage Agreement. Under this agreement, the utility will deliver gas to a marketer in the prompt month and the marketer will deliver back the same volume of gas three months from now. For this "synthetic storage" service, the Agreement requires the utility to pay $0.03/MMBtu.



Advantages to Utility

This packaged structure offers the utility relief from the concerns listed above:

1) No explicit forward purchase or sales contracts are required. No regulatory risk is incurred. A storage contract documents a single $0.03 storage fee, which should be passed on to ratepayers, with little controversy.

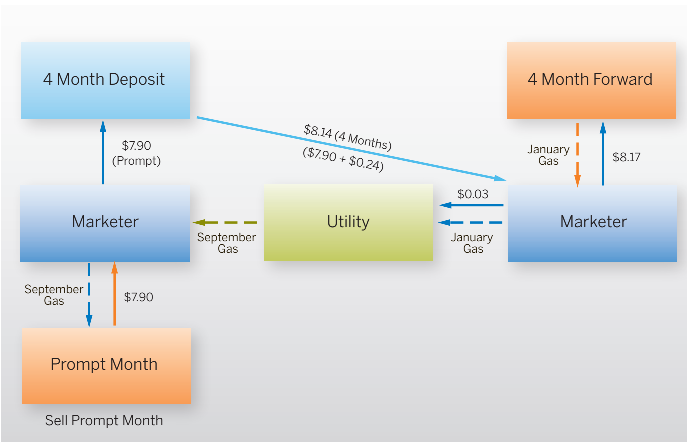
2) The financing benefit is realized by the manager's business unit as partof the contract's fee of $0.03.

3) The utility still loses the optionality of physical storage.

4) Also still incurs higher physical supply risk, but for a $0.18 realized savings, the economics become more favorable.

Marketer's Hedge

Under the synthetic storage contract, the marketer will receive gas in the prompt month and must deliver that same volume back in three months. The marketer is paid $0.03. The marketer clearly will not store the gas in the ground. It earns only $0.03 and storage will cost $0.21.

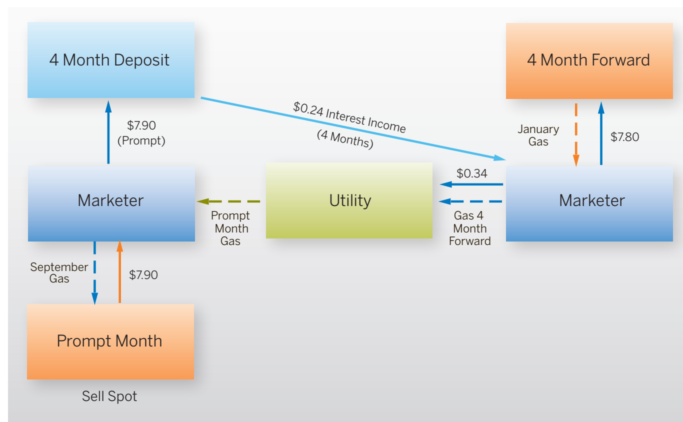


Sell Spot/Buy Forward

Rather the marketer sells the gas spot (i.e. prompt month) and buys it back in the forward market. When selling spot gas, it earns cash – cash it will not need for three months – and so can invest the proceeds and earn interest.

Looking at synthetic storage as a loan:

September Forward:	$ 4.471
January Forward:	$ 4.398

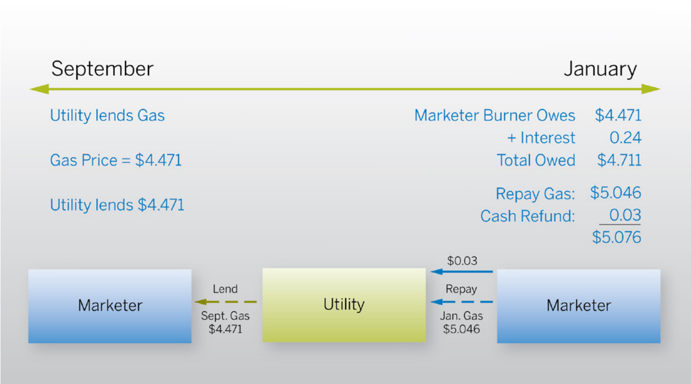


Synthetic Storage Cost in backwardation is a negative cost – the user gets paid to store:

+$ 4.471 [spot] - $ 4.398 [forward] + $0.24 [financing]
= ($ 0.313)

Synthetic Storage as Lending

The utility in the example is lending energy to be repaid at a future date with an equal volume of energy. Nevertheless, energy has financial value, and lending energy is economically equivalent to lending money.



