



Short-Term Energy Outlook

Energy Price Volatility and Forecast Uncertainty¹

May 11, 2010 Release

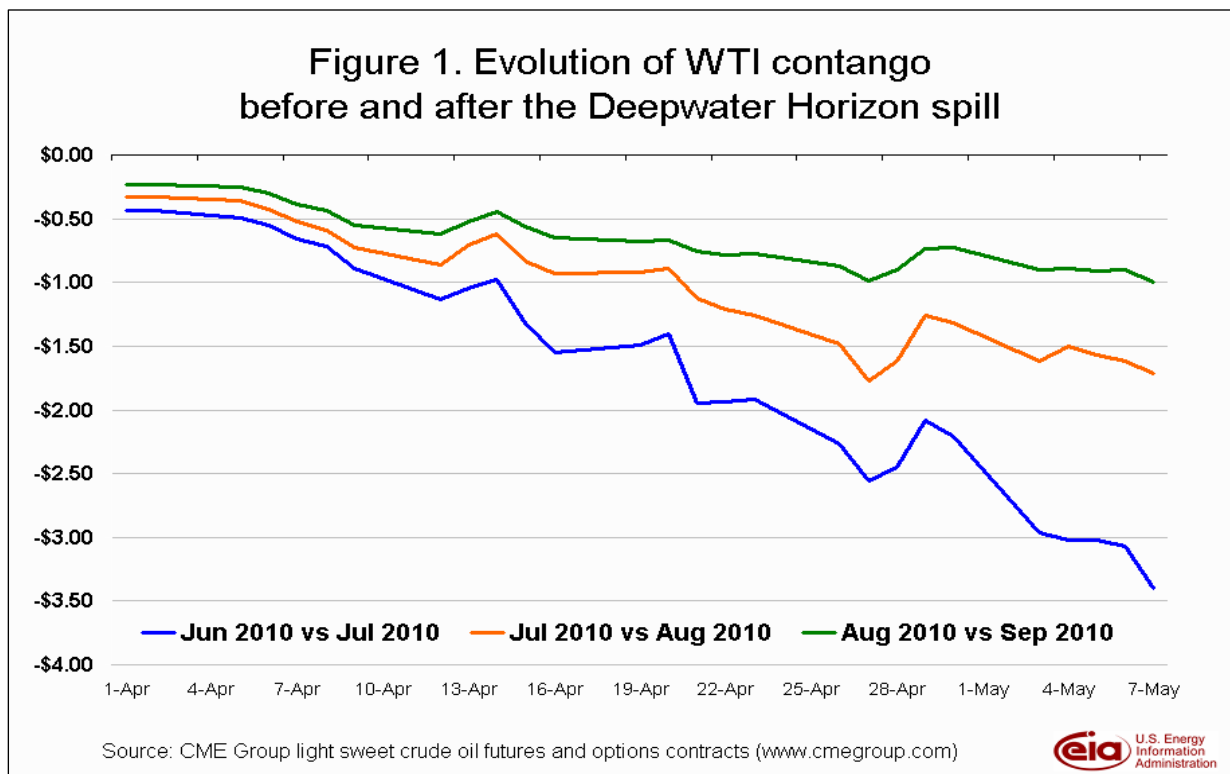
Crude Oil Prices. WTI crude oil spot prices averaged \$84 per barrel in April 2010, about \$3 per barrel above the prior month's average and \$2 per barrel higher than forecast in last month's *Outlook*. EIA projects WTI prices will average about \$84 per barrel over the second half of this year and rise to \$87 by the end of next year, an increase of about \$2 per barrel from the previous *Outlook* ([West Texas Intermediate Crude Oil Price Chart](#)). Energy price forecasts are highly uncertain, as history has shown. Prices for near-term futures options contracts suggest that the market attaches significant likelihood to the movement of prices over a wide range within a relatively short period.

