



Short-Term Energy Outlook

Energy Price Volatility and Forecast Uncertainty¹

March 9, 2010 Release

Crude Oil Prices. WTI crude oil spot prices averaged \$76.39 per barrel in February 2010, almost \$2 per barrel lower than the prior month's average and very near the \$76 per barrel forecast in last month's *Outlook*. Last month, the WTI spot price reached a low of \$71.15 on February 5 and peaked at \$80.04 on February 22. EIA expects WTI prices to average above \$80 per barrel this spring, rising to an average of about \$82 per barrel by the end of the year and to \$85 per barrel by the end of 2011 ([West Texas Intermediate Crude Oil Price Chart](#)).

Following a slight increase in expected WTI price volatility early in February, implied volatility trended lower through the rest of the month, continuing a trend begun in the fourth quarter of 2009. Over the 5-day period ending March 4, May 2010 WTI futures averaged \$80.21 per barrel. Over the same 5-day period, the lower and upper limits for the 95-percent confidence interval for May 2010 futures were \$65 and \$99 per barrel, respectively, based on the May 2010 implied volatility, calculated from New York Mercantile Exchange (NYMEX) near-the-money options on WTI futures (see [Energy Price Volatility and Forecast Uncertainty](#)).

One year ago, WTI delivered into Cushing, Oklahoma, in May 2009 averaged about \$45 per barrel and implied volatility, at 74 percent, was more than twice the rate now trading in the options markets. The 95-percent confidence interval for May 2009 WTI futures thus had lower and upper limits of \$28 and \$75 per barrel, respectively.

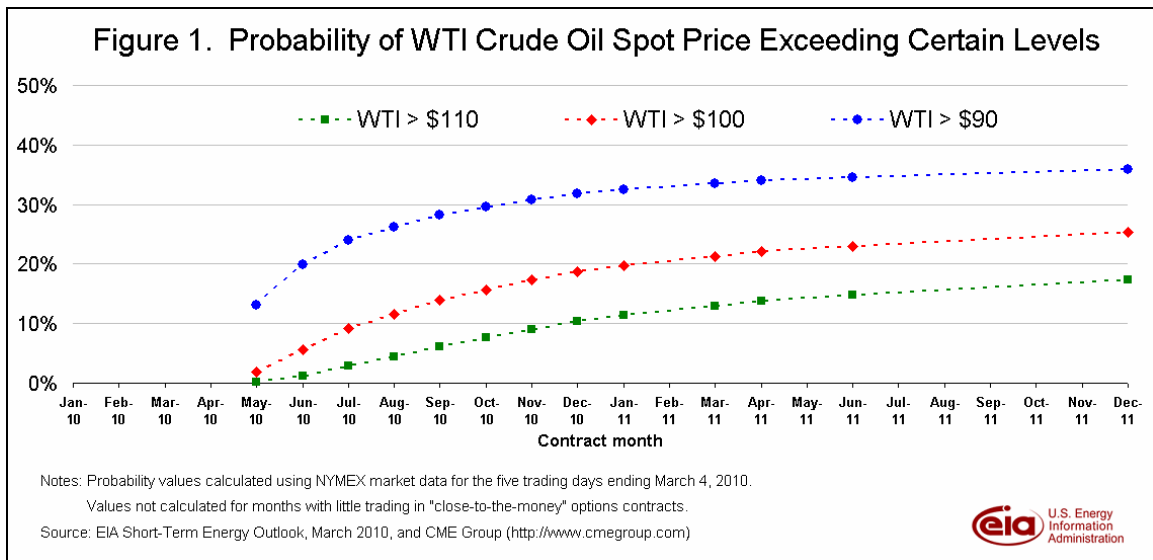
Assessing Crude Oil Price Probabilities. Confidence intervals are one way of assessing market participants' lack of certainty regarding the path prices will take during an option's life. With confidence intervals, futures prices and option volatilities are used to specify a range in which prices are most likely to trade over a

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(<http://www.eia.doe.gov/emeu/steo/pub/contents.html>)

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given period with a given degree of confidence. Futures prices and implied volatilities also can be used to calculate the probability a given price will be exceeded during an option's life, a statistic corporate-finance specialists, private- and public-sector researchers, and market participants find useful in budgeting, risk management and market analysis. This statistic is calculated using a cumulative normal density (CND) function. It can be shown that the risk-neutral methodology used to derive the Black (1976) commodity option pricing model generates this CND as one of its terms.²

