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April 4, 2016

If PUDs are "free", we may be a buyer at that price!

As E&P companies are releasing their year-end 2015 financials, they all show significant write-offs for the value of their Proved Undeveloped Properties, or "PUDs." These are driven by their independent engineer's calculations that many of their PUDs have no value at current prices. As shown below, Chesapeake Energy's PUDs were written down on average 60% over the 12-months ending December 2015.

Chesapeake Energy Corporation
2015 Form 10-K

Proved Undeveloped Reserves	Oil (mmbl)	Gas (bcf)	NGL (mmbl)	Total (mmboe)
Beginng of Period	192	2077	68	605
End of Period	98	712	26	242
% Change	-49%	-66%	-62%	-60%

Their engineer's calculations following a standardized discounted cash flow model which, if negative, shows a zero value for the PUD location. The real question is that IF these PUDs are worth zero dollars, then why are so many private equity groups lining up to buy them? **The simple answer is called the option value of the PUDs.**

Real Options

In general, a financial option gives the holder the right, but not the obligation, to act (or drill in this case). A PUD location can be thought of as a call option, i.e., the holder has the right but not the obligation to drill and produce the hydrocarbons at prevailing commodity prices.

In option terminology, drilling the well is like paying the "strike price" of an option to receive the present value of the future production (analogous to a "stock price"). A simple form of this model is called the Black Scholes model. To make up a simplistic example, let's say a PUD had an expected value for its production of $3 million and it would cost $4 million to drill, frac and complete. Therefore, the net value of that well is a negative $1 million if drilled at today's prices.

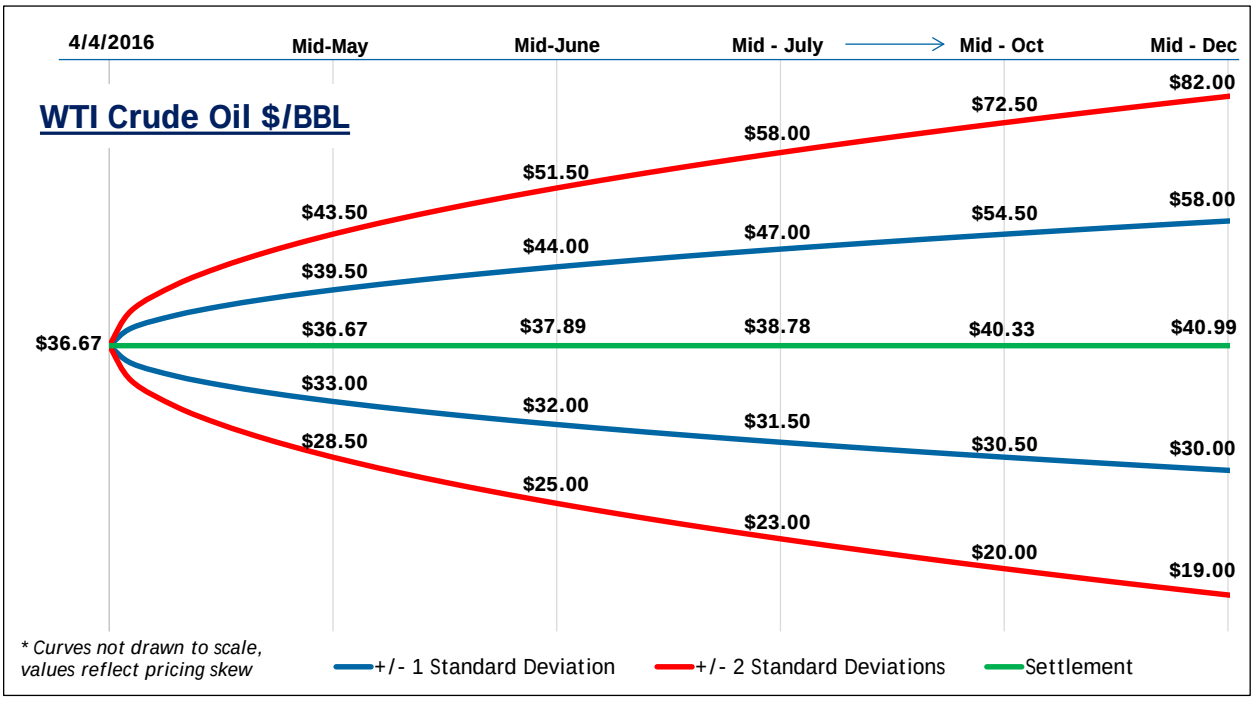
Real Option Values		3-Year Option Value Comparison		
	Traditional DCF	No Volatility	25%	50%
PV Cash Flows - Current	$3,000	$3,000	$3,000	$3,000
Capital Cost to Complete	$4,000	$4,000	$4,000	$4,000
Years until expiration		3.0	3.0	3.0
Volatility (sigma)		0.0%	25.0%	50.0%
Value	**-$1,000**	**$0**	**$248**	**$759**

However, owners have the option to not spend those funds now, and if no volatility in prices were assumed, the option value is zero (versus a negative $1 million). However, considering the volatility of oil and gas prices, the model shows that there is value to this option. In this simplistic example, at an assumed 25% volatility, the PUD would be worth $248,000 and at 50% volatility it would be worth $759,000. So is this a sure thing? Of course not, but optionality has value and PUDs are a classic real option.

Crude Oil Outlook

While futures markets aren't a crystal ball, their price levels and related options are useful for estimating future price ranges or "confidence intervals" for crude oil and natural gas.

The graphic below shows the crude oil price on April 4, 2016 and predicted crude oil prices based on options on oil futures contracts (ticker /CL). The blue lines are within one standard deviation (σ) of the settlement price (green line) and the red lines are within two standard deviations for each month (for a refresher on standard deviations, see the January 2016 blog).



Based on the April 4, 2016 prices, the markets indicate that in mid-May, there is about a 68% chance that oil prices will be between $33.00 and $39.50 per barrel. Likewise, there is about a 95% chance that prices will be between $28.50 and $43.50. For a longer-term view, I am also showing the year-end ranges, which indicates that by mid-December 2016, the +/- 1σ price range is $30.00 to $58.00 per barrel. This upward skew in the price ranges also drives the expected midpoint of approximately $41.00 per barrel at year end.

Natural Gas Outlook

We can do the same thing for natural gas futures, currently trading at about $2.03 per MMBTU on the Henry Hub (ticker /NG). Although more affected by seasonal factors than crude oil, six months from now in mid-October 2016, the +/- 1σ price range is $1.75 to $3.05 per MMBTU and the 2σ range is $1.25 to $4.25 per MMBTU.

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