# *Notes at the Margin*

**Philip K. Verleger, Jr.** **Volume XIX, No. 20** **May 11, 2015**


## The Data Must Be Wrong

### Current US Output Probably Overestimated by 1.6 Million Barrels per Day

Something is amiss. All of the data cannot be correct. The forecasters have predicted large increases in crude oil stocks. Inventories should be approaching record levels if they are correct. Yet returns to storage, the mathematical representation of the forward price curves, show no inventory build anywhere in the world. Either the data used by forecasters to prepare their projections are wrong or the firms buying and selling oil in world oil commodity markets are out of touch. We are convinced the data are wrong.

Here we explain that the US Energy Information Administration is drastically overestimating US crude production. US output in April was probably 1.1 million barrels per day less than the published figure of 9.3 million barrels per day. The May discrepancy may be 1.6 million barrels per day.

This is a large variance that could have enormous implications for the global economy. Prices will be higher because the glut was phantom. Federal Reserve policy could easily have been different had the error been understood.

The explanation for the mistake indicates a gross dereliction of responsibility on the EIA's part. Rarely if ever has a US agency charged with collecting data made a miscue of this magnitude. The EIA administrator should be dismissed immediately for gross incompetence.

#### Background

The instrumentation in most of today's modern oil and gas extraction, refining, and distributor business is state of the art. Producers know exactly how much oil and/or gas is produced by the minute, hour, and day. Most good companies also know the composition of the material produced. This information is essential for effective maximization of production and yield.

These data almost certainly make it to the headquarters of producing companies daily or weekly. You can be sure that William Thomas, chairman and CEO of EOG Resources, gets reports each day on the company's oil and gas output. You can also be sure the key individuals overseeing production at BP, ExxonMobil, Shell, and every other company producing oil and gas get such information regularly. Every executive wants to know about output volumes and any problems that occur.

This information could get to government agencies relatively quickly if the agencies demanded it. The US Energy Information Administration, for example, could ask companies to transmit production information on a prompt basis along with the data on inventory holdings they already must supply.

However, EIA seems not to have asked for such information. Instead, it chooses to


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estimate production volume. The agency has followed this procedure since it started publishing weekly data back when Jimmy Carter was president. The technique might have been adequate then. It is not, however, today. Given the oil market's new, more dynamic nature, better information is required.

The data problem can be seen from this relatively simple calculation. According to most forecasters, global oil supply was supposed to exceed global oil demand in the second quarter. Specifically, the International Energy Agency believes stocks should be increasing 1.8 million barrels per day in the second quarter. EIA predicts an increase of 1.7 million barrels per day. The Energy Intelligence Group expects stocks to rise 2.4 million barrels per day, and Argus Media puts the increase at 3.1 million barrels per day. Table 1 shows the summary numbers from these projections.

Table 1. Calculation of Second Quarter Global Oil Supply-and-Demand Balances by Different Organizations (Million Barrels per Day)

| | IEA | EIA | EIG | Argus |
|---|---|---|---|---|
| Demand | 92.7 | 92.6 | 93.0 | 92.9 |
| Supply | 94.5 | 94.3 | 95.4 | 96.0 |
| Stock Change | 1.8 | 1.7 | 2.4 | 3.1 |

Source: As noted above.

If the forecasts are correct, one should be observing an increase in contango. The contango would be extreme if the IEA forecast made a few months ago—that world storage capacity would be exhausted by summer—came to pass. Furthermore, given the low storage costs in the US, one would expect to see stocks here increasing rapidly as traders look for homes for crude. US stocks should be rising around seven million barrels per week or more.

Stocks are not increasing as predicted. A check of the market reveals that contango has decreased, not increased, and US stocks have begun to decline as well. To borrow from Ben Franklin, current projections have become beautiful theories mugged by gangs of brutal facts.

The cause behind the market's directional change is unknown, though, because our data are so poor. The failure of reported stocks to increase and record-breaking contango to occur could be explained by an unexpected surge in global consumption. It might also be explained by increased stock building outside the OECD—for example, by the governments of China or India. Alternatively, the absence of a stock build could be explained by a very large drop in US oil production. Indeed, the evidence suggests that stocks have not increased because US output has fallen at an unexpectedly high rate.

Unfortunately, the EIA provides no helpful information. To the contrary, a skeptic might argue that the agency is assisting the oil industry in "covering up" the decline. Officials there may believe this course somehow benefits the industry. A more reasonable explanation is they are just incompetent.

The basis for calling this a data cover-up or, perhaps worse, a dereliction of the EIA's duty can be found in the agency's own documents: *EIA estimates weekly domestic crude oil production using a combination of short-term forecasts and the latest available production estimates from Alaska"*[1][emphasis

[1] EIA, *Weekly Petroleum Status Report*, May 1, 2015 (http://goo.gl/5NFGIk), p. 38. See the appendix on page 12 for the full text of this disclosure.

added]. The explanation continues by noting that the number reported is based on actual data for Alaskan production and on "the most recent *Short-Term Energy Outlook* model estimate" for production from the lower forty-eight states.

This forecast of crude production appears in a table in the EIA's *Weekly Petroleum Status Report*. There is nothing in the table or the footnotes that tell the reader the numbers are based on a model forecast. Worse, there is no indication that the model used to generate the weekly numbers is any good. One only knows that the same agency that publishes this report did not recognize the success of fracking until US production was double the level forecasted. Indeed, the agency's model predicted that US production in 2014 would average five million barrels per day. The actual average turned out to be 11.6 million barrels per day.

Gustave Holst, composer of *The Planets*, reportedly expressed disgust on one occasion toward one of the symphony's movements. The effort required for the segment was extensive and painful. When asked how it was going by a friend, Holst snarled, "It's a piece of crap." Most people would disagree. Those who follow oil would agree, though, that the comment is apt regarding oil production data.

Anecdotal evidence for production dropping sharply is accumulating. On Thursday, an Argus Media report observed that the narrow spread between Bakken and Brent points to a drop in output. Bakken should be trading at a $14 per barrel discount to Brent due to the high cost of transporting it by rail to the East Coast. The spread has recently collapsed, though, even as volumes continue to move east. According to the Argus report, a diminished supply of Bakken has forced firms with term contracts for rail service to bid up the price for remaining supplies to perform on their contracts.[2]

Further anecdotal evidence comes from data on Canadian imports. Canadian refiners had become large buyers of US crude in 2014 when the oil sold at a discount to world prices. Platts reported on May 5 that Canadian imports of US crude dropped to four hundred fifteen thousand barrels per day in March from four hundred thirty-eight thousand barrels per day in February and five hundred thirty thousand barrels per day in January. Canadian refiners substituted less-expensive crudes from Algeria, Nigeria, Angola, and Saudi Arabia.[3]

A Platts report adds that Canadian imports from the Bakken dropped eleven thousand barrels per day from one hundred ten thousand barrels per day in February while exports from Texas rose. The decline in Bakken shipments is consistent with a decrease in production.