While press reports about the Deepwater Horizon oil spill have arrived continuously since the incident, markets are focusing more on inventories and economic activity than on any potential for spill-related transportation disruptions. Following a 1.5-percentage-point increase in July 2010 implied volatility a few days after the sinking of the drilling rig on April 22, the futures market resumed its downward trajectory in volatility. For the 5 days ending May 7, July 2010 WTI futures contracts were trading at an average of \$83.32 per barrel. With implied volatility for the July 2010 contract averaging 33.2 percent for those same 5 days, the lower and upper limits of the 95-percent confidence interval were \$67 and \$103 per barrel, respectively (see [Energy Price Volatility and Forecast Uncertainty](#)).

Last year at this time, WTI for July 2009 delivery averaged \$56.35 per barrel and volatility averaged 51.5 percent, translating into a lower and upper limit of \$40.26 and \$78.88 per barrel for the 95-percent confidence interval.

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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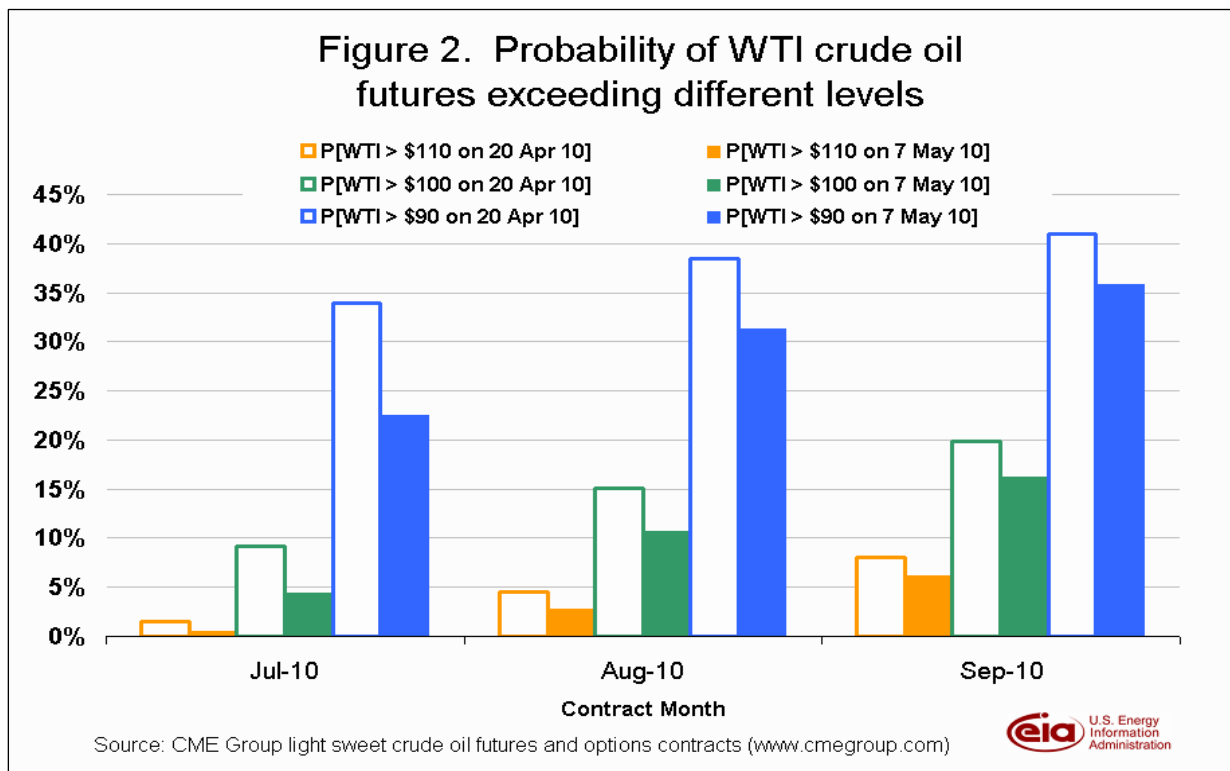
The Horizon spill did not affect current flowing supply or crude oil inventories in storage, which dominated pricing during the late-April, early-May period (Figure 1). Market participants follow the evolution of storage economics via inter-month spreads between futures contracts. That is, the value of buying a prompt-delivered futures contract and selling a deferred contract should be closely aligned with the actual cost of purchasing physical oil on the spot market (so-called “wet barrels”), storing them in Cushing and selling them at some future date. Arbitrage ensures this actually does occur: Any time a physical-market participant can buy wet barrels and sell futures forward at a greater differential than the all-in cost of buying and carrying the oil in physical inventory he will do so. These inter-month spreads also are known as “time spreads.”