As with lending money, market interest rates and credit risk spread should be earned.

Fully Loaded Storage Costs

When measuring storage costs from a zero cost basis, financing is not considered committed. The cost of synthetic storage reduces simply to:

Synthetic Storage Cost = Time Spread

This is compared to the alternative cost paid to the storage operator:

Physical Storage Cost =
Physical Storage Fee + Finance Cost

Measuring Synthetic Storage Cost

The synthetic storage price reflects the incremental cost of replacing existing storage with a synthetic transaction. The finance cost is considered a previously committed cost, which can be retrieved in the synthetic transaction.

Synthetic Storage Cost = Time Spread - Finance Cost

This is compared to the cost paid to the storage operator:

Physical Storage Cost = Physical Storage Fee

Managing Storage & Time Spread Risk

Time spreads can be used to hedge or replace storage requirements. Since storage is a time spread position, it can be used to hedge or offset a time spread risk.

Using Storage to Fix a Time Spread

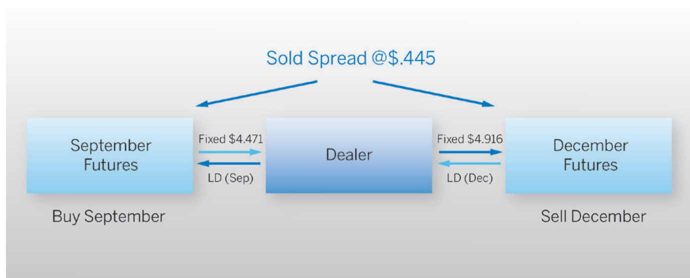
The same time spread fixing can be achieved by taking physical delivery and storing, though the storage costs must be known at the time of the deal execution.

In early August, a mild summer has brought down near-term pricing for power and natural gas. Winter prices remain largely unchanged resulting in a steepening of the curve. A dealer has sought to exploit this unusually wide fall-winter time spread by shorting the September-December spread.

Current Forward Pricing

September $4.471

December $4.916



Profit Opportunity

The dealer has sold the Sep-Dec spread for $0.445 and can earn a profit if it can buy it back for less than $0.445. In late August, natural gas prices have declined. Current forward prices now are:

September $3.682

December $3.972

Buying the Spread with Reversing Futures

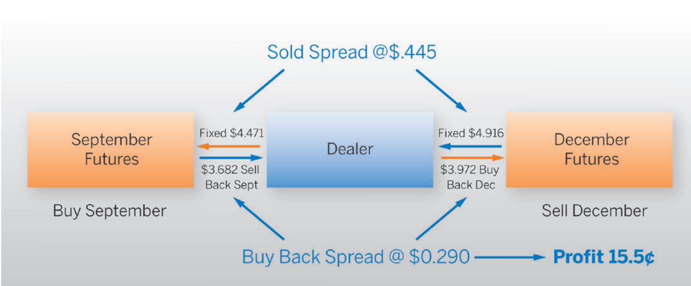
The dealer, now short December and long September, could reverse those futures positions by buying back December and selling back September. At current prices, this would cost $0.290. Having sold the spread at $0.445, this would produce a profit of 15.5¢.

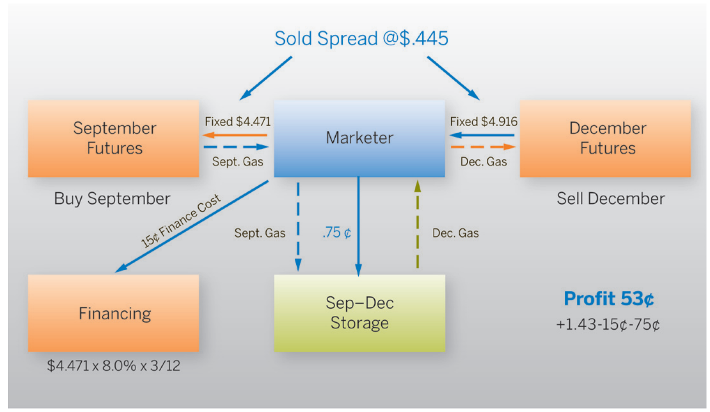
Buying the Spread with Physical Storage

The dealer can alternatively buy back the spread by taking delivery of September gas and storing it, withdrawing the gas in December to meet the requirements of the short December futures contract.