A third indicator of reduced demand for Bakken came from PBF, the US independent refiner. CEO Tom Nimbley told reporters the company had reduced Bakken purchases in the first quarter and would continue doing so in the second as long as the economics were unfavorable.[4]

Offsetting these comments were reports of increased first-quarter Bakken production by three companies: Continental, Oasis, and Marathon. Taken at face value the reports

[2] "Bakken Prices Tighten to Fill Rail, NTI, *Argus Media*, May 6, 2015.
[3] James Bambino, "Canada Opts for Cheaper Non-US Imports in March," *Platts Global Alert*, May 5, 2014.
[4] "US Crude Discount to Widen: O'Malley," *Argus Media*, April 30, 2015.

suggest production continues to rise. The story changes, though, when examined more closely.

Together the companies account for two hundred sixty-one thousand barrels per day of Bakken production, approximately one quarter of North Dakota's total output. Continental reported a seven-percent increase, Oasis a one-percent increase and Marathon a four-percent increase in production during the first quarter compared to the fourth quarter of 2014, which all sounds good. However, Continental would have reported a nine-percent increase had production continued to rise at rates set in 2014, while Oasis would have reported a four-percent increase and Marathon an eight-percent increase.

Growth was slower, however. Furthermore, the reported growth could all have occurred in January and early February as wells brought into service in late 2014 peaked. March production may well have been down from March of the prior year. The data are obviously available to the companies and could be available to the public if DOE demanded it. DOE has not.

North Dakota, of course, is not the only area to suffer. Citing data from a producer source in Utah, Platts reported Friday that production in Utah's Uinta Basin had fallen from one hundred ten thousand barrels per day in the middle of last summer to eighty thousand barrels per day today.[5] The decrease accelerated in February when a leading exploration company, Newfield, stopped drilling. The Uinta decline rate is twenty-seven percent.

Twenty-seven percent seems like a very large number. Even so, it is more realistic than the national estimate published by EIA. The agency's figure, published in its *Weekly Petroleum Status Report* for the week ending May 1, 2015, was 9.373 million barrels per day. This represents a nine-percent *increase* from mid-summer of last year. The diversion in views is startling.

### An Alternative Measure of Supply

The amount of oil being produced in the United States can be approximated using this simple identity:

$$\Delta stocks \equiv Production - Refinery\ Runs + Imports - Exports$$

where $\Delta stocks$ is the change in crude inventories, *Production* the volume of crude produced, *Refinery Runs* is the volume of crude processed at refineries, *Imports* is the volume of crude imported, and *Exports* is the volume of crude exported. With a simple adjustment, production would be defined as

$$Production \equiv \Delta stocks - Refinery\ Runs + Imports - Exports$$

The EIA publishes most of the elements required. It collects data on crude inputs to refineries, commercial crude inventories, and crude imports. Export data are taken from a Department of Commerce survey and are subject to some uncertainty. Thus the calculation will contain some noise, especially as exports rise.

Presumably oil that is partially processed before being exported will be counted first

[5] David Arno, "Salt Lake Refiners Prepare to Use Out-of-State Crude Slate as Uinta Production Falls," Platts, May 7, 2015.

as an input to a refinery and then as a product export. Crude oil imported from Canada and then exported may be another matter. It would not be surprising to learn that EIA counts the imports but not the exports. Arithmetic has never been the agency's strong suit. Thus any EIA calculation must be treated with some caution.

Figure 1 presents data on production calculated using the identity described above for 2008 through 2015. Also shown is the data series from EIA's *Weekly Petroleum Status Report* for the same period.

For presentation purposes, the calculations used represent a four-week moving average. DOE reportedly uses a four-week moving average as well so the comparison is fair.

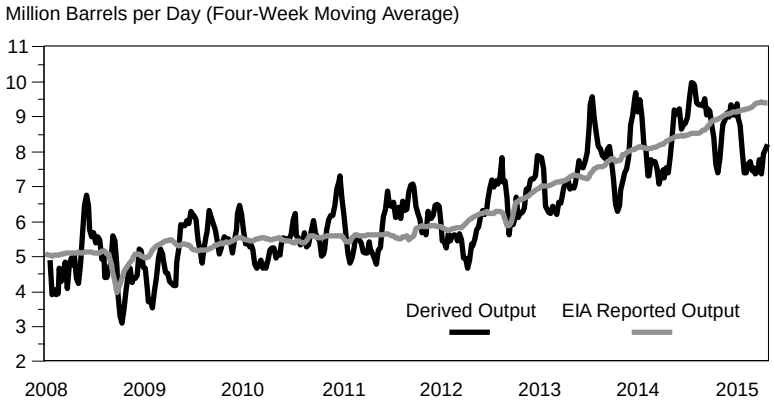
One can note from the graph that the calculated figures fluctuate around the EIA estimates but have a much larger week-to-week change. This could be explained by the day-to-day variance in output that is not captured by DOE. It might also stem from oil held in pipelines or in transit on ships not being counted in the identity. On the whole, though, the volume calculated here tracked the volume reported by EIA through most of the period.

The calculated volume has diverged dramatically of late, though. Through the end of April, it was one million barrels per day less than the number reported by DOE.

The divergence can be quantified using a simple statistical analysis. From 2008 to November 1, 2014, the average error was thirty-one thousand barrels per day. Errors were large, though. The standard error for the period was seven hundred twenty thousand barrels per day.

The divergence increased after November. For the six-month period from November 1, 2014, to April 30, 2015, the average error was nine hundred seventy-four thousand barrels per day. For the three-month period from February 1 to April 30, 2015, the error was 1.694 million barrels per day. Figure 2 (page 6) tracks the error.

**Figure 1**
**US Derived Crude Oil Production Volume* vs. Output Reported by EIA in Weekly Petoleum Status Report**




*Derived from data on US crude stocks, refinery inputs, imports, and exports.
Source: EIA; PKVerleger LLC.

