David Doerksen, Director, Market Planning & Administration, Cameco Corporation, Canada

Price Transparency in the Uranium Market - A Producer's Perspective

Introduction

The nuclear industry is taking its first steps along the path of renaissance. Nuclear power is increasingly viewed as a critical part of the world's energy solution as energy demand continues to grow along with an increasing focus on climate, safety and energy security concerns. To support growing demand expectations, the nuclear fuel cycle has started to make needed capacity adjustments in all segments, including the uranium market.

The uranium market has recognized that significantly more primary production will be needed and the industry has responded with capital investment to expand short-term production capacity, numerous feasibility studies to advance potential supply sources and increased exploration spending to support long-term growth. Uranium price levels have reached all time highs as the market deals with rapid adjustments in response to changing supply and demand expectations, growth plans, the introduction of financial market players and a growing need for supply certainty. However, behind this implied market efficiency of activity and adjustments, questions and concerns about the "true" uranium price remain. The lack of price transparency has long been an issue in the uranium market, and while historical market practices have served to bring adequate supply to the market in the past, it can be argued that transparency issues have driven inefficiencies into the industry. These inefficiencies must be eliminated to support the demands of a growing international nuclear fuel cycle.

The primary purpose of this paper is to provide a uranium producer's perspective on the issue of price transparency in the uranium market. It will look at market practices, consider recent market changes, including application of the futures market, and offer ideas for further market development.

In this paper, price transparency is defined as a market process that allows the industry to be fully informed of price changes and the level of active interest for uranium deliveries for any time period - spot, mid-term, or long-term - on a timely basis. With complete price transparency, buyers and sellers would have a clear sense of market clearing price levels and the level of demand and supply at these price levels without having to enter into negotiations with another party. The term "market efficiency" is used interchangeably with the notion of price transparency throughout this paper.

The degree of price transparency in the market has significant implications for both uranium buyers and sellers. From a producer's perspective, low price transparency adds uncertainty, which ultimately results in economic inefficiency. Uranium mine development is capital intensive and can take up to 10 years and more to move from discovery to being fully operational. To support a development decision, producers may require some level of fixed revenue to recover capital costs, cover operating costs and provide a rate of return with some degree of certainty. Hence, many producers will prefer to enter into at least some fixed-price contracts. At the same time, profit-motivated producers generally also want to maintain exposure to market prices to realize the benefit of positive price movements and will have a mix of fixed-price and market-related contracts in their sales portfolio. Faced with an inefficient market - where the market-clearing price and the level of buyer interest are ambiguous - producers may not have the necessary information to make long-term investment decisions on a timely basis or, in some cases, sub-optimal decisions will be taken. In the short-term, a lack of price transparency can arbitrarily help or hinder the market-related portion of a sales portfolio. Hence, in both the short- and long-term, the lack of price transparency creates additional risk for the producer and adds a significant element of uncertainty to financial performance.

The lack of liquidity in the uranium market is a contributing factor to the price transparency issue and is mentioned here briefly for purposes of context. Transactions in the uranium market have historically been relatively large and infrequent. For example, prior to the recent run up in market activity over the last three years, it was not uncommon to average six or fewer transactions per month in the spot market and half that many in the long-term market. The lack of transactions exacerbated the price transparency issue by simply providing very few data points. In the current market environment, the number of transactions has increased, but a series of relatively small-volume transactions in the spot market have triggered significant price changes - a sure sign of poor liquidity. In this case, price transparency is hampered by lack of information about market depth.

Uranium market practices

Uranium has the physical characteristics of a "commodity" - it is a fungible product that meets standard quality parameters and can easily be stored, transported and delivered for physical settlement. It could theoretically trade on an organized exchange as a true commodity whose price is impacted only by supply and demand perceptions. This, however, has not been the case.

The uranium market operates in a unique environment of strict regulatory oversight and international safeguards that impacts almost every aspect of buying, selling, transporting and storing uranium. The complexities of transacting in this regulatory system may very well have been a factor in how the industry has evolved over time. In any event, market practices in the uranium industry have remained relatively unchanged since the inception of the commercial uranium market in the 1960s. Sales agreements for the physical delivery of uranium continue to be based on direct negotiations between buyer and seller with most of the volume (about 85%) sold under long-term contracts. Most transactions in the long-term market continue to occur between producers and utilities, with a smaller percentage of activity (about 30%) flowing through brokers or other trading establishments. The inverse is true in the spot market where brokers and traders tend to transact about 80% of the volume. Pricing parameters in long-term contracts - fixed prices, market-related prices, floors, ceilings, discounts, premiums, re-openers, escalation factors - have adapted to reflect changes in the market power of buyers or sellers through different stages of the price cycle, but otherwise the mechanisms have generally remained the same. Similarly, other commercial terms such as volume flexibility, notification periods, storage and contract duration are negotiated to the benefit of the party with market power at the time, but the underlying structure of these terms has largely remained unchanged over time. Perhaps most importantly, price information has historically been manually collected, interpreted and distributed by a range of market reporters.

