U.S. Energy Information Administration

October 2010

Short-Term Energy Outlook
Energy Price Volatility and Forecast Uncertainty[1]

October 13, 2010 Release

Crude Oil Prices. WTI oil prices averaged $75 per barrel in September but rose above $80 at the end of the month and into early October. EIA has raised the average fourth-quarter 2010 forecasted WTI spot price to $79 per barrel compared with $77 per barrel in last month's Outlook. WTI spot prices are projected to rise to $85 per barrel by the fourth quarter of next year.

As has been the case for most of 2010, WTI futures traded with a notable lack of volatility during the third quarter of 2010 (Figure 1). However, prices did bounce in early October: for the 5-day period ending October 7 WTI futures for December 2010 delivery averaged $83 per barrel, and implied volatility averaged 30 percent per annum. This made the lower and upper limits of the 95-percent confidence interval $68 per barrel and $101 per barrel, respectively, for WTI delivered in December 2010. Last year at this time, WTI for December 2009 delivery traded lower, at $69 per barrel, while implied volatility was higher, averaging 48 percent. This made the lower and upper limits of the 95-percent confidence interval $49 per barrel and $96 per barrel, respectively.

[1] This is a regular monthly supplement to the EIA *Short-Term Energy Outlook.* (http://www.eia.doe.gov/emeu/steo/pub/contents.html)
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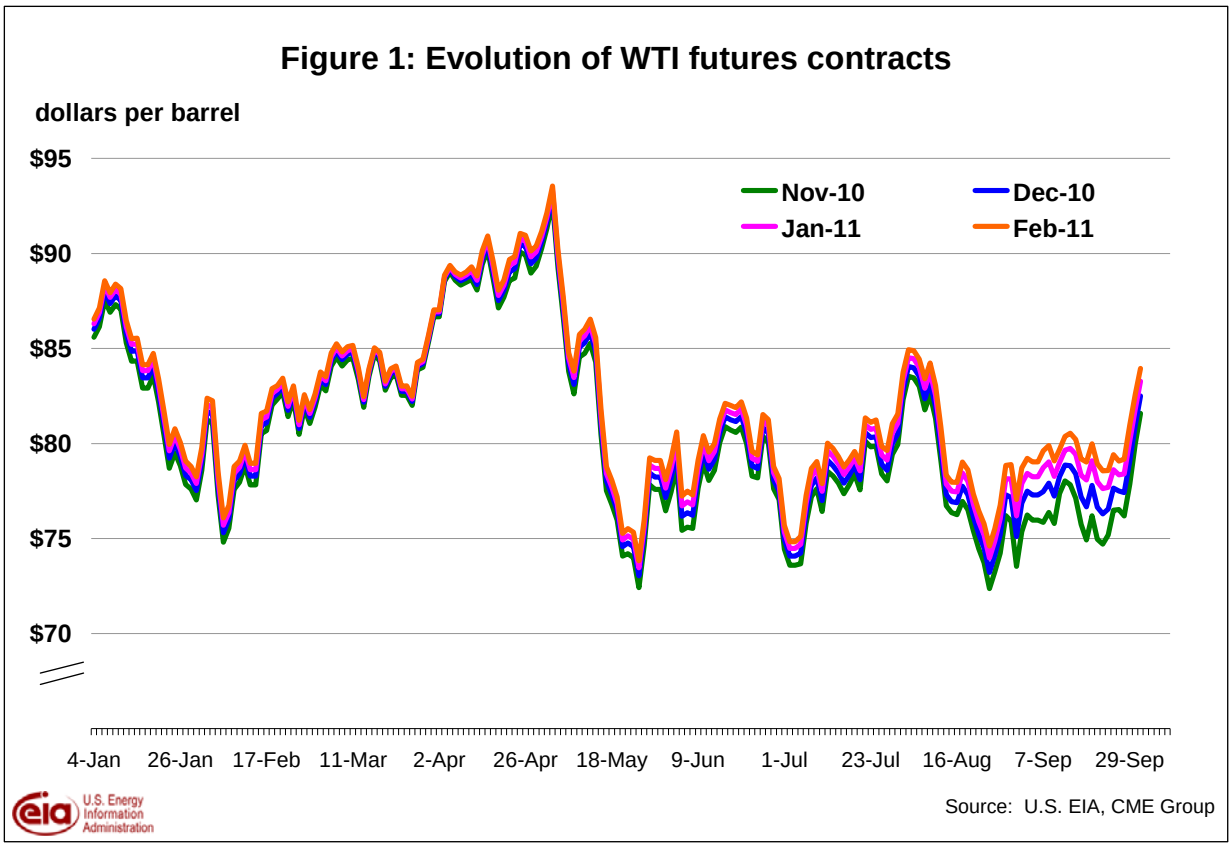
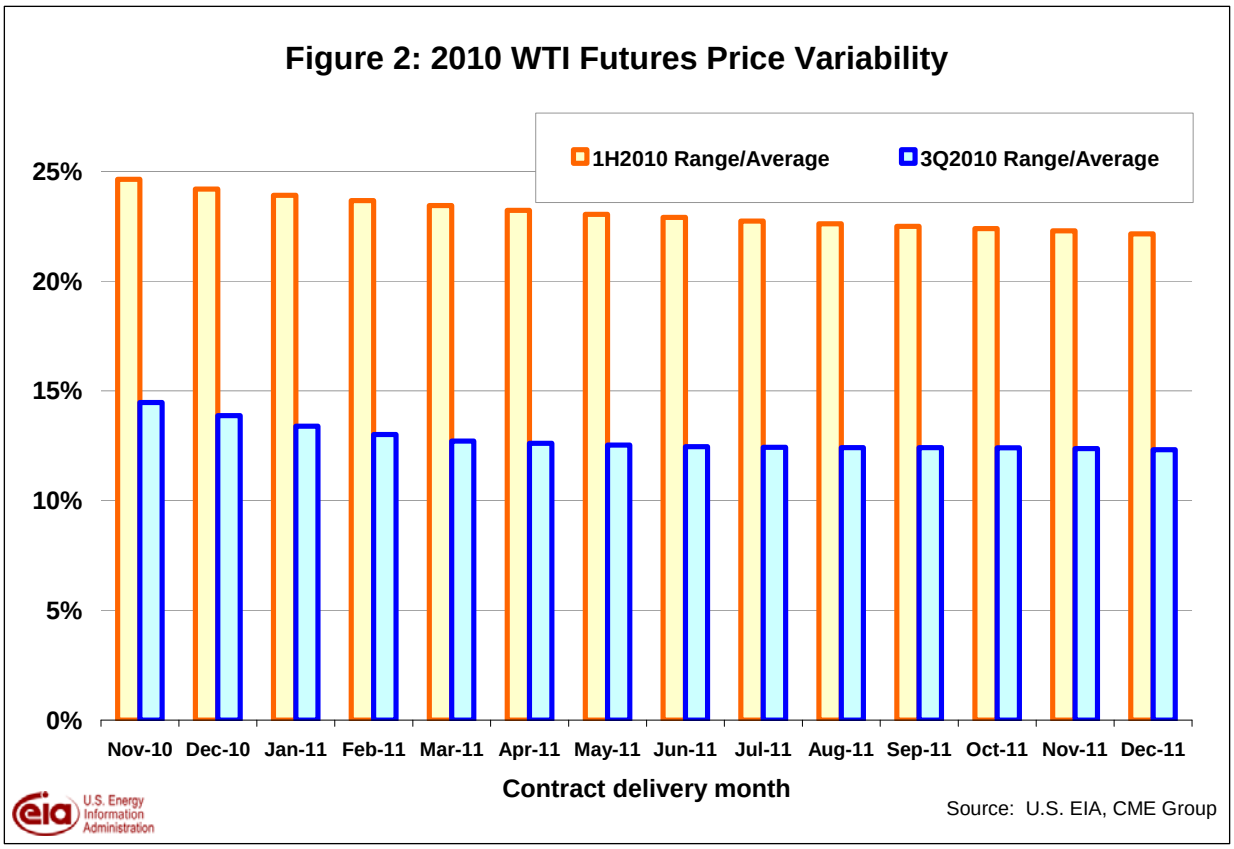
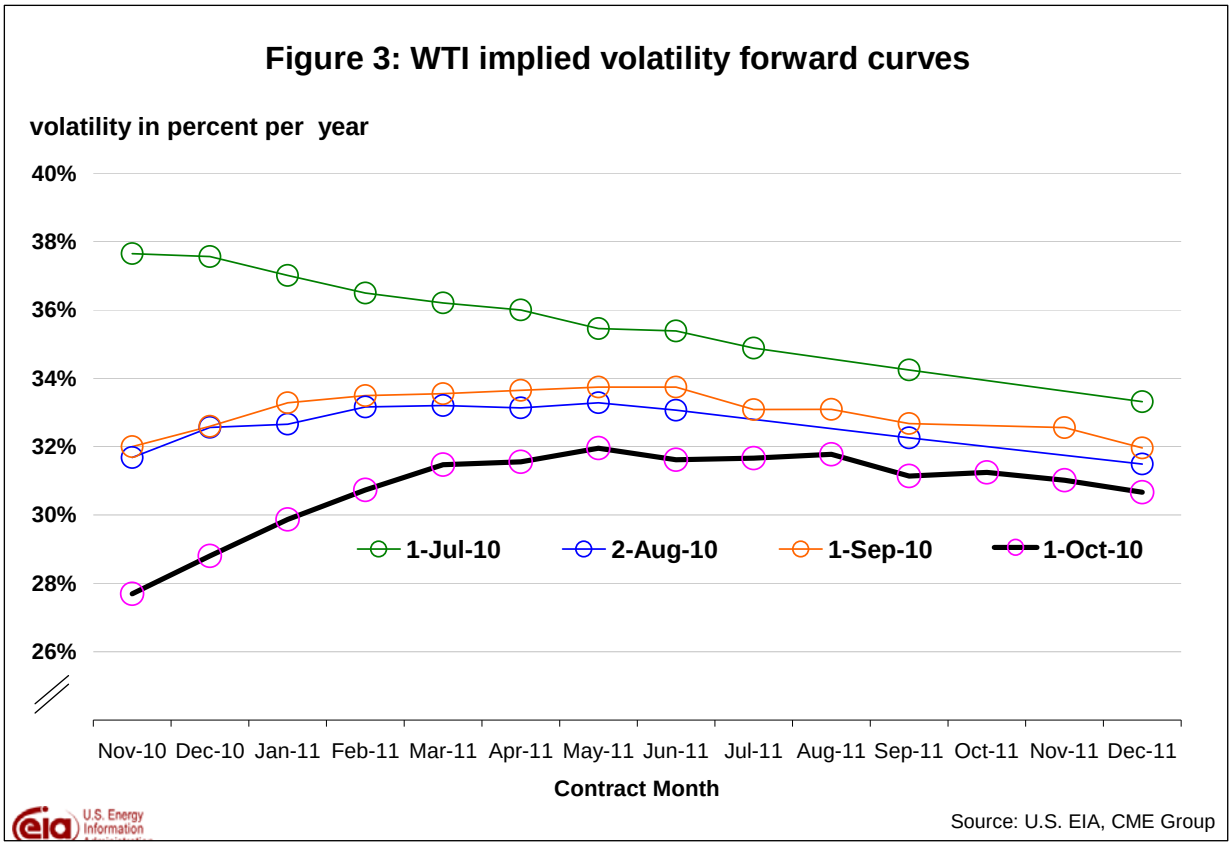