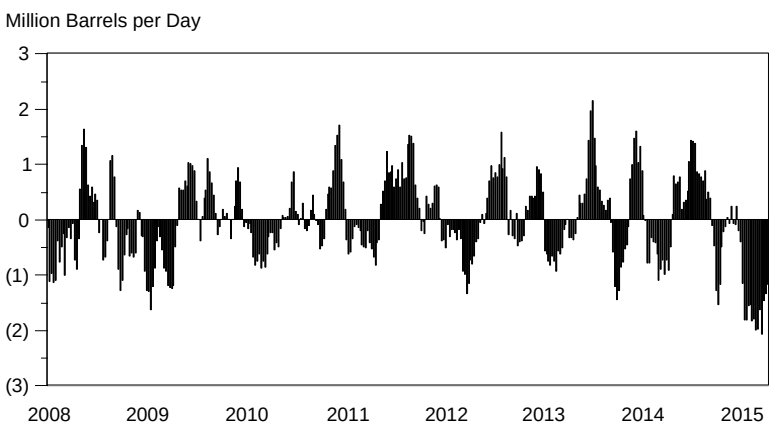
The decline in production explains the strength in prices. PKVerleger LLC has been relying on its "but-for" model to indicate price direction. In recent reports we noted that the model predicted very low prices by the end of 2016 under some supply-and-demand forecasts, particularly if Iranian production increased.

These price simulations were based on forecasts of global supply and demand developed by the IEA, EIA, and other organizations. The projections all accepted EIA's view of continued growth in US production.

Figure 3 shows the price projections produced by the "but-for" model if one corrects the EIA data on petroleum supply using actual data rather than EIA's procedure, which is to present its forecast of production as actual data. The average price for Dated Brent in May is put at $68 per barrel, close to the current level.

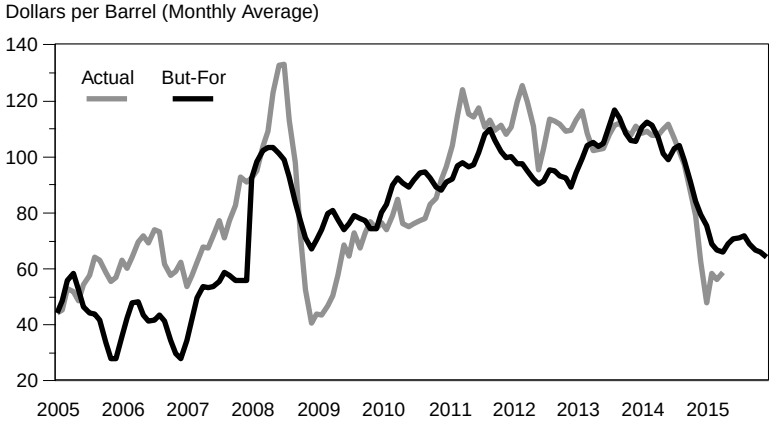
EIA's treatment of its forecast of future production as actual data is an important mistake. The agency's failure to make contemporaneous accuracy checks of the numbers it represents as fact marks an arrogance seldom seen in business or government. The miss of one million barrels per day in US supply represents an error of between twelve and fifteen percent. Some may brush it off. However, imagine the outrage if

**Figure 2**
**Difference between Derived Calculations of US Crude Oil Production and US EIA's Published Estimates of Output**




Source: US EIA; PKVerleger LLC.

**Figure 3**
**Actual Dated Brent Price vs. "But-For" Model Price after Adjusting Non-OPEC Output Projections for EIA's Data Error**




Source: Platts; PKVerleger LLC.

> the Bureau of Economic Analysis explained it had overestimated GDP by ten percent;
>
> the Bureau of Labor Statistics reported it had underestimated the employment rate by five percentage points;
>
> the BLS reported that the real inflation rate was ten percent, not two percent; or
>
> the Census Bureau corrected its estimates of retail sales, admitting that sales

had declined three percent rather than increasing five percent.

Any of these mistakes would have unimaginable consequences for markets. Few governments in the world would risk making such errors. Few governments would risk the consequences of what could be seen as lying. One government that found itself in that circumstance, Greece, is now paying an enormous penalty.

Certainly, the US government does not want to risk issuing false numbers on growth, inflation, unemployment, or retail sales. Investors, bankers, and economists understand the importance of accuracy. Apparently, though, the US government does not believe it needs to offer accurate statistics on energy production. This author spent a month in Yemen of all places years ago as a consultant to the IMF helping that country improve its data. Although Yemen's government had only one old personal computer, its officials were able to get their production figures right. Today their output numbers are far more accurate than those issued by the United States.

Qualified well-trained experts are the key to getting accurate and timely economic information out to the world. Table 2, which list several US agencies, the name of their director, and the director's training, may explain much. Most agencies have well trained experts. EIA, in contrast, is led by a political hack. The current administrator follows a long line of individuals who have earned the position by pleasing the energy industry rather than developing the professional expertise required to produce accurate and timely information. Investors have lost billions in the last three months as a result.

Years ago Eric Zausner, the head of the organization that became EIA, commented that following the 1973 energy crisis the government scrambled to create an energy information service. He added that other agencies shunted over employees they really wanted to be rid of. He complained in a meeting with Alan Greenspan, then chair of the Council of Economic Advisers, that "The Department of Agriculture sent us chicken pluckers when we really needed rocket scientists to understand the issues." Unfortunately, the "chicken pluckers" won out. These individuals were brilliant bureaucrats, adept at feathering their own nests and utterly unqualified to build the systems required to collect accurate information on energy use or production. The evidence suggests these bureaucrats promoted younger bureaucrats equally unqualified as their replacements.

It is interesting to contrast the educational background of the individuals leading the agencies we rely on for accurate economic information with that of the EIA's leader. As Table 2 shows, most administrators have advanced degrees, often PhDs, in relevant fields. Most are very familiar with

Table 2. Name and Academic Background of Directors or Administrators of Principal US Government Economic Agencies

| Agency | Director/Administrator | Director/Administrator Educational Background |
|---|---|---|
| Bureau of Economic Analysis | Brian Moyer (acting) | PhD, Economics |
| Bureau of Labor Statistics | Erica L. Groshen | PhD, Economics |
| US Census Bureau | John H. Thompson | Masters, Mathematics |
| USDA Economic Research Service | Mary Bohman | PhD, Agricultural Economics |
| Federal Reserve | David Wilcox | PhD, Economics |
| US Energy Information Administration | Adam Sieminski | Masters, Public Administration |

Source: PKVerleger LLC.

problems associated with collecting economic data. The head of the Census Bureau, while not a PhD, has a Masters in math and has worked at Census for many years.