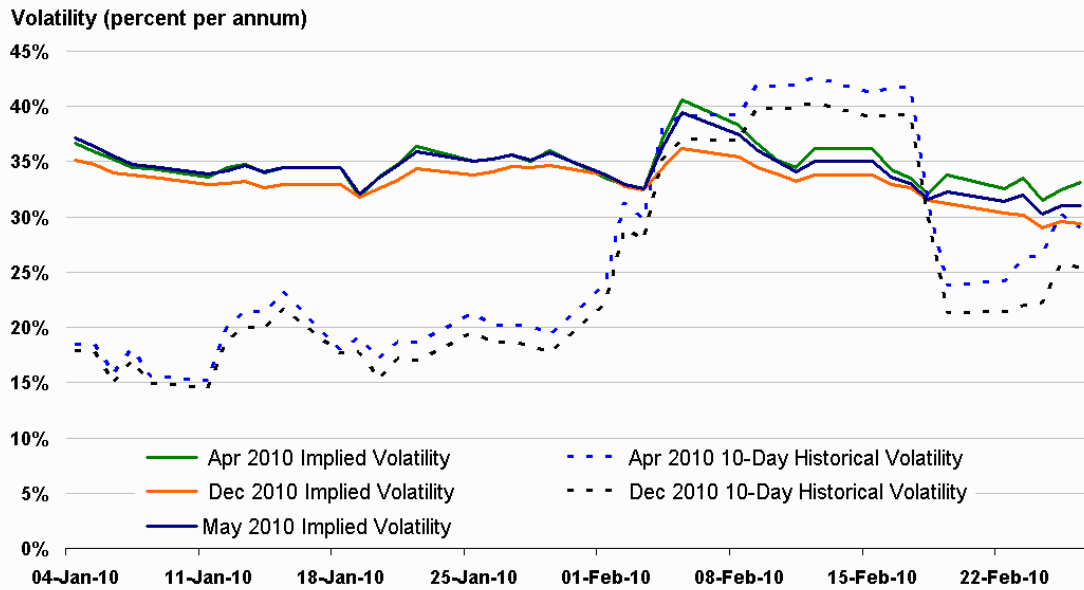
The futures and options markets' assessments of different price levels being exceeded can be calculated using the forward curves for WTI futures and option volatilities (Figure 1). A probability is calculated for each contract month given the futures price for that contract, its implied volatility, and its time to expiration. Like the confidence intervals reported by EIA, this is a market-based probability estimate derived using traded futures and options prices.



WTI implied volatilities continued on the downward trend observed during the fourth quarter of 2009 and earlier this year. This has been a persistent feature of volatility in the WTI futures markets, as Figure 2 illustrates.

² See Appendix II of [Energy Price Volatility and Forecast Uncertainty](#), beginning on page 22.