The WTI futures time-spreads widened throughout April and in to early May, indicating crude oil inventories were building in Cushing. As available storage fills, the remaining supply of storage diminishes, thus the value of the remaining storage increases. Market participants must therefore pay more for the next increment of storage. This is reflected in a widening of the intermonth time spreads in WTI futures.

The market appears to be pricing a reduction in inventories coincident with the middle of the summer driving season, as is seen in the roughly \$2-per-barrel difference between the August-September spread and the June-July spread.

Crude Oil Price Probabilities. Current high inventory levels were not enough to keep options market participants from increasing the likelihood prices would increase this summer shortly after the Deepwater Horizon oil spill. On May 4, the market briefly priced a better-than-45-percent chance (almost 1 in 2 odds) WTI futures would exceed \$90 per barrel in September, up from a little over 40 percent on April 20, just two days prior to the sinking of the Deepwater Horizon platform. However, as May progressed, lower crude oil prices produced a lower likelihood of prices exceeding \$90, \$100 and \$110 per barrel by September’s delivery in Cushing. Figure 1 shows that by May 7, market participants were pricing the odds of oil prices being over \$90 per barrel by September’s delivery at slightly better than a one-in-three chance versus the close-to-one-in-two chance shortly after the oil spill.



These probabilities represent a cumulative normal density function, derived using Fischer Black’s (1976) option pricing model (see Appendix II of [Energy Price Volatility](#))

[and Forecast Uncertainty](#), beginning on page 22). The probability for each month is calculated using the futures price for that contract, its implied volatility, and its time to expiration. As is apparent, the probability of an event is a function of the time when that probability is calculated. Like the confidence intervals reported by EIA, this is a market-based probability estimate derived using traded futures and options prices (see April STEO Supplement, [Probabilities of Possible Future Prices](#)).

