
MUSINGS FROM THE OIL PATCH

December 16, 2014

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Note: *Musings from the Oil Patch* reflects an eclectic collection of stories and analyses dealing with issues and developments within the energy industry that I feel have potentially significant implications for executives operating and planning for the future. The newsletter is published every two weeks, but periodically events and travel may alter that schedule. As always, I welcome your comments and observations. Allen Brooks

Debate Grows Over Illusion of 100-Year Gas Supply Scenario

Our lead article questioned whether the liquefied natural gas (LNG) export market in the United States might be derailed almost before it gets underway

In our November 18th issue of the *Musings*, our lead article questioned whether the liquefied natural gas (LNG) export market in the United States might be derailed almost before it gets underway due to there being less natural gas supply around, especially at low prices, than commonly assumed. Our article was based on a presentation given in Houston a few weeks prior by Dr. Scott Tinker, a professor of geology at the Jackson School of Geology, at the University of Texas at Austin and the director of the Texas Bureau of Economic Geology (BEG), which is leading an assessment of shale oil and gas plays across the country. We had attended the breakfast meeting where Dr. Tinker made his presentation, during which he showed a slide comparing the BEG's assessment of future natural gas output utilizing the Energy Information Administration's (EIA) gas price forecast to the EIA's gas production forecast and a very optimistic production outlook from the Rice University world gas model.

The resulting picture showed the BEG forecast being less than that of the EIA

The BEG forecast was prepared by examining all the producing wells in each of the four major natural gas shale plays and developing a model to forecast the number of additional wells that could be drilled and the incremental reserves and associated production those wells would deliver. The resulting picture showed the BEG forecast being less than that of the EIA and substantially below the optimistic forecast of Rice University. (See Exhibit 1, next page.)

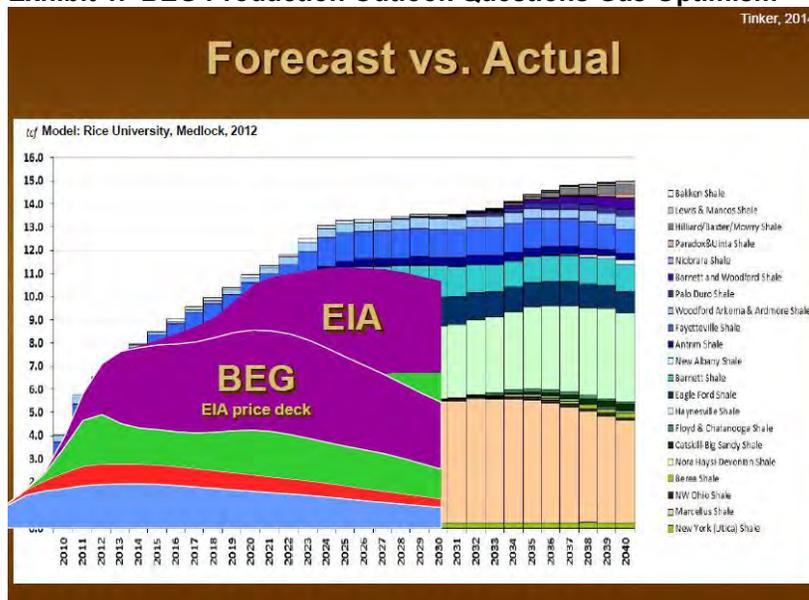
Natural gas prices will need to rise substantially

By implication, the BEG forecast suggests that either the other two projections are based on unrealistic reserve and/or well productivity assumptions, or natural gas prices will need to rise substantially higher than currently forecast in order to elicit the supply/drilling response required from the exploration and production companies if

Could be a serious problem for our nescient LNG export business

those optimistic projections are to be attained. In either case, there will be an impact on the availability and/or cost of natural gas in the United States. That could be a serious problem for our nescient LNG export business that is counting on a voluminous supply of natural gas at very low prices in order to capture the arbitrage that currently exists between high-priced LNG in Asian and European markets and low-priced natural gas in the United States.