Potential for Greater Profit

Assuming available storage capacity, if storage, related transport cost and finance costs are less than $0.290, this alternative would be more attractive than the futures reversal.





Using Time Spreads to Increase Storage Margins

Storage owners are long the time spreads (going into winter). By selling storage, the owner takes a short time spread position (long the near month, short the far month).

Converting Fixed Price Storage to Variable

When storage prices are linked to time spreads, storage buyers are most eager to secure storage costs when time spreads are narrow, which is the least attractive time for the storage owner to sell its capacity. But by buying back the short spread position financially, the storage seller can realize any subsequent widening of the spread.

In March, a storage owner is asked by one of its regular utility customers to purchase storage capacity from September to December. Pricing is specified as the differential between current December and September prices less an adjustment for time value of money.

A cold winter has depleted storage levels and elevated prices through summer, an apparent temporary reaction. Prices for next winter have not responded. The result is a narrow Sep-Dec spread:

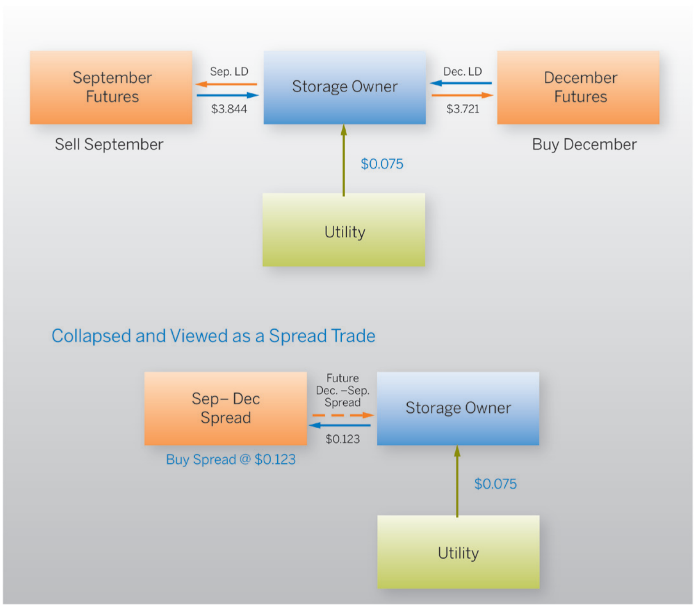
September	$3.844
December	$3.721
Spread	$0.123
Less Time Value	- $0.048 ($3.844 × 5.0% × 3/12)
Net	$0.075

Selling at a Fixed Price

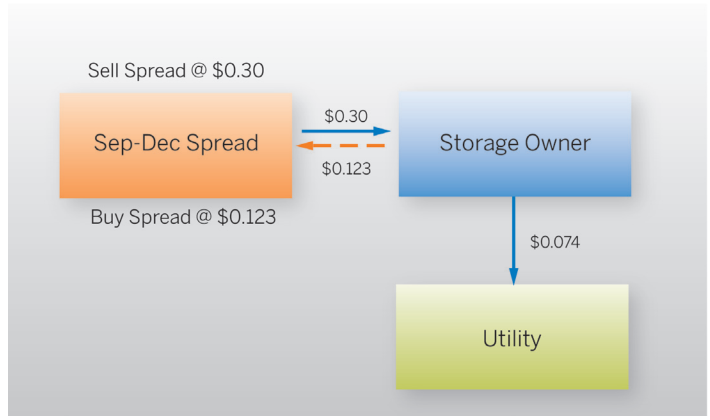
By selling storage at a fixed price, the storage owner has sold the Sep-Dec spread at a fixed price. However, this fixed price is not optimal as the spread is expected to widen. Nevertheless, the owner wants to lock in the sale of capacity while meeting the needs of a good customer.

Convert Fixed to Variable

The owner can sell the storage to this customer, but retain upside on the pricing by buying back the spread financially: buy December and sell September (i.e. buy the spread for $0.123).



If, between March and September the Sep-Dec spread widens back to a more normal differential the storage owner can sell back the spread at the higher price (sell Dec and buy Sep). For example, if the spread is now $0.30:



Synthetic Swap

The spread structure can be thought of as a synthetic swap of storage prices.

The owner sold fixed price, expected higher prices, so swapped into a variable price. In our example, prices rose and the owner now realizes an all-in storage price of $0.21.

Swing Swap Options as Storage Alternative

Swing swap options ("swing options") are highly effective risk management tools, used to mitigate economic risk associated with price or volume optionality embedded in a physical transaction within and including a full calendar month. They offer an alternative to storage for dealing with volumetric and timing risks.