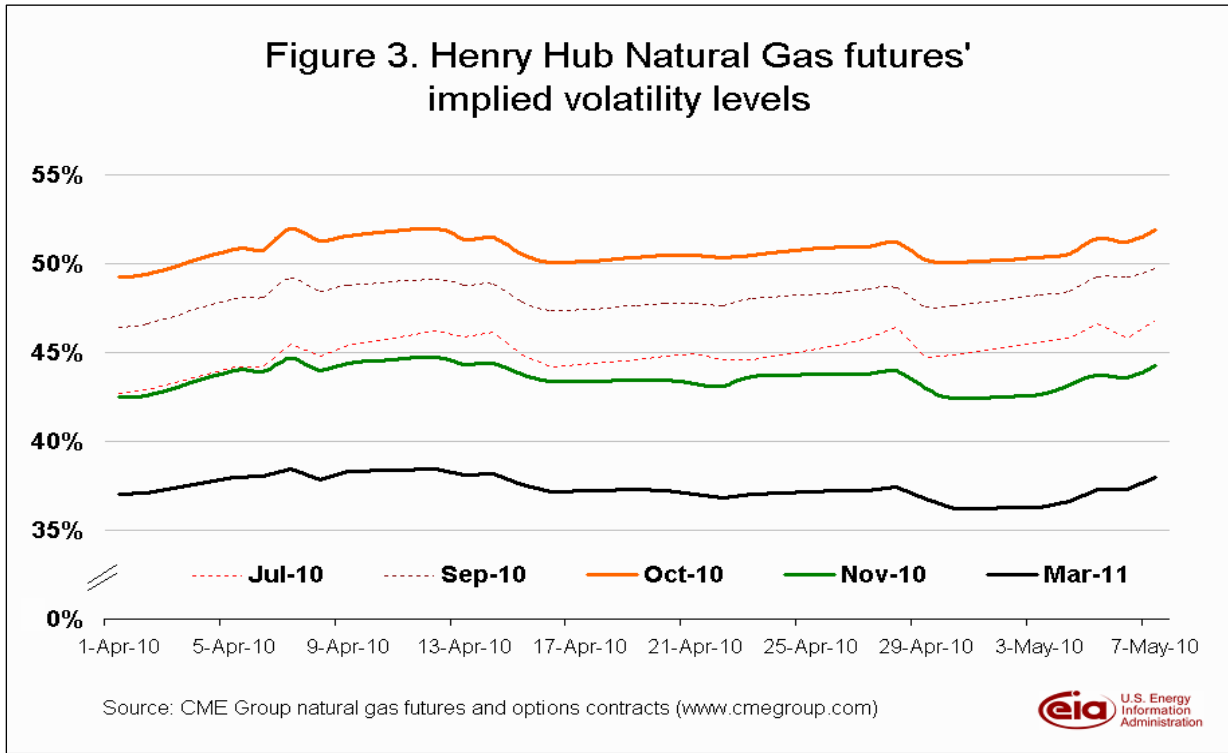
U.S. Natural Gas Prices. The Henry Hub spot price averaged \$4.03 per MMBtu in April, \$0.26 per MMBtu lower than the average spot price in March ([Henry Hub Natural Gas Price Chart](#)). Resilient production and mild weather in March and April have combined to keep near-term prices low. However, the forecast for sustained low natural gas prices this summer will likely contribute to a decline in natural gas drilling activity over the next several months. As a result, the current 2011 forecast of higher prices comes as production begins to decline later this year. The Henry Hub spot price forecast averages \$4.48 per MMBtu in 2010 and \$5.34 per MMBtu in 2011.

Natural gas options markets were fairly stable in April, with implied volatilities finishing the month close to where they started. July 2010 natural gas futures prices averaged \$4.11 per MMBtu for the 5 days ending May 7, roughly where they started the month. Implied volatility averaged 46.1 percent for the same five-day period, rendering the lower and upper limits of the 95-percent confidence interval at \$2.95 and \$5.70 per MMBtu, respectively.

A year earlier, natural gas delivered to the Henry Hub in July 2009 was trading at \$3.90 per MMBtu and implied volatility averaged about 66 percent. The lower and upper limits for the 95-percent confidence interval were \$2.42 and \$6.28 per MMBtu.

U.S. Natural Gas Price Probabilities. The highest volatility in the natural gas options market for the current injection season, which runs from April thru October every year, is found in October (see Figure 3). October typically is the month during which the market gains certain knowledge as to beginning-of-winter stocks available for the coming November – March withdrawal period. Leading up October, the market will continually revise storage expectations (e.g., will natural gas storage fill earlier than expected, thus leaving flowing gas to clear the market at low levels, or will demand prove too strong for flowing supply to fill storage and meet flowing gas demand). At either extreme, markets appear to be pricing inelastic supply and demand, which, all else equal, translates into higher volatility expectations at the end of the injection season in October, and the beginning of the withdrawal season in November.

The probabilities in Figure 4 are cumulative normal densities (see Appendix II of [Energy Price Volatility and Forecast Uncertainty](#)). EIA uses market-based parameters derived



from futures and options prices to calculate these densities (see April STEO Supplement, [Probabilities of Possible Future Prices](#)).