The lower variability in WTI futures prices during the just-ended third quarter of 2010 can be seen in the ratio formed by dividing the futures price range (i.e., the absolute high minus the absolute low) by the average futures price. During the first half of 2010, this ratio averaged a little over 23.1 percent for futures contracts extending to December 2011. In the third quarter, however, this ratio averaged slightly over 12.8 percent. Roughly speaking, the third-quarter high-low range around the average price for WTI futures was nearly half the high-low range around the average price registered during the first half of this year (Figure 2).



Market participants' forward-looking volatility expectations were lower during the third quarter as well. Implied volatilities were marked down by roughly 10 percentage points in the front of the forward volatility curve – i.e., the November and December 2010 contracts – over the course of the July-September period, and by approximately 3 percentage points in the deferred 2011 options contracts extending to December. This can be seen in the spread between the green (July 1 forwards) and black curves (October 1 forwards) in Figure 3.



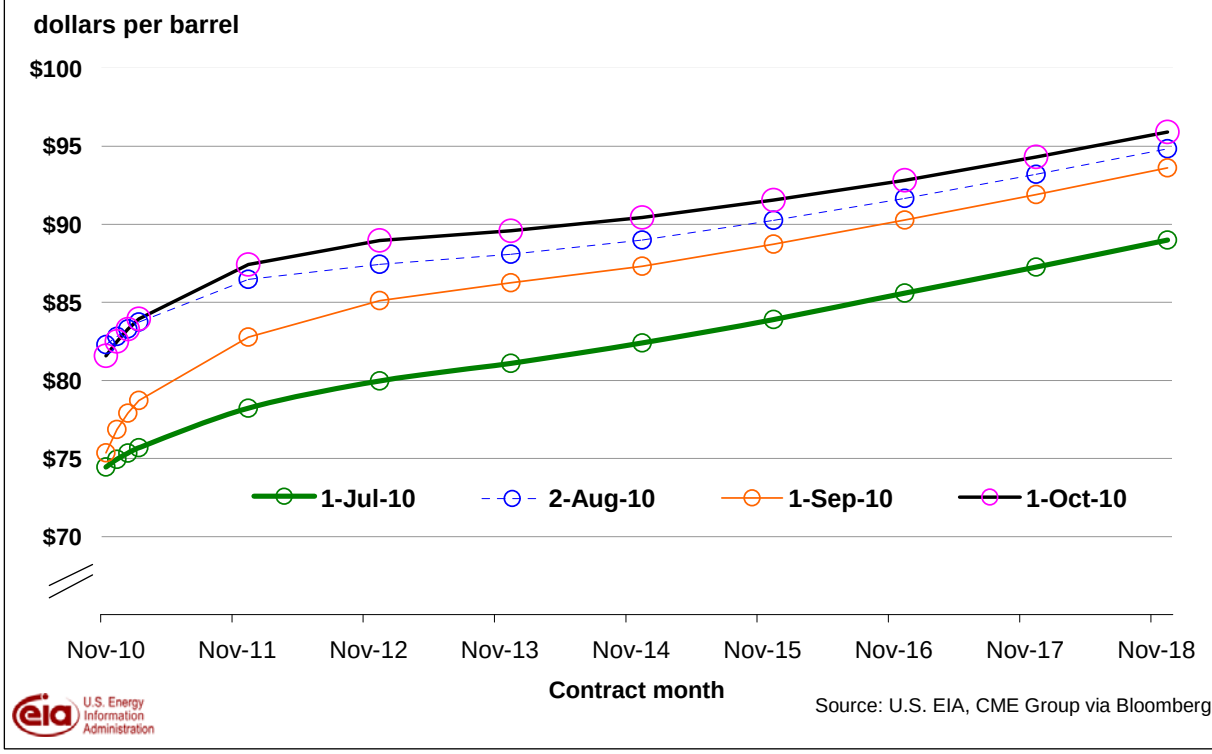
While volatility was marked down, the WTI forward price curve through 2018 registered an upward shift of $6 to $10 per barrel between the beginning of the third quarter on July 1 (the green curve in Figure 4) and the beginning of the fourth quarter on October 1 (the black curve in Figure 4). A relatively uniform shift in the forward curve indicates the market is pricing a persistent adjustment in longer-term supply-demand balances, which, in this case, is expected to result in higher prices. This is in contrast to a transitory, or short-term, supply-demand adjustment, which requires inventories to adjust to meet either unexpected demand or unanticipated inventory accumulation – the former typically manifesting itself in a backwardated (i.e., negatively sloped) forward curve, while the later is consistent with contango (i.e., positively sloped forward curve).[2]

The proximate causes of the shift in the WTI forward curve, according to analysts and media reports, were economic data showing global oil demand reviving and the

[2] See Roache, Shaun and Nese Erbil (September 2010), "How Commodity Price Curves and Inventories React to a Short-Run Scarcity Shock," International Monetary Fund Working Paper 10/222, particularly pp. 2 – 7, for an excellent discussion of storage economics. This paper is available at http://www.imf.org/external/pubs/cat/longres.cfm?sk=24253.0.