The EIA administrator, in contrast, has a Master's in Public Administration and no background in data collection. Prior to his appointment, he was a Wall Street analyst whose writing blindly accepted as fact the numbers the EIA produces. He also worked with and followed many of the companies that have added to the US oil supply. One would think executives from those firms might have made him aware of the errors in production data. One would also think that some economist at EIA, watching the market's behavior, might have thought to make the very simple calculation presented here. This did not happen. From experience, we know the oil industry wants EIA and other agencies to be passive in collecting data. Innovative thinking, or even thinking at all, is not desired unless it applies to a topic favored by the industry, such as removing barriers to oil exports.

Unfortunately, many of the current administrator's predecessors at EIA also lacked the necessary background to address problems related to data collection. Perhaps the agency's problem is that it is asked to take on two assignments: forecasting and data collection. Forecasting is obviously the more attractive of the two responsibilities. EIA is asked to make short and long-term projections, as well as to assess various policies. Significant resources are devoted to these activities. Data collection seems to be the stepchild.

The other main economic agencies separate analysis and forecasting from the essential job of data collection. The topics listed on the BEA's home page deal with economic data. The reports address issues associated with data such as measuring the value of land. The same is true with BLS. EIA's web pages, on the other hand, are split between data collection and forecasting. Currently, the agency is engaged in an important data collection effort on the size and energy efficiency of commercial buildings. Other items call attention to the agency's forecasts.

EIA is obviously being asked to do too much. Its failure to report correctly the decline in US oil production has enormous consequences. The rise in oil price, for example, has baffled many who believed global stocks were surging. Global stocks would have done so had DOE's numbers been correct. Macroeconomists in the US and across the world have been surprised at the strength in prices. It is even possible that central bank policies have been influenced by the error. This is not a trivial mistake. It should not be brushed off lightly. Action needs to be taken immediately.

EIA's inept approach to data collection, which has now persisted for almost forty years, has obvious consequences for those seeking to invest or speculate in the oil or other energy sectors. The published data cannot be accepted at face value. Those planning to use it need to perform careful tests to confirm the claims. It is a sad observation that war-torn Yemen produces higher quality data than the US Energy Information Administration.[6]

[6] Years ago I traveled to Yemen as part of an IMF team assigned to help the country better the quality of its production data to boost tax revenues. Until recently Yemen had a very good system despite the tensions in the country.

## Market Data

The current market data, derived entirely from the three major futures exchanges, reveal a balanced market, one in which supplies are adequate. These numbers certainly do not reflect the widely discussed glut. Returns to storage for crude and products, for example, are well below the highs recorded at this time in 2009 when global supplies really did exceed demand. The tables at the end of the report tell the story.

> Today, the return on August WTI is 0.9 percent. Six years ago it was forty percent.
>
> Today the return on September Brent is 12.8 percent. Six years ago it was twenty-seven percent.

Returns that incorporate the cost of storage for crude indicate it generally does not pay to play the cash-and-carry game. Tables 3 and 4 (page 11) show the calculation PKVerleger LLC has been offering for the last several months. Table 3 shows returns by contract for oil stored under various financial terms. For Brent we show returns to storage without storage costs and after deducting $1.50 per barrel per month for storage at sea. The numbers make clear there is no profit in holding oil if one must charter a tanker.

The absence of an incentive to store at sea has kept shipping rates down. Share prices of tanker companies have remained very low consequently.

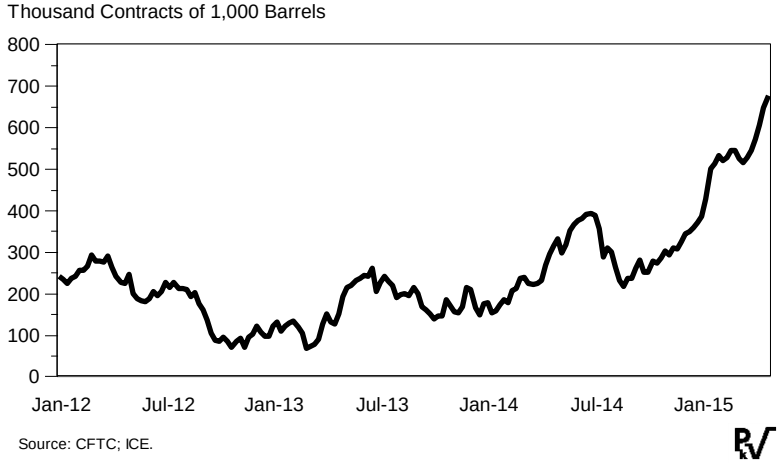
Table 3 also shows returns to storage for WTI after accounting for a $0.50 per barrel per month storage cost and the cost of financing the crude purchases. In these cases also, the incentive to store has vanished.

Table 4 traces returns to storage, including storage costs, from March 2, 2015, to last Friday for WTI and Brent. In no instance does one see the rise in returns that would be associated with the inventory build forecasters keep predicting.

These data seem to confirm our conclusion that the supply-and-demand data are wrong. Unless the companies and individuals buying and selling oil are collectively delusional (an impossibility), there is no glut. It is the individuals at EIA who are deluded and they have misled the rest of the world.

Financial markets, however, are providing a strong stimulus for US producers to hedge. Merchants have continued to add to their short positons, as Figure 4 shows. In past reports, we have indicated that the short is divided between producer hedges of future production and trader hedges of stored

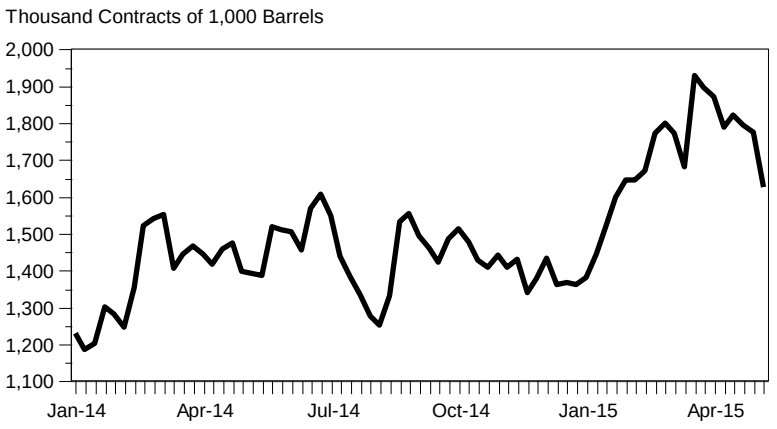
**Figure 4**
**Merchant Short Positions in Crude Oil Futures and Options Equivalents, 2012 to 2015**



oil. The latter should be declining. Apparently producers are hedging more.