Swing Swap Option Structures

Swing swap options can be structured as follows:

- A fixed strike price against a daily price Index
- A first-of-the-month Index against a daily price Index
- One daily price Index against another

Option Package

Swing options are usually dealt in monthly packages. A swing option consists of 30 or 31 distinct daily options or a series of single day options.

Physical or Financial Structures

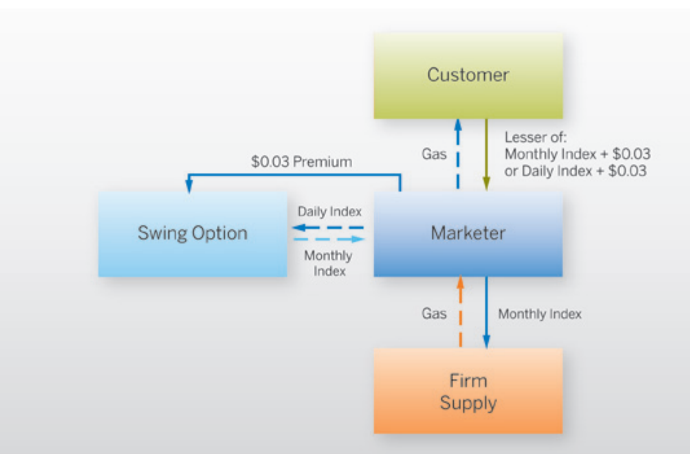
Swing options can be exercised into physical natural gas or settled financially as the difference between the daily market price and the strike price.

Spread Option

An option on the difference between two unknown price indices is a spread option. The option will pay the buyer the spread, daily Index minus the monthly Index, but only if the spread is positive (i.e. daily prices are above monthly prices). This sets the monthly Index price as the maximum price.

Alternate Structure

The marketer could also structure this with the purchase of gas at the monthly Index. The swing option in this case would pay the difference of the monthly Index minus the daily Index, but only if the difference is positive (i.e. when the daily price is lower than the monthly price).



Short Term Storage Strategies

"Park-and-Loan" Programs

Short-term, intra-month storage needs can be met by pipeline and storage operators who offer a service to natural gas users. Excess supply can be "parked" temporarily during periods of reduced demand for delivery to the user at a future date. Users can also borrow molecules during peak demand periods, which are repaid at a later date.

Physical/Operational Flexibility

The park-and-loan programs enable the customer to balance receipts and deliveries while providing flexibility to meet variable operating needs.

Non-firm Service/Non-firm Price

Unlike leased storage capacity with a rate schedule for firm injection and withdrawals, these services are offered as fully interruptible and without default penalty. Accordingly, the fees are considerably lower.

Trading for Value Using "Park-and-Loan" Programs

Originally designed to address peaking and operational management requirements in a deregulated market, storage offers profit enhancement opportunities.

Constant Daily Supply vs. Variable Daily Demand

The need for these programs is rooted in the conventional monthly supply terms where volumes are delivered at equal daily volumes throughout the month.

The intra-month demand profile for most utilities and end users does not follow this supply pattern.

Weekends

Demand is often reduced on weekends. The user can still sell surplus weekend volumes, though daily prices for weekend gas are likely to be much lower than weekday prices, making this a less desirable approach.

An end user, with 24/7 plant operations (24 hours per day, 7 days per week), has direct service off the pipeline. During May, the plant operation will be reduced to half on the weekends for refurbishing.

The end user's gas requirement will be 135,000/MMBtu for the month:

5,000 MMBtu/day (23 weekdays) = 115,000 MMBtu

2,500 MMBtu/day (8 weekend days) = 20,000 MMBtu

135,000 MMBtu

Alternative 1

Buy 5,000 MMBtu/day for the month (155,000 MMBtu) at the first-of-the month Index flat and sell the surplus weekend volume. The supplier quotes a price of $0.10 below the first-of-the-month Index to buy back, in effect, the weekend volume.

Total cost: $0.10 × 20,000 MMBtu = $2,000

Alternative 2

The end user purchases the net requirement of 135,000 MMBtu, priced at flat Index but delivered ratably over the month (4,355 MMBtu/day), and makes arrangements with the pipeline's park-and-loan service to borrow the weekday shortage with weekend payback:

Weekday shortfall borrowed: 645 MMBtu (5,000 - 4,355)

Weekend repayment: 1,855 MMBtu (4,355 - 2,500)

The pipeline service charges a fee of $0.035/MMBtu for the borrowed volumes.