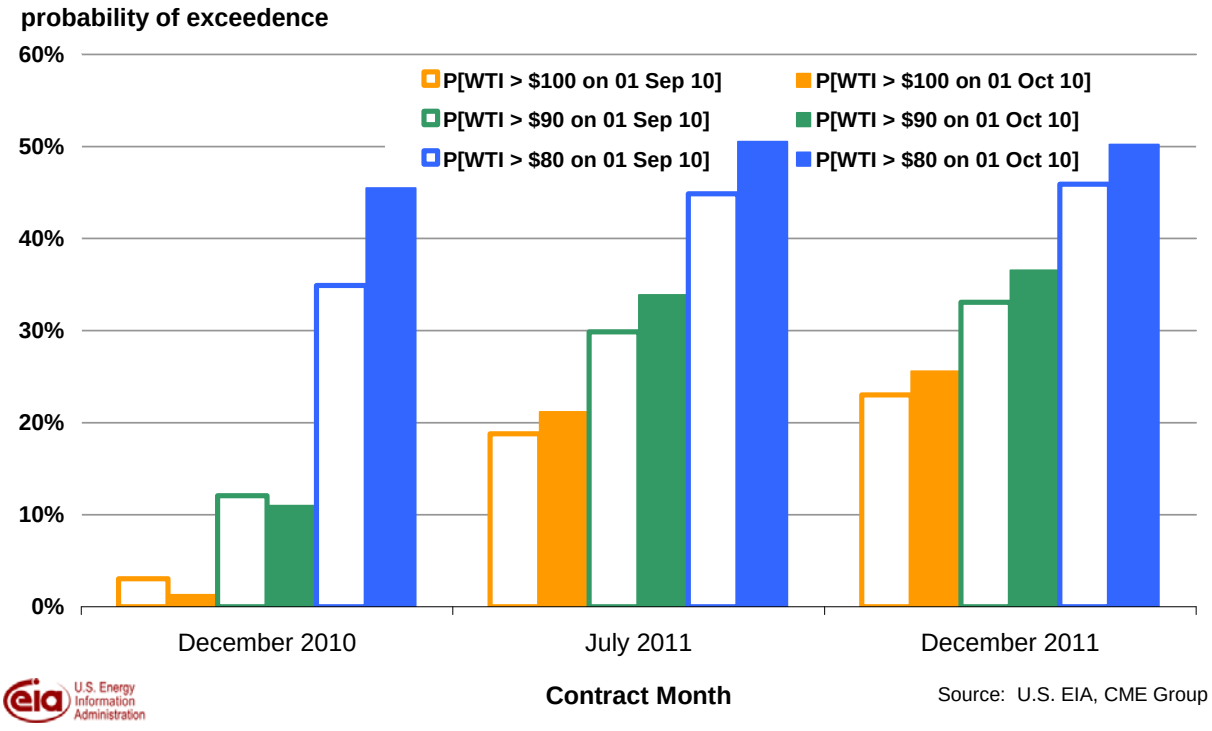
markets' expectation of continued monetary policy accommodation signaled by the U.S. Federal Reserve System at its September Federal Open Market Committee meeting. Remarks by Eric Rosengren, William Dudley and Charles Evans, presidents, respectively, of the Boston, New York and Chicago Federal Reserve banks, reinforced expectations the U.S. central bank was prepared to expand its accommodative monetary policy, should economic conditions warrant. Indications of increasing U.S. demand for petroleum products, particularly distillates, were apparent in EIA's Weekly Petroleum Status Report for October 1, 2010.