Further evidence of a shift to hedging production from hedging stocks can be observed in the decline in open interest in contracts expiring in less than three months (see Figure 5). Open interest in the first three contracts on ICE, IPE, and CME rose from 1.4 million to 1.9 million contracts between January and the end of March. It has since decreased to 1.6 million contracts as speculators and investors exited. During the same period, total open interest fell slightly from 4.2 to 4.1 million contracts. Obviously open interest in contracts expiring in more than three months rose by two hundred thousand contracts. Some of that increase resulted from producer hedging.

**Figure 5**
**Open Interest in the First Three Crude Oil Futures Contracts, January 2014 to My 2015**




Source: NYMEX/CME; IPE; ICE.

The conclusion from good hard data then is that the market is well supplied but that no glut is developing. Additionally, producers have seized on the rise in prices to hedge additional oil. This oil will be produced in the next six months.

Given this analysis, one must wonder whether these volumes will be recorded by EIA.

Table 3. Returns to Storage on May 8, 2015, for Brent and WTI Adjusted for Storage Cost and Returns for WTI Purchases Financed at 2.5% or 5% Interest (Percent at Annual Rates)

| Contract | Brent No Storage Cost | Brent Stored at Sea for Cost of $1.50/bbl/month | WTI No Storage Cost | WTI Stored for Cost of $0.50/bbl/month w/o Financing | WTI Stored for Cost of $0.50/bbl/month; 80% Financing at 2.5% | WTI Stored for Cost of $0.50/bbl/month; 80% Financing at 5% |
|---|---|---|---|---|---|---|
| June 2015 | 19.4 | 19.4 | 0.1 | 0.1 | 0.1 | 0.1 |
| July 2015 | 17.3 | 4.7 | 7.7 | 3.6 | 3.6 | 2.8 |
| August 2015 | 13.7 | (1.8) | 8.1 | 2.3 | 2.3 | 1.2 |
| September 2015 | 12.8 | (5.2) | 7.7 | 1.0 | 1.0 | (0.3) |
| October 2015 | 12.1 | (7.6) | 7.6 | 0.2 | 0.2 | (1.2) |
| November 2015 | 11.5 | (9.3) | 7.5 | (0.2) | (0.2) | (1.7) |
| December 2015 | 10.9 | (10.8) | 7.4 | (0.6) | (0.6) | (2.2) |
| January 2016 | 10.3 | (12.0) | 7.3 | (1.0) | (1.0) | (2.6) |
| February 2016 | 9.8 | (13.1) | 6.9 | (1.5) | (1.5) | (3.1) |
| March 2016 | 9.3 | (14.2) | 6.6 | (1.9) | (1.9) | (3.6) |
| April 2016 | 8.9 | (15.0) | 6.3 | (2.4) | (2.4) | (4.1) |
| May 2016 | 8.5 | (15.8) | 6.1 | (2.7) | (2.7) | (4.5) |

Source: PKVerleger LLC.

Table 4. Brent and WTI Returns to Storage including Storage Costs of $1.50 per Barrel per Month for Brent and $0.50 per Barrel per Month for WTI, March 2 to May 11, 2015 (Percent at Annual Rates)

| Contract | 3/02 | 3/09 | 3/16 | 3/23 | 3/30 | 4/04 | 4/13 | 4/20 | 4/27 | 5/04 | 5/11 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| WTI | | | | | | | | | | | |
| Second | 8.6 | 12.6 | 17.1 | (14.3) | 17.9 | 5.5 | 2.0 | 8.8 | 17.9 | 4.0 | 3.6 |
| Third | 11.5 | 16.0 | 23.0 | 0.2 | 22.5 | 8.5 | 5.9 | 10.4 | 15.6 | 3.9 | 2.3 |
| Fourth | 13.5 | 16.7 | 23.6 | 6.8 | 23.0 | 8.6 | 5.8 | 8.7 | 12.9 | 3.1 | 1.0 |
| Fifth | 14.9 | 16.6 | 22.7 | 9.3 | 22.2 | 8.0 | 5.3 | 6.6 | 10.8 | 2.4 | 0.2 |
| Sixth | 15.2 | 15.7 | 20.9 | 9.7 | 21.4 | 7.5 | 4.6 | 5.0 | 9.2 | 1.9 | (0.2) |
| Seventh | 14.6 | 14.2 | 19.0 | 9.3 | 20.5 | 6.9 | 4.1 | 3.9 | 7.9 | 1.5 | (0.6) |
| Eighth | 13.3 | 12.8 | 17.4 | 8.7 | 19.8 | 6.5 | 3.7 | 3.2 | 6.7 | 0.9 | (1.0) |
| Ninth | 12.1 | 11.6 | 16.0 | 8.2 | 18.9 | 5.9 | 3.2 | 2.3 | 5.6 | 0.2 | (1.5) |
| Tenth | 8.7 | 8.1 | 11.9 | 5.1 | 18.0 | 5.3 | 2.7 | 1.5 | 4.6 | (0.5) | (1.9) |
| Eleventh | 7.9 | 7.3 | 10.8 | 4.7 | 17.2 | 4.8 | 2.2 | 0.8 | 3.7 | (1.0) | (2.4) |
| Twelfth | 8.1 | 7.5 | 10.9 | 5.3 | 16.5 | 4.3 | 1.8 | 0.2 | 2.9 | (1.6) | (2.7) |
| Brent | | | | | | | | | | | |
| Second | (2.6) | (6.3) | (8.7) | 7.8 | (6.5) | 3.4 | 3.4 | 16.3 | 10.8 | 9.5 | 4.7 |
| Third | (5.4) | (8.4) | (10.2) | 2.2 | (8.7) | (1.6) | (1.6) | 5.9 | 3.0 | 1.6 | (1.8) |
| Fourth | (6.8) | (9.4) | (10.7) | (1.1) | (9.4) | (4.0) | (4.0) | 0.4 | (1.1) | (2.4) | (5.2) |
| Fifth | (7.6) | (9.8) | (10.7) | (3.3) | (10.4) | (5.8) | (5.8) | (3.1) | (4.1) | (5.3) | (7.6) |
| Sixth | (8.7) | (10.6) | (11.3) | (5.2) | (11.4) | (7.4) | (7.4) | (5.7) | (6.2) | (7.4) | (9.3) |
| Seventh | (9.8) | (11.4) | (12.1) | (6.8) | (12.3) | (8.6) | (8.6) | (7.7) | (8.0) | (9.1) | (10.8) |
| Eighth | (10.6) | (12.3) | (12.8) | (8.2) | (13.3) | (9.9) | (9.9) | (9.3) | (9.5) | (10.5) | (12.0) |
| Ninth | (11.5) | (13.1) | (13.6) | (9.4) | (14.1) | (11.1) | (11.1) | (10.7) | (10.8) | (11.8) | (13.1) |
| Tenth | (12.3) | (14.0) | (14.5) | (13.5) | (17.7) | (15.1) | (15.1) | (11.9) | (12.1) | (13.0) | (14.2) |
| Eleventh | (13.0) | (14.7) | (15.2) | (14.4) | (18.3) | (15.9) | (15.9) | (13.1) | (13.0) | (14.0) | (15.0) |
| Twelfth | (13.8) | (15.5) | (15.9) | (12.5) | (16.3) | (13.9) | (13.9) | (14.0) | (14.0) | (14.9) | (15.8) |