Each reporting entity has a different approach to determining current market prices - some refer only to actual transactions, others combine actual transactions with theoretical or estimated market price levels. Several entities also publish multiple prices such as spot price, long-term price, restricted price, unrestricted price, price ranges, and regional prices. Several of the main price reporters active in the industry today are outlined in *Schedule 1*.

While the different prices and compilation methodologies add a certain richness of information, a number of underlying factors limit the transparency of this reporting process:

- variations in pricing parameters, such as the presence/absence of ceilings, floors, discounts and premiums, impact the value of the underlying contract and obscure the true market-clearing price;
- similarly, variations in other commercial terms such as volume flex, storage and contract duration impact the value of the underlying contract but would not necessarily be reflected in the reported price;
- variations in compilation methodologies that include reliance on a mix of actual transactions, bid activity, and judgement calls introduce subjectivity into determination of market-clearing price levels;
- price reporting delays due to manual data collection and interpretation resulting in infrequent price publication limit applicability of the reported price for real-time transactions;
- limited or no indication of market depth limits the applicability of the report price;
- inconsistent industry participation in providing price details to the reporting entities can skew reported prices.

All of these factors will tend to result in a reported price that lags the market to some extent and does not fully represent the price level at which uranium can actually be bought and sold.

Recent developments have addressed several of these constraints and introduced positive elements of price transparency into the long-term uranium market. The joint initiative by NYMEX and Ux Consulting to launch a uranium futures contract on the NYMEX is a significant first step toward truly commoditizing uranium, along with the related transparency benefits.

These financially settled futures contracts provide exchange-based prices for up to five years forward and, in principle, provide the basis for price management by all industry participants. From a producer perspective, assuming sufficient liquidity on the exchange, futures contracts could be used to lock in a price on a market-related sales contract (by selling futures; a payoff diagram for this transaction is shown in Schedule 2), to "unlock" the price on a fixed-price sales contract (by buying futures), or to simply take a speculative position on the direction of market prices (sell futures if prices are expected to drop, buy futures if prices are expected to rise). All of this could be accomplished with relative ease - no need to look for a counterparty willing to buy/sell, no bid/offer documents, no price negotiation and no legal reviews - and with confidence that transactions were being done at the market-clearing price. Unfortunately, these scenarios are somewhat theoretical at this point.

The NYMEX futures contracts currently have several practical constraints from a hedging perspective. Exchange volumes are extremely low relative to overall market volumes and, as such, do not have sufficient depth to give a strong price signal. Secondly, trading constraints (a maximum position of 250 000 pounds in the expiry month) are too tight to provide a meaningful price management tool for producers with multi-million pound sales portfolios. Finally, while the exchange enhances price transparency in medium- to long-term markets, the lack of a transparent spot market introduces pre-settlement exposure to margin calls. The first two constraints will presumably diminish as exchange activity increases. The third is a structural constraint that will only be mitigated as the spot market gains efficiency.

For clarity, futures contracts are marked-to-market on a

daily basis and contract holders will usually realize daily gains or losses, which are supported by margin accounts. Futures and spot prices normally have a high level of correlation. To the extent a spot price movement is impacted by lack of transparency and also causes futures prices to move, margin requirements could be impacted. This would result in a direct cash or credit exposure to poor price transparency, an exposure that would increase directly with the size of the underlying contract position: hence the need for an efficient spot market in order to facilitate large volume trading in NYMEX uranium futures.

Other market initiatives are evolving, including electronic trading platforms for physical uranium transactions, physically settled uranium forward contracts, fixed/market price swaps and the occasional option. While these initiatives are positive contributions to price transparency they are not "pure" trading platforms. Although bids and offers are posted electronically, buyers and sellers will normally enter into a bilateral contract to complete the transaction, sometimes after negotiating final terms "offline". This type of trading has attracted some activity but the current number of transactions is too low to provide meaningful price data on a stand-alone basis.