Exhibit 1. BEG Production Outlook Questions Gas Optimism



Source: BEG

Possibly politics had entered into the equation because the more optimistic production forecasts support the claims that the U.S. can not only satisfy growing domestic gas supply needs but also can become a leading LNG exporter

The interesting aspect of Dr. Tinker's presentation, as we duly commented on in our article, was that when it was posted on the web site of the company hosting the meeting, all the data Dr. Tinker presented regarding the BEG's recent, yet unpublished assessment of the Marcellus/Utica formation and the slide comparing the BEG forecast to the EIA's and Rice University's forecasts was absent. He had told the meeting sponsors that he needed to do a final edit of the presentation before he could provide them with the final slides for posting online. We spent considerable time investigating why the final edit cut such important information, especially since it had been shown to the breakfast audience. We also began an effort to find the missing, or similar, slides from other presentations made by Dr. Tinker. We were fairly successful in the latter effort, but we could never answer the question about why the slides were deleted from the posted presentation as we found similar ones from some of his other recent presentations. We speculated at that time that quite possibly politics had entered into the equation because the more optimistic production forecasts support the claims that the U.S. can not only satisfy growing domestic gas supply needs but also can become a leading LNG exporter. Both goals can be attained while at the same time not significantly increasing natural gas prices in the

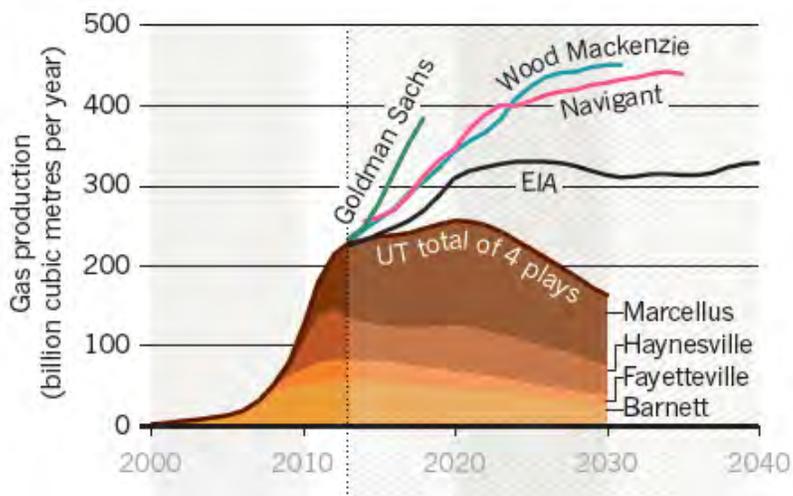
“The United States is banking on decades of abundant natural gas to power its economic resurgence. That may be wishful thinking.”

future. The implications of the BEG forecast would certainly undercut those optimistic projections.

The mystery of why the Marcellus and the overall gas market assessment slides were eliminated from the posted presentation may have been answered. The December 4th edition of the magazine *Nature* contains an article by freelance writer Mason Inman entitled, “The Fracking Fallacy.” The article’s byline says: “The United States is banking on decades of abundant natural gas to power its economic resurgence. That may be wishful thinking.”

Mr. Inman focuses on the differences between the BEG and EIA gas production forecasts and how much industry activity is being based on the optimistic assumption that the U.S. has a huge, and potentially growing, volume of cheap natural gas. This view is uniformly accepted by influential energy consulting and investment firms as demonstrated by one chart that accompanied the article (Exhibit 2). What stands out from this chart is that at the time the BEG forecast calls for a peak in gas output (about 2020) essentially all the other forecasts show output continuing to grow.