Figure 4: WTI futures term structure



Higher WTI futures prices, coupled with lower implied volatilities in the deferred contracts, resulted in a slight increase in EIA's probability assessment for higher prices in 2011 (Figure 5). The likelihood WTI prices will exceed $100 per barrel next year remains above a one-in-five chance (20%), based on the cumulative normal densities derived from market expectations using futures and options prices. (See Appendices I and II of EIA's October 2009 *Energy Price Volatility and Forecast Uncertainty* article for discussion of how these probabilities are derived.)

Figure 5: Probabilities for higher near-term WTI prices



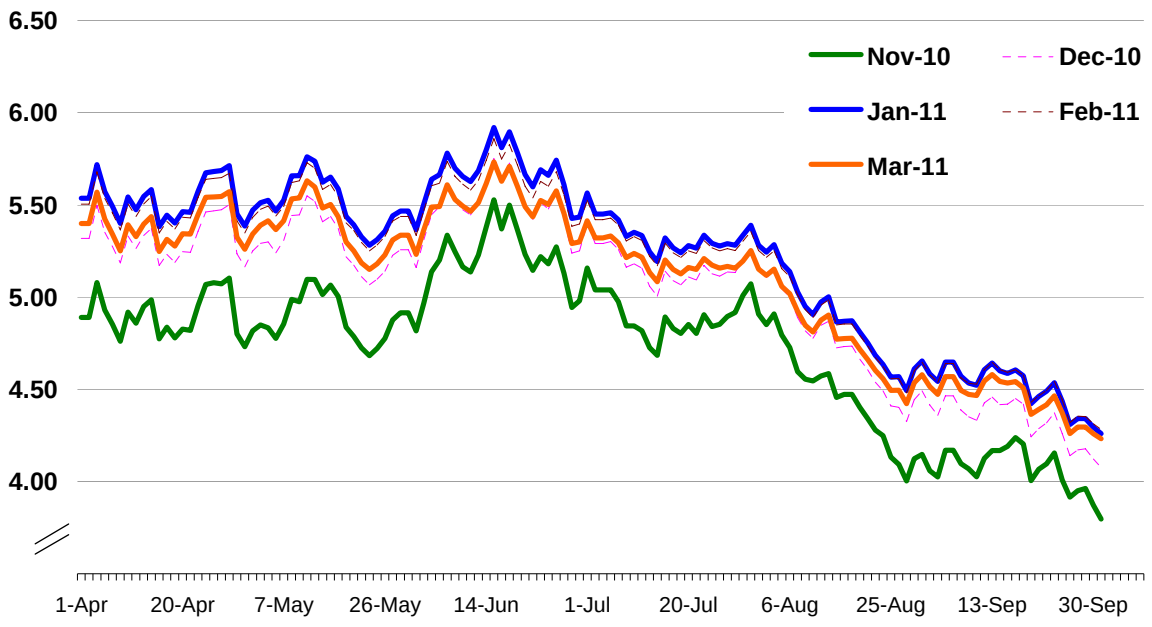
U.S. Natural Gas Prices. The Henry Hub spot price averaged $3.89 per million Btu (MMBtu) in September, $0.43 per MMBtu lower than the average spot price in August (Henry Hub Natural Gas Price Chart). Prices are expected to remain below $4 per MMBtu in October but rise to $4.68 per MMBtu in January as space-heating demand increases this winter. EIA has revised its projections for natural gas prices downward through 2011. Expectations are now for a price of $4.16 per MMBtu for the last quarter of 2010, $0.27 per MMBtu (6 percent) lower than last month's Outlook, based on several weeks of strong inventory builds. Price expectations for 2011 are $4.58 per MMBtu, which is $0.18 per MMBtu (4 percent) lower than last month's forecast primarily due to a stronger domestic production forecast.