Figure 2. Evolution of WTI futures volatility
First quarter 2010

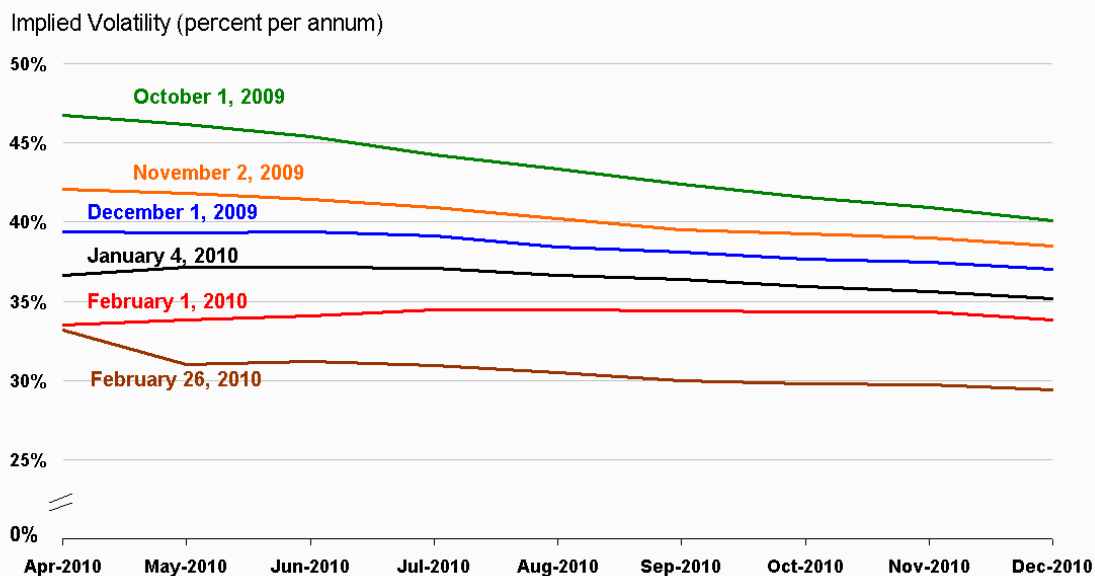


Source: CME Group: Light sweet crude oil futures and options contracts (<http://www.cmegroup.com>)



As implied volatility edged lower during February, the forward volatility curve returned to a more “normal” backwarddated structure (i.e., nearby volatility was higher than deferred implied volatility), as seen in Figure 3. In the “normal” term structure for WTI implied volatility, prompt implieds typically are higher than longer-dated implieds, because supply and demand are [price-inelastic](#). (See the [January 12, 2010, Energy Price Volatility and Forecast Uncertainty](#) article describing these mechanics of the WTI implied volatility forward curve.)

**Figure 3. WTI implied volatility forward curve evolution
2009 - 2010**



Source: CME Group: Light sweet crude oil futures and options contracts (<http://www.cmegroup.com>)