Exhibit 2. BEG Has Most Conservative Outlook For Shale Gas



Source: *Nature*

A crucial difference is the granularity underlying the analyses

In the article, the point is made that both the EIA and BEG studies employ similar methodologies – assess the well production and reservoir dynamics of each shale basin, estimate the number of additional wells that would be drilled and their future production and model all the wells’ decline rates. However, there are some critically different assumptions that may help explain the discrepancy in outcomes. A crucial difference is the granularity underlying the analyses. The BEG study analyzes the wells and geology within one square mile blocks. In contrast, the EIA separates its shale play analysis into a county by county examination, which in some states can be up to 20 times larger in areal extent than BEG’s preferred

Although shale formations blanket large areas, the quality of shale may differ significantly over the entire area

study area. Why is this difference important? One lesson learned from the short history of the shale revolution is that although shale formations blanket large areas, the quality of shale may differ significantly over the entire area. This is why we now understand that shales have “sweet spots” that yield significantly greater production than other surrounding areas. As a result, wells within the sweet spot have much greater outcomes than those located outside. If producers have followed a traditional exploration plan then they have likely drilled and produced their best acreage first, meaning that future wells will likely not to be as productive as the earlier ones in the basin.

The EIA assumes that all future wells drilled in a shale formation will be equally as productive as the most recent wells drilled

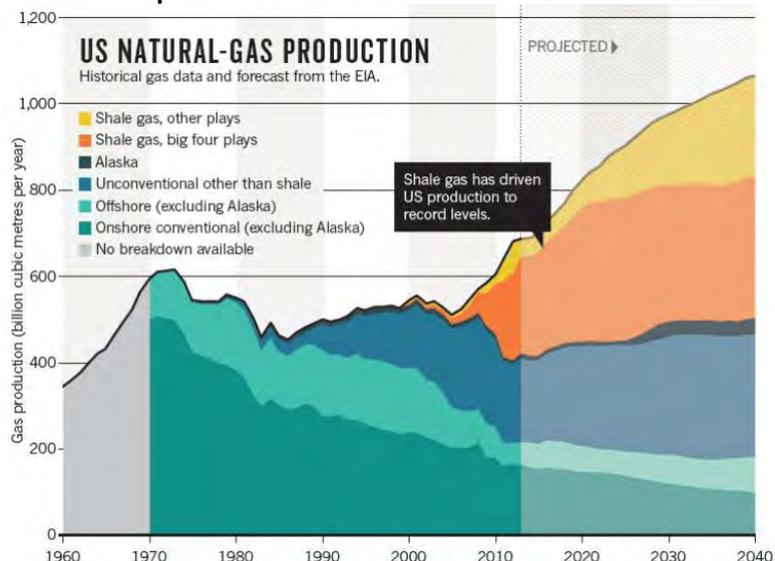
The BEG analysis embraces this understanding, which means that as it developed its production model, future wells were assumed to not be as productive as the earlier wells despite technological improvements in drilling and completing them. This is a significant difference as the EIA assumes that all future wells drilled in a shale formation will be equally as productive as the most recent wells drilled. Another important difference between BEG and the EIA is that the latter forecasts the number of its future wells irrespective of the topography of the area. That means they will be counting on future wells being drilled under lakes and cities, while the BEG study looks at the topography and adjusts its well forecasts for the physical realities of the area. These differences in approach caused one of the co-directors of the BEG study to suggest that the EIA’s model leads to a more optimistic conclusion, which might explain why the BEG study projects less gas output.

Dr. Patzek believes that actual production could be lower than the BEG’s forecast, meaning that production will peak sooner than expected with a steep decline on the other side

Even within the BEG group of scientists who conducted the study there are differences as pointed out by Mr. Inman. In interviewing the two leaders of the BEG study – Dr. Tinker and Dr. Ted Patzek, head of the University of Texas at Austin’s department of petroleum engineering and geosystems engineering - he uncovered this difference. Dr. Tinker believes the BEG team’s estimates are “conservative” and that actual production could be higher than projected. He believes, as he has said at the two conferences we have seen him present, that the industry’s shale gas success is providing the nation and the planet with the time necessary to allow a transition to the next primary energy source to power the world, whatever that source may be. In contrast, as quoted in the *Nature* article, Dr. Patzek believes that actual production could be lower than the BEG’s forecast, meaning that production will peak sooner than expected with a steep decline on the other side. When that decline begins, Dr. Patzek says, “that’s when there’s going to be a rude awakening for the United States.”