A point to note is that all derivatives - futures contracts, forwards, swaps and options - normally rely on a robust spot market as a basis for initial pricing (in the case of options), mark-to-market, or settlement calculation. All of the current attempts to establish greater transparency for long-term prices rely on a spot price that is based on manual interpretation of market conditions. For these derivative-trading initiatives to be successful, further market development will be needed to establish a transparent spot price.

After 40 years of commercial activity in the uranium market, we have arrived at a market system that still relies largely on negotiated transactions, manual price interpretation and reporting, but that has started to take steps to enhance price transparency.

Future market developments

So how do we move toward a more efficient market, one with price transparency in both spot and long-term markets? Perhaps more importantly, do we as an industry want to move toward more efficient markets, or are we satisfied with the current methods of price discovery? Are we willing to accept financial trading activity as a positive contribution to market liquidity and price transparency? Depending on our collective response, future market developments - including continuation of the status quo - could be grouped into three broad market scenarios:

- Bilateral Market;
- Limited Trading;
- Commodity Market.

BILATERAL MARKET

The Bilateral Market would essentially be a continuation of the current system. Sales contracts would continue to be non-standard, bilateral agreements negotiated directly between buyer and seller. Pricing mechanisms and other commercial terms would generally remain the same. Price reporting processes would remain largely unchanged resulting in a lagging "market price" that might not represent true market-clearing price levels. Individual industry participants would continue to supplement market price intelligence through "request for quote", bid/offer and contract negotiation processes.

This is likely a workable outcome. The uranium market has functioned in this way for the last 40 years and may very well manage to meet future growth demands on the same basis. Industry participants would need to accept the arbitrary impacts of limited transparency as price responds to supply and demand cycles. Producers would benefit in the short term from overheated price peaks, while suppliers would benefit from overstated troughs.

One of the key risks would be that all industry participants could face long-term supply instability if inaccurate price signals persist. Given relatively inelastic demand for uranium, price inefficiencies would likely be realized on the supply side. Consistently understated prices would result in supply shortages due to insufficient investment on the supply side and, similarly, overstated prices would result in excess supply. Neither extreme is sustainable and the market would self-correct. Given a lack of price transparency, price and supply corrections would tend to over-shoot equilibrium levels driving continued instability into the nuclear fuel cycle.

Other risks include industry reliance on two or three price reporting entities. The continuity of price reporting procedures and personalities may be at risk as these entities continue to evolve. The result is another element of uncertainty.

This scenario would likely have about the same level of market participation by financial investors as we see currently.

LIMITED TRADING

In the Limited Trading market scenario, the uranium industry would take steps to increase price transparency through cooperative information sharing but would stop short of becoming a fully developed Commodity Market. Industry participants could agree to take several different approaches in this scenario:

- Regular Auctions

  o *Approach* - industry participants would periodically (i.e. monthly or quarterly) offer uranium at auction for immediate or future delivery. Volumes to be sold would be pooled and an independent third party would administer all aspects of the auction. Auction timing and volumes would be announced with sufficient notice to allow all industry participants, including those who are auctioning material, to bid.

  o *Transparency Benefits* - the primary benefit to the industry would be consistently reported prices for various delivery periods. The significance of these prices would depend on the underlying volumes offered for auction. The use of standardized contracts and commercial terms (i.e. notice periods, volume flex provisions, payment terms, transportation and storage provisions) for all auctioned material would help to ensure that reported prices mean the same thing to everyone in the market.

- Publicly Posted Buy/Sell Prices

  o *Approach* - industry participants would agree to publicly post bid/ask prices on a periodic basis (i.e. weekly, monthly) for uranium volumes in standard lot sizes that are more representative of physical industry requirements (i.e. 100,000 lbs). All postings would have standard settlement dates (i.e. 3, 6, 9, 12 months forward, standard day of month settlement).

  o Transparency Benefits - the benefit to the industry would be a broad sampling of real time bid/ask prices for standard lot sizes and delivery terms. Further benefit would depend on the willingness of participants to disclose additional details about the success of bid/ask postings and to use standardized contracts and commercial terms.