Source: PKVerleger LLC.

## Appendix: EIA's Explanation of How It Produces the Data Shown for US Oil Production

### Data Obtained Through Models[7]
### Domestic Crude Oil Production (Tables 1 and 9)

EIA estimates weekly domestic crude oil production using a combination of short-term forecasts and the latest available production estimates from Alaska. The four data elements contributing to the estimate are

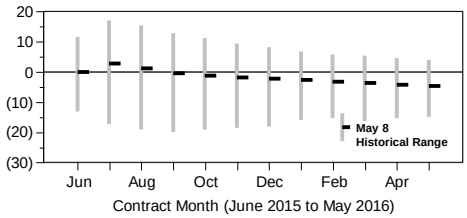
- the most recent Short-Term Energy Outlook (STEO) model estimate (including interim estimates) for average daily production for the lower 48 States and the Federal Gulf of Mexico (GOM) (STEO Table 4a: http://www.eiagov/forecasts/steo/data.cfm?type=tables);
- daily production volumes delivered from the North Slope of Alaska to the Trans-Alaska Pipeline System (TAPS) (reported to EIA by the Alyeska Pipeline Service Company);
- daily volumes of natural gas plant liquids produced on the North Slope delivered to TAPS (reported to EIA by BP); and
- daily production for South Alaska estimated from monthly production reports (lagged by two months) from the Alaska Oil and Gas Conservation Commission (AOGCC).

Most of the uncertainty in the weekly estimate is associated with the STEO forecast for lower 48 and GOM production.

[7] EIA, *Weekly Petroleum Status Report*, May 1, 2015 (http://goo.gl/5NFGIk), p. 38.

**Returns to Storage for WTI —
May 8 Returns vs. Historical Range**

Percent at Annual Rates

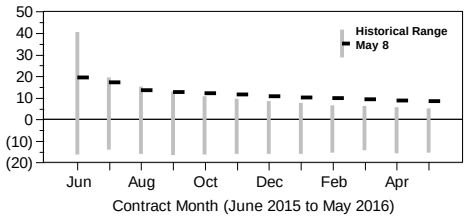



Contract Month (June 2015 to May 2016)

**Note: Returns adjusted for the cost of money.**
**Source: PKVerleger LLC.**

**Returns to Storage for Brent —
May 8 Returns vs. Historical Range**

Percent at Annual Rates

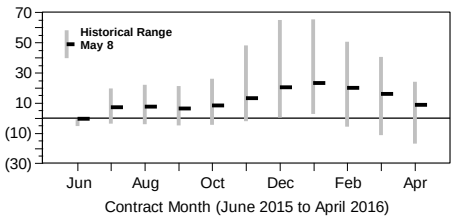



Contract Month (June 2015 to May 2016)

**Note: Returns adjusted for the cost of money.**
**Source: PKVerleger LLC.**

**Returns to Storage for Natural Gas —
May 8 Returns vs. Historical Range**

Percent at Annual Rates

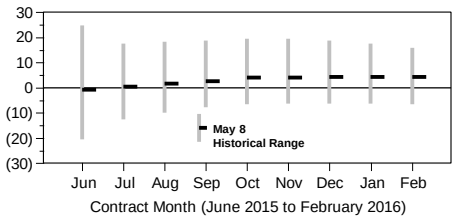



Contract Month (June 2015 to April 2016)

**Note: Returns adjusted for the cost of money.**
**Source: PKVerleger LLC.**

**Returns to Storage for Gasoil —
May 8 Returns vs. Historical Range**

Percent at Annual Rates

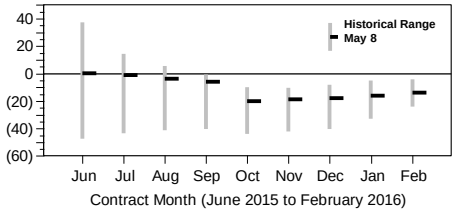



Contract Month (June 2015 to February 2016)

**Note: Returns adjusted for the cost of money.**
**Source: PKVerleger LLC.**

**Returns to Storage for Gasoline —
May 8 Returns vs. Historical Range**

Percent at Annual Rates

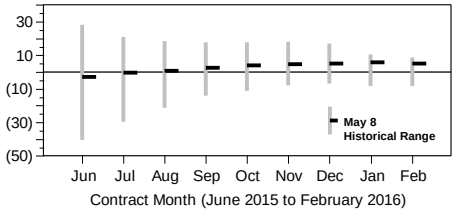



Contract Month (June 2015 to February 2016)

**Note: Returns adjusted for the cost of money.**
**Source: PKVerleger LLC.**

**Returns to Storage for Heating Oil —
May 8 Returns vs. Historical Range**

Percent at Annual Rates

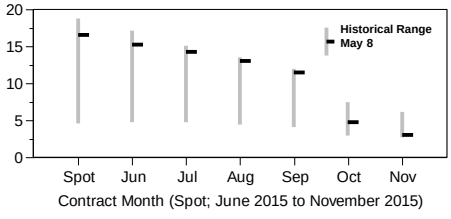



Contract Month (June 2015 to February 2016)