The essence of Dr. Patzek’s concern is what was behind our reaction to Dr. Tinker’s slide shown during his presentation at Decision Strategies’ Oilfield Breakfast Forum. Unless he believes that actual production will not only exceed the BEG forecast but also outdo that of the EIA, then this nation will experience much higher

Exhibit 3. Optimistic Gas Outlook Built On Shale Success



Source: EIA, Nature

We are less concerned about high gas prices derailing the petrochemical industry expansion in this country

natural gas prices than currently being forecast by the industry and consultant optimists. It is why we raised the question about the viability of the billions of dollars planned to be invested in new LNG export terminals. We are less concerned about high gas prices derailing the petrochemical industry expansion in this country because the health and growth of the U.S. economy should be able to absorb those raw material price increases for the outputs from these new plants. Remember that most of the new plants are expansions to existing facilities so companies are adding new, more efficient capacity to their already depreciated plants resulting in financial returns that may be reduced only marginally by higher gas prices. In other words, bet on growth.

2014 Atlantic Hurricane Season Was Least Active In 30 Years

It was so quiet that no newsperson was able to bolster his or her career by standing out in the wind and rain of an approaching storm

The 2014 Atlantic hurricane season officially ended on November 30; most people missed it as the season was so quiet this year. In fact, it was so quiet that no newsperson was able to bolster his or her career by standing out in the wind and rain of an approaching storm as CBS television’s Dan Rather, then a young unknown reporter working for the local Houston CBS affiliate KHOU-TV, did in 1961 as he reported from the Galveston weather bureau on the impending arrival of Hurricane Carla, one of the largest and strongest storms to hit the Texas Gulf Coast. That coverage, along with Mr. Rather’s ability to use the television medium to educate and fascinate the American public about hurricanes, led to his hiring as a national reporter for the network that ultimately led to his rise to replace iconic Walter Cronkite as the nightly news anchor and hosting the news show *Sixty Minutes*.

The season ended with the fewest named storms in 17 years

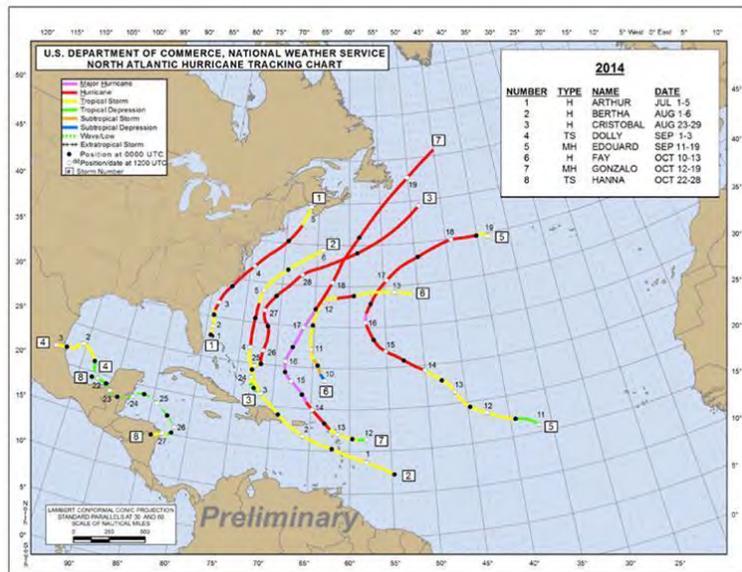
The last major storm to hit the U.S. coast was Hurricane Wilma in October of 2005

The lack of storms was not a total surprise as virtually every forecaster anticipated the season to be a relatively inactive, based on the typical storm signals and precursors. The season ended with the fewest named storms in 17 years. On average, based on the record of 1981-2010, the Atlantic basin experiences 12 named tropical storms with 6-7 of them becoming hurricanes and two that reach major hurricane status. This year, the basin experienced only eight named storms, although six became hurricanes and two were major, but they were all in the Atlantic. Only one storm brushed the Outer Banks of North Carolina before heading out to sea.

This year marked the ninth without a major hurricane making landfall in the U.S. The last major storm to hit the U.S. coast was Hurricane Wilma in October of 2005. Hurricane Arthur, a category 2 storm when it hit the U.S., was the strongest hurricane to make landfall since Hurricane Ike devastated Galveston island and the upper Texas Gulf Coast in September 2008. Amazingly, of the last 25 major hurricanes to develop in the Atlantic basin, none have hit the United States.