Uncertainty over future natural gas prices is lower this year compared with last year at this time. Natural gas futures for December 2010 delivery for the 5-day period ending October 7 averaged $4.07 per MMBtu, and the average implied volatility over the same period was 39 percent. This produced lower and upper bounds for the 95-percent confidence interval of $3.09 per MMBtu and $5.37 per MMBtu, respectively. At this time last year, the natural gas December 2009 futures contract averaged $5.59 per MMBtu and implied volatility averaged 56 percent. The corresponding lower and

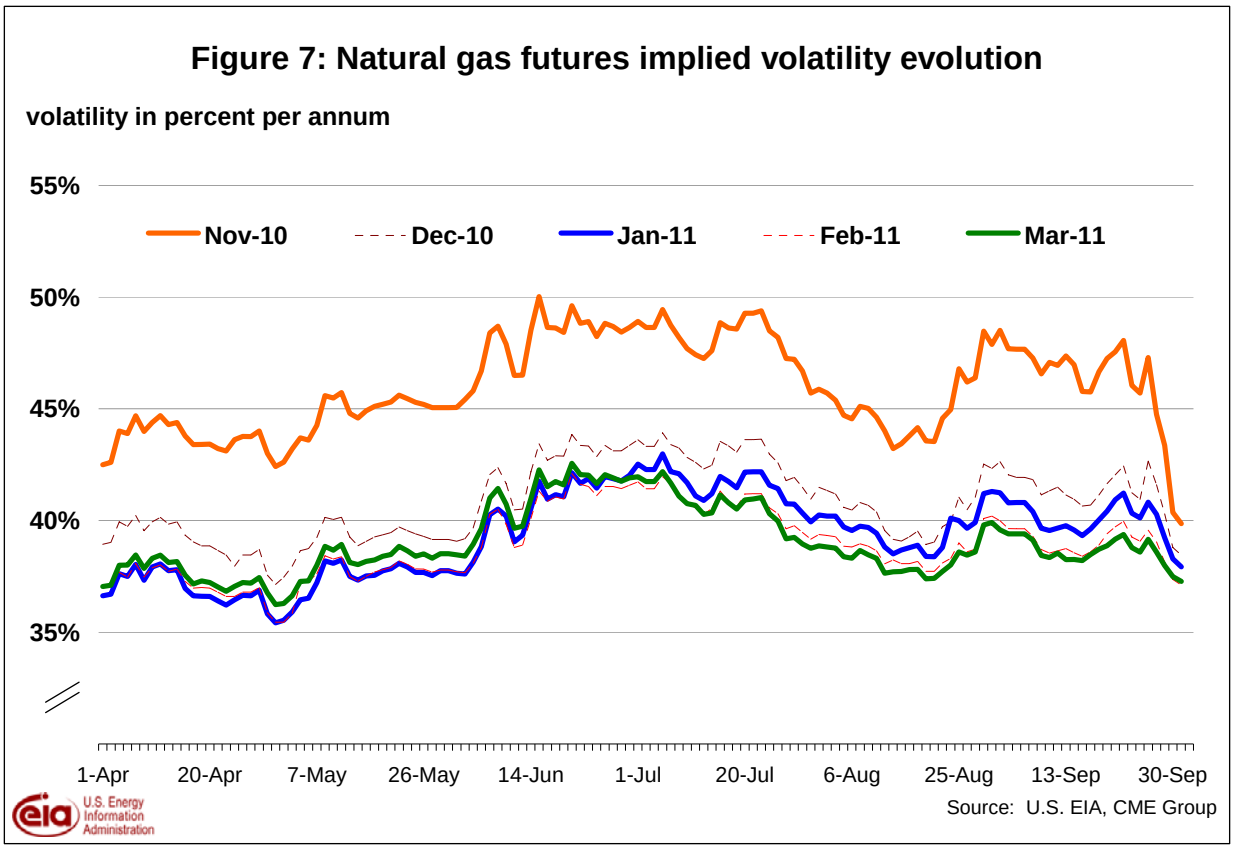
upper limits of the 95-percent confidence interval were $3.70 per MMBtu and $8.50 per MMBtu.

Both futures prices and implied volatility declined in September, as the height of the hurricane season in the Gulf of Mexico passed without any significant disruption of production. By October 1, 2010, November natural gas futures had fallen to $3.80 per MMBtu, while December gas was trading at $4.08 per MMBtu (Figure 6).