- Industry Trading Group

  o Approach - industry participants would form an independent trading group with the purpose of establishing a competitive and transparent clearing price for physically settled spot and long-term uranium transactions. This arrangement could be structured as follows:

    - Ownership - ownership in this entity would be open to all industry participants. The ownership group would be responsible for high-level governance functions. The owners would also commit to trade a certain level of uranium volumes to provide some level of guaranteed liquidity.
    - Management - an independent management team would be responsible for managing the trading system (electronic or manual), performing back office functions, providing reporting, management control and oversight. The management team could be comprised of owners or it could be a separate entity contracted via a service agreement. Lot sizes, contracts, non-price commercial terms and settlement dates would be standardized. Price reporting would be made public for the benefit of the industry.
    - Participants - access to trading would be open to all industry participants.

  o *Transparency Benefits* - the main benefit to the industry would be consistently reported real-time prices for a minimum level of volumes in the spot market and a series of forward time periods. Transactions would be highly standardized and would ensure that reported prices mean the same thing to everyone in the market.

To be successful, all of these approaches would require broad industry support. Utilities seem to have had limited, if any, participation in the auctions that have characterized spot market activity over the last year or so. Whether this is due to internal constraints or simply company preferences, changes would need to be made to ensure that these trading approaches could rely on support from the largest buyer segment in the industry. The first two options in particular would depend heavily on voluntary participation and would require strong leadership within the industry to succeed.

The structure of the Industry Trading Group would have the potential to move beyond physical transactions to support financially settled transactions. As such, it has the potential to create the efficient spot market needed to support expanded derivative trading on an organized exchange such as the NYMEX.

An increasing level of market involvement by financial investors, including hedge funds, would likely characterize this scenario as they respond to greater price transparency - hence greater flexibility - in the uranium market.

COMMODITY MARKET

In the Commodity Market scenario, the industry would have decided to fully commoditize the uranium market. Sufficient price transparency would have been established in the physical spot market to support efficient trading of all derivatives - futures, forwards, swaps and options. Like other mature commodities, financial investors, or at least financially settled transactions, would dominate transactions in the uranium market.

The transition to a Commodity Market could be facilitated in several ways. One or more of the electronic trading or exchange initiatives could partner with suppliers in the industry to provide some level of underlying inventory and supply-side support to add market depth to these trading activities. The existing infrastructure that suppliers use for transporting and storing uranium would likely need to be modified to support standard physical settlement procedures - inventory at participating facilities would need

to be managed, transportation times, cost and delivery procedures would need to be standardized, and a higher volume of participant accounts and daily transactions would need to be accommodated. As the number of transactions grows, physical supply could be modified as needed to balance the demand for physical and financial settlement.

Another approach to commoditizing uranium would be to establish the Industry Trading Group outlined above as an intermediate step. In this case, the structure would be set up with a longer-term goal of establishing high liquidity levels, developing financial settlement capability and providing support to an organized exchange or electronic trading platform.

As the Commodity Market scenario is realized, industry participants would have full access to the price management tools that are available in mature commodity markets. Like participants in the oil and gas or gold markets, a uranium producer that wants to lock in prices on future sales volumes or has contracted volumes with a market-related price could establish a forward sale price without entering into negotiations with a buyer. Similarly, a uranium buyer could establish a future purchase price without negotiating terms with a seller. Buyers and sellers could enter into offsetting contracts to "undo" previous deals. The options implicit in volume flexibilities and ceilings and floors could now be entered into, or undone, based on real-time market prices and all without entering into negotiations with another party. All of these transactions could be entered into for physical or financial settlement as needed.

The net effect is that the Commodity Market scenario would resolve the issue of price transparency and offer significant flexibility to all industry participants to manage their exposures and act on their individual market views.

Conclusion

The uranium industry has made significant advances over the last four decades but fundamentally has remained the same. While the market practices that the industry has relied on during this time have successfully brought us to the point of nuclear renaissance, they can be improved to eliminate or at least minimize the inefficiencies driven by the lack of price transparency.

There are many other approaches and ideas to consider as we move toward greater efficiency in the uranium market. However, as we collectively debate next steps the key point to keep in mind is that the time for action is now. Given an increasingly strong mandate to support a rapidly growing global nuclear industry, the uranium market is at a point where fundamental change is no longer an option, it is a requirement.