**Note: Returns adjusted for the cost of money.**
**Source: PKVerleger LLC.**

**Refining Margins for Gasoline —
May 8 Margins vs. Historical Range**

Dollars per Barrel

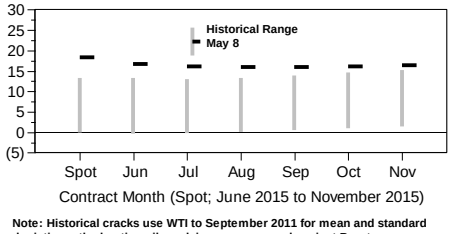



Contract Month (Spot; June 2015 to November 2015)

**Note: Historical cracks use WTI to September 2010 for mean and standard deviations; the gasoline crack is now measured against Brent and corrected for the cost of RINs.**
Source: PKVerleger LLC.

**Refining Margins for Heating Oil —
May 8 Margins vs. Historical Range**

Dollars per Barrel




Contract Month (Spot; June 2015 to November 2015)

**Note: Historical cracks use WTI to September 2011 for mean and standard deviations; the heating oil crack is now measured against Brent.**
Source: PKVerleger LLC.

Table 5. Returns to Storage for Crude, Products, and Natural Gas — Second Week of May vs. Prior Week and Second Week of May in Prior Years (Percentage at Annual Rates)

| | Current | Last Week | 2014 | 2013 | 2012 | 2011 | 2010 |
|---|---|---|---|---|---|---|---|
| Gasoline | | | | | | | |
| July | (1.2) | (4.8) | (4.1) | (2.1) | (26.1) | (21.4) | 5.2 |
| August | (3.7) | (7.0) | (6.6) | (4.8) | (23.6) | (19.5) | 4.9 |
| September | (5.9) | (8.8) | (8.7) | (7.0) | (21.8) | (17.8) | 3.9 |
| October | (19.8) | (21.5) | (18.3) | (16.3) | (27.6) | (24.1) | (6.9) |
| November | (18.8) | (20.3) | (18.1) | (15.5) | (24.4) | (22.5) | (6.0) |
| Distillate | | | | | | | |
| June | (2.9) | (1.9) | 1.9 | (0.3) | 4.2 | 4.8 | (19.5) |
| July | (0.3) | (0.1) | 1.6 | (0.5) | 2.7 | 4.7 | (4.4) |
| August | 0.9 | 1.0 | 1.4 | (0.4) | 2.4 | 4.6 | 1.3 |
| September | 2.5 | 2.2 | 1.3 | (0.3) | 2.4 | 4.9 | 4.4 |
| October | 3.9 | 3.3 | 1.2 | (0.1) | 2.4 | 5.1 | 6.4 |
| Gasoil | | | | | | | |
| June | (0.8) | (0.3) | (4.1) | 3.1 | (8.7) | 5.7 | 12.8 |
| July | 0.6 | 0.5 | (4.2) | 3.8 | (6.9) | 6.2 | 11.4 |
| August | 1.6 | 1.5 | (3.6) | 4.1 | (5.3) | 5.8 | 11.4 |
| September | 2.7 | 2.6 | (3.1) | 3.9 | (4.1) | 5.5 | 11.3 |
| October | 4.0 | 3.8 | (2.8) | 3.7 | (3.5) | 4.9 | 11.1 |
| WTI | | | | | | | |
| June | 0.1 | (1.6) | (0.5) | 0.8 | 2.3 | 2.7 | (0.3) |
| July | 2.8 | 7.8 | (3.5) | 1.8 | 3.2 | 4.2 | 28.4 |
| August | 1.2 | 9.4 | (5.5) | 1.1 | 3.0 | 4.1 | 28.4 |
| September | (0.3) | 9.6 | (6.7) | (0.0) | 3.0 | 4.0 | 25.0 |
| October | (1.2) | 9.5 | (7.5) | (1.0) | 2.9 | 3.7 | 22.3 |
| Brent | | | | | | | |
| June | 19.4 | 25.8 | (2.8) | 2.0 | (3.0) | 3.7 | 28.6 |
| July | 17.3 | 21.3 | (4.3) | 11.4 | (4.0) | (0.4) | 22.4 |
| August | 13.7 | 16.4 | (4.9) | 7.3 | (4.3) | (1.8) | 19.8 |
| September | 12.8 | 14.9 | (5.5) | 4.8 | (4.6) | (2.7) | 17.8 |
| October | 12.1 | 13.7 | (5.6) | 3.3 | (4.9) | (3.1) | 14.2 |
| Natural Gas | | | | | | | |
| July | 7.3 | 8.0 | 1.1 | 8.4 | 20.2 | 10.6 | 17.9 |
| August | 7.5 | 7.9 | 0.2 | 7.8 | 22.1 | 11.1 | 22.3 |
| September | 6.4 | 6.8 | (1.8) | 5.6 | 20.1 | 9.9 | 22.8 |
| October | 8.2 | 8.2 | (1.0) | 5.8 | 24.1 | 10.8 | 26.5 |
| November | 13.1 | 13.2 | 1.0 | 9.1 | 45.8 | 17.4 | 46.5 |

Note: “Current” = May 8, 2015. All returns to storage are adjusted for the cost of money.

Source: PKVerleger LLC.