Figure 6: Natural gas futures price evolution

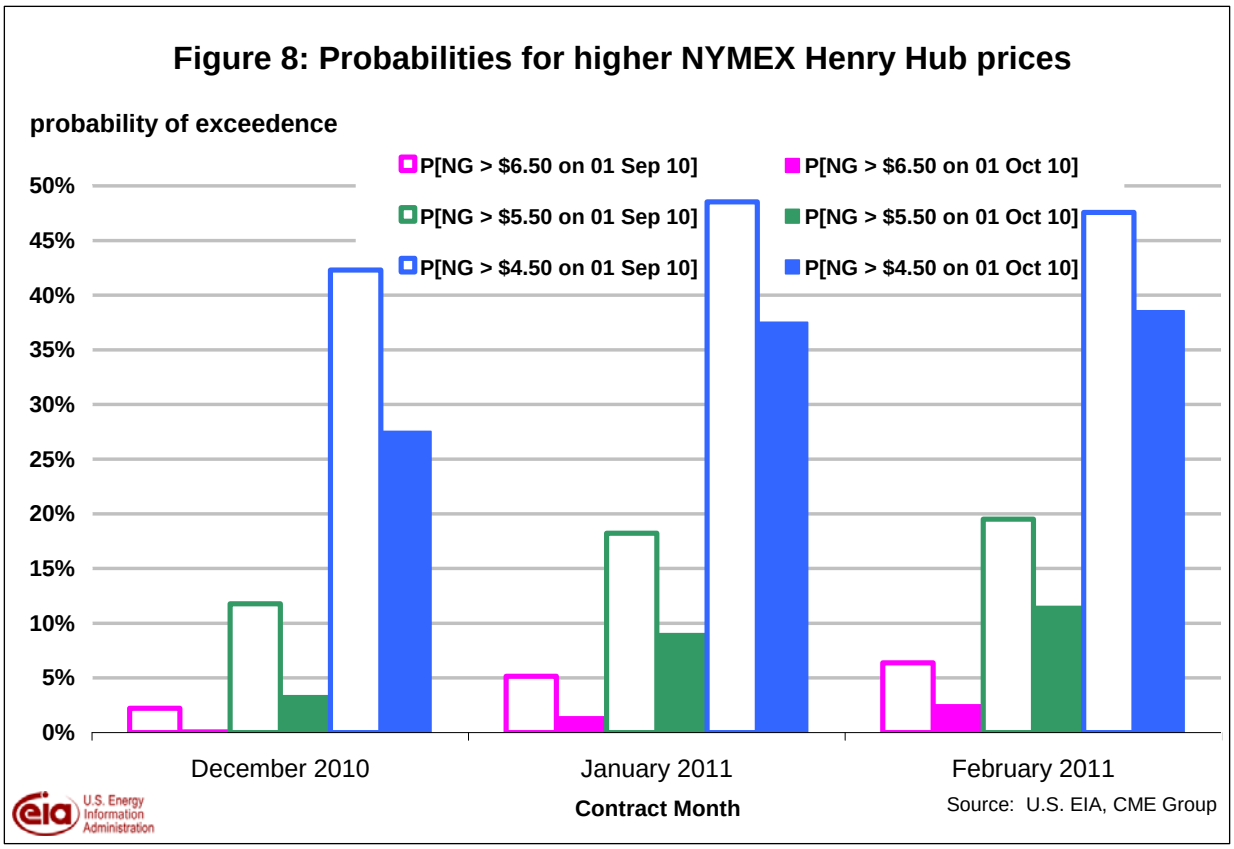


Source: U.S. EIA, CME Group



Implied volatility levels for November and December fell approximately 8 and 4 percentage points, respectively, during the month of September (Figure 7).

The combination of sharply lower prices and volatilities translated into reduced probabilities of seeing higher prices during the upcoming heating and storage drawdown season (Figure 8). By October 1, natural gas markets were forecasting a less than 40 percent chance Henry Hub futures prices would exceed $4.50 per MMBtu during the December through February peak of the winter heating season, compared to an almost one-in-two chance (almost 50 percent) at the beginning of September 2010.



These natural gas probabilities are cumulative normal densities, which are generated using market-based inputs provided by futures and options markets – i.e., futures prices and implied volatilities. (See Appendices I and II of EIA's October 2009 *Energy Price Volatility and Forecast Uncertainty* article for additional discussion).