Schedule 1. Price Reporters

Reporting Entity	Frequency	Prices Reported *	Price Methodology **
Ux Consulting	Weekly (Spot Price) Monthly	Spot Price Long Term Price CIS Price Russian Discount	The Ux Prices indicate, subject to the terms listed, the most competitive offers available for the respective product or service of which the The Ux Consulting Company, LLC (UxC) is aware. The **Ux U_3O_8 Price (Spot)** includes conditions for delivery timeframe (= 3 months), quantity (= 100 000 pounds), and origin considerations, and is published weekly. The **Ux LT U_3O_8 Price (Long-Term)** includes conditions for escalation (from current quarter), delivery timeframe (= 24 months), and quantity flexibility (up to ± 10%) considerations.
TradeTech (previously Nuexco)	Weekly (Spot Price) Monthly	Spot Price Long-Term Price Restricted Price Unrestricted Price US Premium	TradeTech's **Exchange Value [Spot Price]** reflects the company's judgement of the price at which spot and near-term transactions for significant quantities of natural uranium concentrates (U_3O_8) could be concluded as of the last day of the month. **The Long-Term Price Indicator for U_3O_8** is TradeTech's judgement of the base price at which transactions for long-term delivery of that product could be concluded as of the last day of the month, for transactions in which the price at the time of delivery would be an escalation of the base price from a previous point in time. Union. All **Market Values** are expressed in US$ and are based on: • Data from recently completed transactions. • Data from pending transactions. • Firm bids to buy and firm offers to sell. • Prices purchasers have expressed a willingness to pay, but for which TradeTech was not aware of firm bids to buy and prices sellers have expressed a willingness to accept, but for which TradeTech was not aware of firm offers to sell. In the determination of all Market Values, TradeTech does not consider: • Prices associated with deliveries under old or renegotiated contracts, or other than arm's-length transactions. • Charges for transportation other than that customarily provided by suppliers. • Prices of services or materials delivered under long-term contracts with primary suppliers.

Platts	Bi-weekly	Spot Price (Forward Uranium Price Indicator)	Bi-weeklyPrices, indexes, assessments and other price information are based on material collected from actual market participants. Prices quoted in tables published in NuclearFuel are obtained firsthand in confidential surveys of actual buyers and sellers.
Energy Intelligence (previously Nukem)	Monthly	Spot Price Range (Low, Mid, and High Price) Unrestricted Spot Price Range (Low, Mid, and High Price)	The price range is based on: • Prices known to Energy Intelligence for firm bids and offers for delivery of natural uranium concentrates, which are valid during the reporting month with delivery taking place during the reporting month or within the six following months. • Prices known to Energy Intelligence for purchases or sales of natural uranium concentrates that are negotiated or finalized during the reporting month, where delivery takes place during the reporting month or within the six following months and where the price is negotiated or established during the reporting month. • In publishing the price range for bids and offers, Energy Intelligence considers only actual occurrences in the natural uranium spot market. • Bids and offers can, for a number of reasons, deviate from the prevailing market situation. Therefore, Energy Intelligence does not, in certain cases, take such bids and offers into account. This includes bids, offers or transactions whose price is fixed as a result of special circumstances. An example is the price for very small amounts of natural uranium concentrates which is generally above the published price range. • Energy Intelligence also excludes from consideration bids or offers that, although they contain normal terms and conditions, obviously do not have a chance of success in the prevailing market because of the price quoted.
UPIS (NAC)	Monthly	Spot Price Long-term Price US Long-term Price Long-term Ceiling Price Long-term Floor Price	The U_3O_8 Spot Price Indicator (SPI) is NAC's opinion of the lowest price (in US$/lb U_3O_8) at which a significant quantity of U_3O_8 concentrates could be bought as of the last day of the reporting period. The price reflects both US and non-US origin material for delivery within 6 months of the publication date of the U_3O_8 SPI, and payment within 30 days of delivery.
Energy Information Administration (US DOE)	Annual	Spot and Long-Term Prices for deliveries in the previous year; assorted origin-specific information.	Weighted-average prices paid by owners and operators of US civilian nuclear power reactors.
Euratom Supply Agency (ESA)	Annual	Spot and Long-Term Prices for deliveries in the previous year; assorted origin-specific information.	Weighted-average prices paid by EU nuclear utilities.