Borrowed volumes:	14,835 MMBtu (23 days × 645/day)
Total cost:	$0.035 × 14,835 MMBtu = $519
Savings:	$2,000 - $519 = $1,481

Pricing Arbitrage Opportunity

During periods when the current cash price diverges from the forward price (arbitrage opportunity), the value discrepancy can be captured using the park-and-loan service.

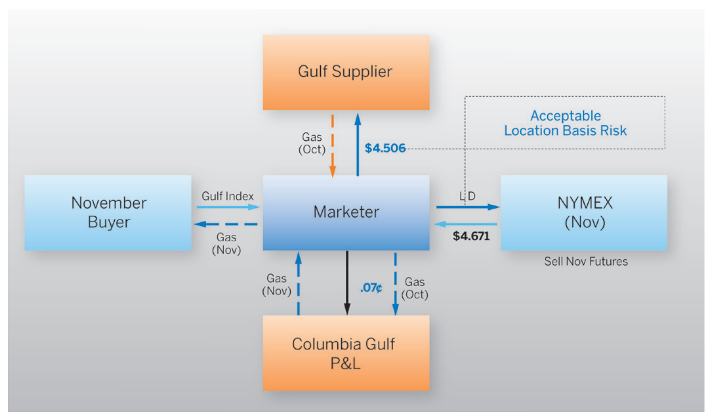
A marketer purchased October natural gas into Henry Hub Natural Gas for $4.506. Cash prices in the daily market in mid-October dropped to $4.321, while the November forward market stayed firm at $4.671.

Park October Gas

The marketer does not want to take a $0.185 loss by selling $4.506 gas at $4.321. Wanting to avoid a loss in October and take advantage of the price disparity between mid-October and November, the marketer arranges to park the $4.506/MMBtu Gulf gas for the balance of the month and have it returned during November at a cost of $0.07/MMBtu.

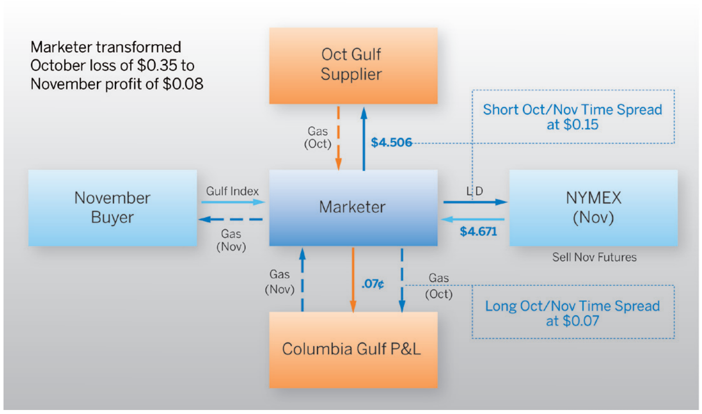
Unhedged Basis

To capture the November price, the marketer sold forward the November contract at $4.671. Gulf, because of its proximity to Henry Hub, has low basis volatility. The marketer does not hedge basis.



Loss Converted to a Gain

Through the use of the park-and-loan program, the marketer effectively replaced a $0.185 loss with a $0.08 gain (less financing cost November-December).



Intentional Imbalance to Extract Value

Natural gas storage takes place underground in depleted gas reservoirs, salt caverns, aquifers, and pipelines.

In-pipe storage or "linepack" is not a traditionally marketed storage form, but it exists because the pipe can never be fully balanced between receipts and deliveries.

Pipelines Take Steps to Minimize Abuse

The pipelines have instituted imbalance penalties for excessive over- or under-deliveries to discourage shippers from "gaming" the system (i.e. taking volume flexibility—park-and-loan style—without compensation).

FERC-Approved Pricing

Each pipeline has a FERC-approved pricing formula usually based on a type of average pricing.

The formula outlines the price calculation to be used for payment by the pipeline to the shipper for over deliveries and payment by the shipper to the pipeline for under deliveries.

Opportunity for Shippers

Because the imbalance penalty formula or "cash-out price" is based on intra-month prices (which in natural gas can be highly volatile), a profit opportunity exists.

A Transco utility shipper purchased 10,000 MMBtu/day at $7.30. Prices have risen steadily since the first of the month and are now at $7.80. The utility has under delivered 900 MMBtu/day to the pipeline. The utility chooses to go to "cash out" and pay the pipeline for the gas taken in excess of its deliveries rather than pay $7.80 to purchase the gas to balance its agreement.

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