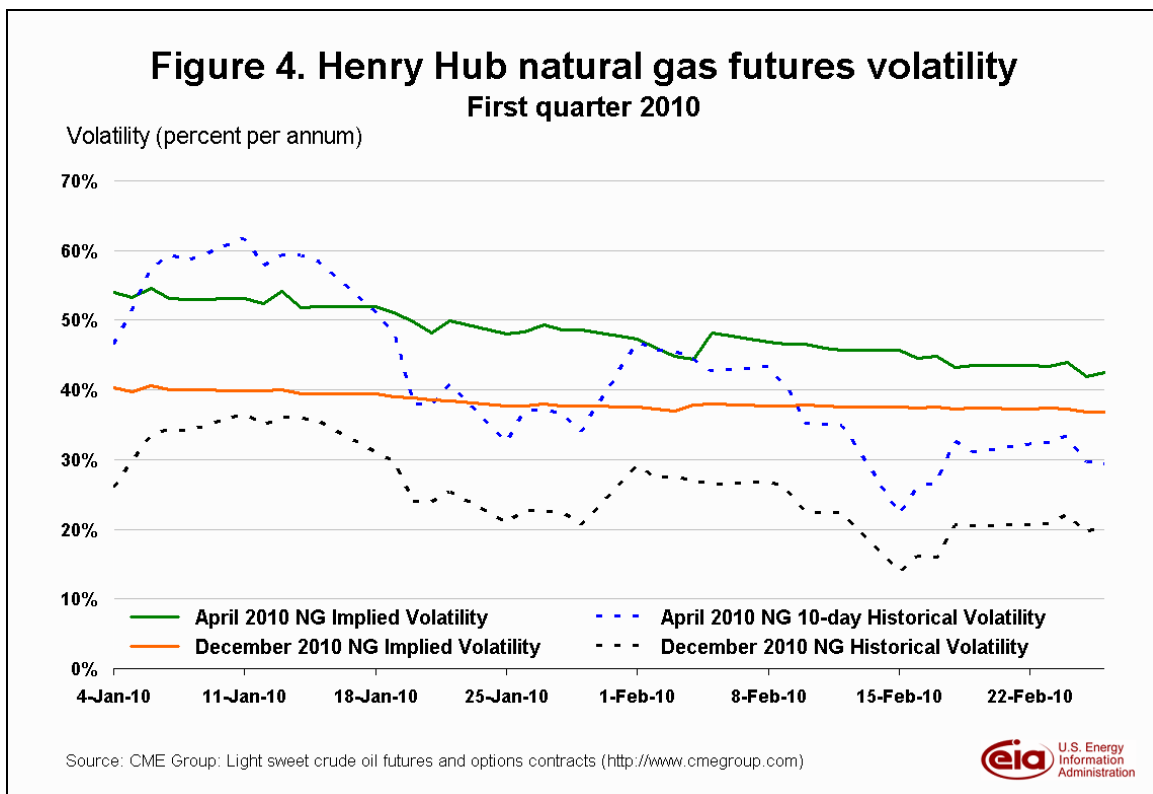


U.S. Natural Gas Prices. The Henry Hub spot price averaged \$5.32 per million Btu (MMBtu) in February, \$0.51 per MMBtu lower than the average spot price in January and \$0.14 per MMBtu lower than the forecast for February in last month's Outlook ([Henry Hub Natural Gas Price Chart](#)). Historically, colder-than-normal weather and correspondingly high demand has contributed to large storage withdrawals and elevated prices during the winter. For example, similar natural-gas-weighted heating degree-days and working natural gas storage withdrawals were recorded in January and February of this year and in 2003. While the cold weather in 2003 contributed to a 63-percent increase in the monthly average spot price from December 2002 to February 2003, the monthly average spot price in February 2010 was virtually unchanged from the average price in December 2009.

Much of the subdued price action this winter is attributable to the level of, as opposed to the change in, working inventories. By the end of February 2003, working stocks stood at 851 billion cubic feet (Bcf) compared with an estimated 1,729 Bcf this February. Prices may strengthen slightly in the coming months as demand to rebuild natural gas in storage from risk-averse local distribution companies begins. However, the potential for higher domestic production, increasing LNG supply, and limited consumption growth all reduce the possibility of sustained high prices as inventories

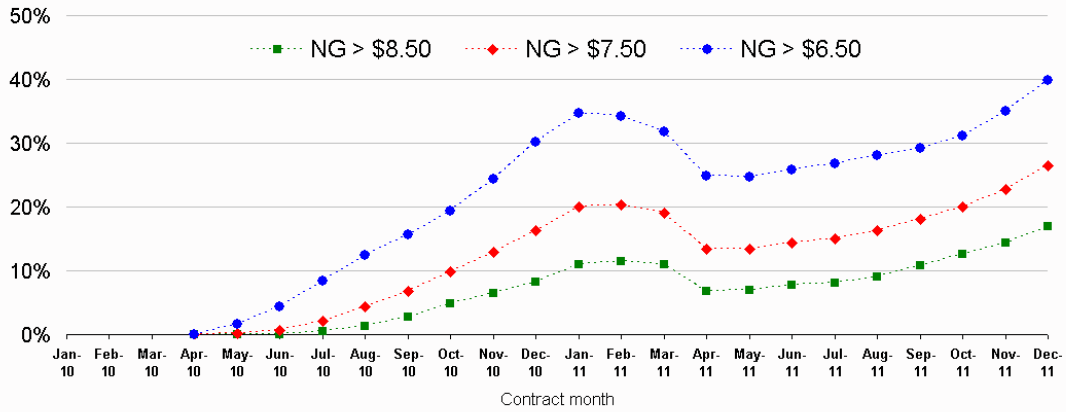
are replenished over the next several months. The Henry Hub spot price forecast averages \$5.17 per MMBtu in 2010 and \$5.65 per MMBtu in 2011.

Volatility in the April and May 2010 futures and options markets trended lower over the last month (Figure 4). For the 5-day period ended March 4, May futures averaged \$4.77 per MMBtu, while the lower and upper limits of the 95-percent confidence interval calculated based on the implied volatility calculated from near-the-money options were \$3.57 and \$6.39 per MMBtu, respectively. A year earlier, natural gas delivered to the Henry Hub in May 2009 was trading at \$4.30 per MMBtu, with lower and upper limit for the 95-percent confidence interval calculated based on implied volatility of \$2.80 and \$6.60 per MMBtu, respectively.



An analysis of the NYMEX natural gas futures' and options markets' assessments of different prices being exceeded over the life of various options contracts is presented in Figure 5. As is the case with WTI crude oil futures above, these probabilities are calculated using a cumulative normal density function that employs market-cleared parameters for an expected value (i.e., the futures price for each contract month) and variance, which is derived from the corresponding options' implied volatilities.

Figure 5. Probability of Henry Hub Spot Price Exceeding Certain Levels



Notes: Probability values calculated using NYMEX market data for the five trading days ending March 4, 2010.

Values not calculated for months with little trading in "close-to-the-money" options contracts.

Source: EIA Short-Term Energy Outlook, March 2010, and CME Group (<http://www.cmegroup.com>)