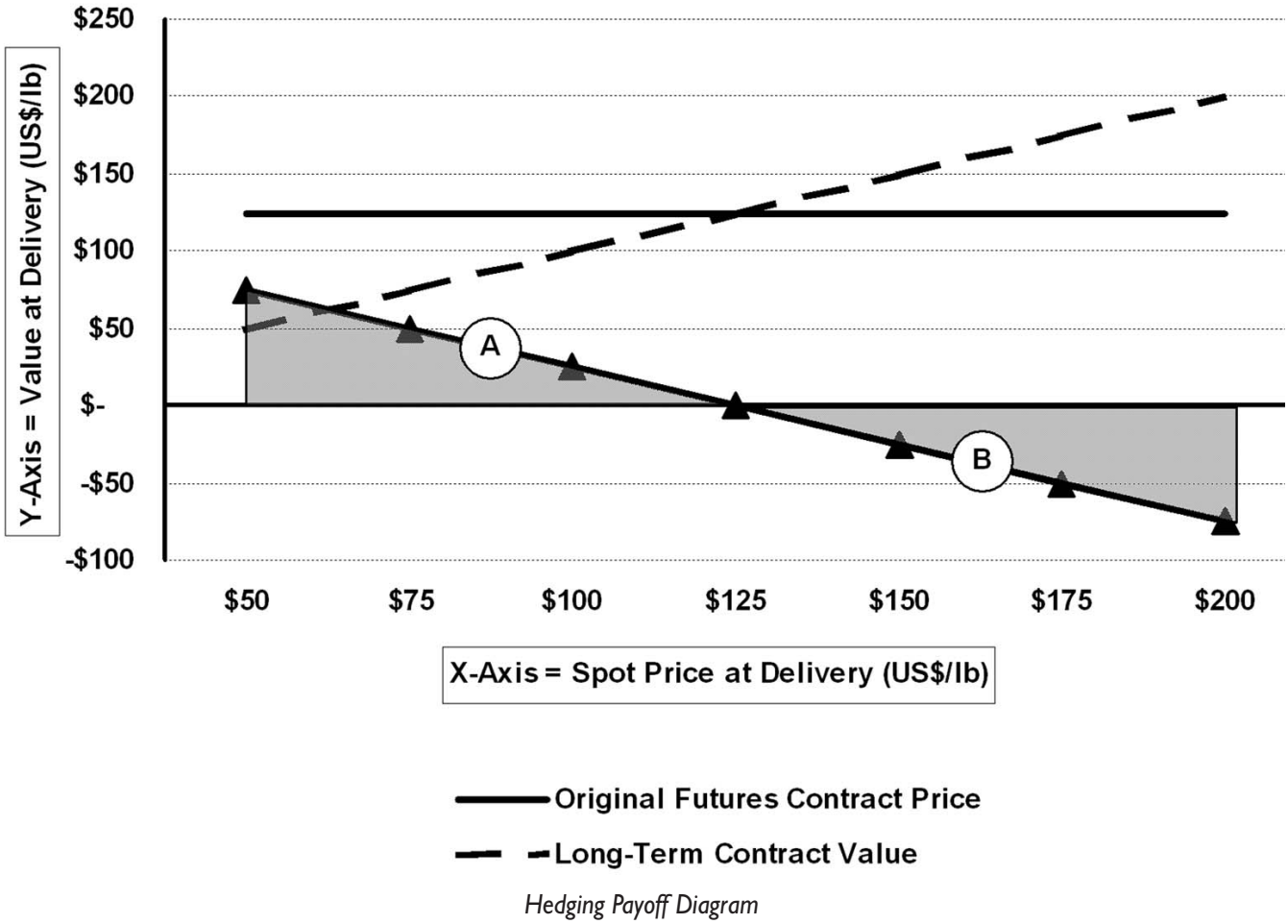
* Not all prices listed are currently actively reported.

** Methodology descriptions may be abbreviated. Reference entity-specific documents for complete descriptions.

Schedule 2. Hedging with Futures

Scenario:

- Producer has entered into long-term market-related contract.
- Producer wishes to lock in a forward price for a delivery to be made under this contract in one year.
- Producer sells a 12-month futures contract for US$125/lb for the volume of the delivery.
- At the time of delivery, producer realizes the spot market price under the long-term contract (any of the prices on the x-axis) and a gain or loss under the futures contract (any of the prices on the y-axis), which matures at the same time.
- If the futures price is greater than the spot price at maturity, the producer will realize a net settlement gain somewhere along line "A". If the futures price is less than the spot price at maturity, the producer will realize a net settlement loss somewhere along line "B".
- Combining the spot market price realized under the long-term contract with the net settlement value of the futures contract, the producer will realize exactly US$125/lb, the price locked in under the original futures contract.
- All prices in this example are shown for illustrative purposes only.



Hedging Payoff Diagram