Table 6. Open Interest for Crude, Products, and Natural Gas — Second Week of May vs. Prior Week and Second May of April in Prior Years (Number of Contracts)

| | Current | Last Week | 2014 | 2013 | 2012 | 2011 | 2010 |
|---|---|---|---|---|---|---|---|
| Gasoline | | | | | | | |
| Total | 392,945 | 374,884 | 329,345 | 294,708 | 311,573 | 282,314 | 298,363 |
| June | 114,611 | 121,915 | 103,914 | 90,216 | 87,319 | 63,324 | 92,115 |
| July | 81,784 | 62,613 | 80,771 | 74,490 | 78,612 | 65,403 | 61,086 |
| August | 34,701 | 34,580 | 38,934 | 29,293 | 31,864 | 27,409 | 34,462 |
| September | 42,600 | 40,763 | 34,070 | 29,643 | 30,875 | 27,869 | 40,426 |
| Distillate | | | | | | | |
| Total | 367,168 | 356,074 | 270,819 | 314,392 | 303,369 | 311,202 | 308,196 |
| June | 90,431 | 104,878 | 75,244 | 85,570 | 78,535 | 75,680 | 86,310 |
| July | 67,585 | 54,105 | 48,682 | 68,315 | 57,823 | 68,015 | 46,275 |
| August | 37,067 | 32,184 | 22,807 | 26,758 | 34,419 | 32,780 | 27,826 |
| September | 32,853 | 32,617 | 19,709 | 27,834 | 30,556 | 24,438 | 23,921 |
| Gasoil | | | | | | | |
| Total | 663,754 | 660,478 | 461,606 | 678,391 | 545,771 | 554,498 | 548,537 |
| June | 169,439 | 154,302 | 125,261 | 181,593 | 116,667 | 144,436 | 117,479 |
| July | 82,317 | 64,096 | 75,994 | 107,925 | 62,783 | 78,828 | 56,652 |
| August | 50,417 | 42,635 | 40,911 | 64,895 | 45,605 | 47,068 | 32,767 |
| September | 40,218 | 35,731 | 43,631 | 58,904 | 43,999 | 49,896 | 35,106 |
| WTI | | | | | | | |
| Total | 1,756,104 | 1,740,231 | 1,637,593 | 1,760,105 | 1,556,759 | 1,663,495 | 1,483,173 |
| June | 317,625 | 425,000 | 242,193 | 197,766 | 179,467 | 208,145 | 331,817 |
| July | 305,318 | 238,406 | 223,352 | 253,446 | 249,394 | 356,216 | 233,630 |
| August | 95,648 | 79,565 | 127,613 | 125,922 | 103,464 | 93,729 | 97,524 |
| September | 158,187 | 150,250 | 114,826 | 121,598 | 79,095 | 88,411 | 94,271 |
| Brent | | | | | | | |
| Total | 1,911,467 | 1,986,992 | 1,557,660 | 1,587,103 | 1,299,831 | 909,154 | 762,091 |
| June | 212,006 | 359,672 | 160,065 | 143,169 | 157,550 | 71,464 | 147,922 |
| July | 359,046 | 349,959 | 285,613 | 260,264 | 252,690 | 218,800 | 179,058 |
| August | 171,215 | 141,726 | 192,417 | 172,714 | 153,650 | 137,156 | 77,503 |
| September | 188,061 | 175,523 | 138,060 | 106,842 | 103,288 | 66,762 | 52,506 |
| Natural Gas | | | | | | | |
| Total | 1,008,269 | 1,036,461 | 1,051,964 | 1,525,641 | 1,233,033 | 965,552 | 865,469 |
| May | 11,574 | 11,652 | 27,495 | 22,941 | 14,276 | 10,773 | 20,584 |
| June | 167,908 | 221,885 | 133,714 | 171,356 | 166,161 | 101,072 | 159,701 |
| July | 202,739 | 189,336 | 188,095 | 247,418 | 222,270 | 207,345 | 158,660 |
| August | 57,723 | 55,593 | 66,791 | 71,284 | 103,677 | 76,439 | 63,339 |

Note: “Current” = May 8, 2015.

Source: PKVerleger LLC.

Table 7. Gasoline Cracks – Second Week of May vs. Prior Week, Prior Month, and Second Week of May in Prior Years ($/bbl)

| | Current | Last Week | Last Month | 2014 | 2013 | 2012 | 2011 | 2010 | 23-Year Average |
|---|---|---|---|---|---|---|---|---|---|
| Spot | 16.60 | 18.79 | 16.24 | 11.77 | 15.46 | 16.70 | 18.68 | 13.63 | 11.97 |
| June | 15.30 | 16.46 | 15.28 | 12.03 | 13.02 | 13.77 | 15.29 | 14.14 | 11.23 |
| July | 14.30 | 15.01 | 14.19 | 11.89 | 12.70 | 11.42 | 13.40 | 11.15 | 10.15 |
| August | 13.04 | 13.49 | 13.12 | 11.21 | 11.88 | 9.81 | 12.15 | 9.77 | 9.25 |
| September | 11.53 | 11.84 | 11.79 | 10.29 | 10.77 | 8.52 | 11.27 | 8.87 | 8.25 |
| October | 4.82 | 5.00 | 10.24 | 4.47 | 5.30 | 3.11 | 5.74 | 4.17 | 5.24 |
| November | 3.09 | 3.18 | 3.81 | 3.19 | 4.47 | 2.14 | 4.75 | 3.47 | 4.43 |
| Average | 11.24 | 11.97 | 12.10 | 9.26 | 10.51 | 9.35 | 11.61 | 9.32 | 8.64 |

Note: "Current" = May 8, 2015. Gasoline cracks measured against Brent from 2010 with RIN cost removed.

Source: PKVerleger LLC.

Table 8. Heating Oil Cracks – Second Week of May vs. Prior Week, Prior Month, and Second Week of May in Prior Years ($/bbl)

| | Current | Last Week | Last Month | 2014 | 2013 | 2012 | 2011 | 2010 | 23-Year Average |
|---|---|---|---|---|---|---|---|---|---|
| Spot | 18.32 | 19.08 | 17.22 | 11.08 | 20.85 | 11.37 | 9.71 | 13.67 | 7.09 |
| June | 16.67 | 16.79 | 16.31 | 14.20 | 18.15 | 12.21 | 11.93 | 12.23 | 7.10 |
| July | 16.17 | 16.27 | 15.43 | 14.59 | 18.07 | 12.88 | 10.29 | 9.68 | 6.95 |
| August | 15.92 | 16.00 | 15.09 | 15.07 | 18.42 | 13.57 | 11.26 | 8.96 | 7.26 |
| September | 15.96 | 16.00 | 15.01 | 15.74 | 18.95 | 14.36 | 12.25 | 9.07 | 7.77 |
| October | 16.20 | 16.16 | 15.17 | 16.32 | 19.51 | 15.20 | 13.34 | 9.42 | 8.34 |
| November | 16.42 | 16.30 | 15.35 | 16.74 | 19.93 | 15.86 | 14.34 | 9.98 | 8.87 |
| Average | 16.52 | 16.66 | 15.65 | 14.82 | 19.13 | 13.64 | 11.88 | 10.43 | 7.62 |

Note: "Current" = May 8, 2015. Heating oil cracks measured against Brent from 2011.

Source: PKVerleger LLC.