Exhibit 4 shows the paths of all eight hurricanes in 2014. The purple color marks the days when the storms were major hurricanes. As shown, only two hurricanes achieved major status with storm 5, Edouard, marking only one day as a major storm, while storm 7, Gonzalo, was a major storm for three days.

Exhibit 4. Most 2014 Hurricane Action Was In Atlantic Ocean



Source: CSU

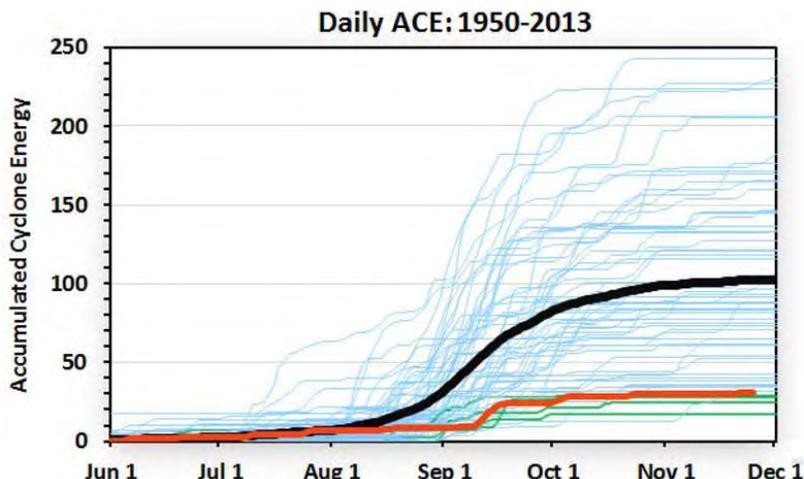
Our favorite hurricane forecasters, the scientific team of Dr. Phil Klotzbach and Dr. William Gray, both of the Department of Atmospheric Science at Colorado State University (CSU), issued

Actual ACE reached 66% with more ACE accrued in October than during August and September combined, something that hasn't happened since 1963

their initial forecast in early April calling for nine named storms, three hurricanes and one major hurricane. The CSU team was also looking for the measure of accumulated cyclone energy (ACE) to reach 55% of an average season, which compares with the long-term ACE average of 92%. Actual ACE reached 66% with more ACE accrued in October than during August and September combined, something that hasn't happened since 1963. We are sure the two scientists were wondering about their forecast when the first three tropical storms of the season all grew into hurricanes, albeit without causing any damage. But from that point forward, the season quieted down.

To appreciate the significance of the low ACE accumulation this year, one only needs to examine the chart in Exhibit 5 showing all the ACE records from 1950 through 2014. The black line on the chart reflects the median ACE value for that period while the red line is 2014's results. The green lines below the red one represent years with less ACE accumulation than experienced in 2014.

Exhibit 5. 2014 Hurricane Season Was Extremely Mild



Source: CSU

While we were sorry to see the island of Bermuda suffer two hurricane strikes, we were pleased that only one relatively minor hurricane made U.S. landfall

For those who are interested, we have presented below the record of the number of named storms, named storm days, hurricanes, hurricane days, major hurricanes and major hurricane days experienced every year since 2003, along with both the CSU team's initial forecast for 2014 and the actual results of this year. As we approach the New Year, we have one wish, which is that the upcoming 2015 season is a repeat of this year's hurricane season. While we were sorry to see the island of Bermuda suffer two hurricane strikes, we were pleased that only one relatively minor hurricane made U.S. landfall. Living in Houston and summering on the Rhode Island coast, we are highly sensitive to hurricane activity and their paths. We understand that the steering conditions for hurricanes in the Atlantic basin are now predicted to take most of the

storms up the Atlantic Coast, a pattern that hasn't existed for many years. Just as the people in the New York-New Jersey metropolitan area were not prepared for the nor'easter Sandy, we worry about all those in the Carolinas and New England who have grown complacent about storm preparation given the long absence of major hurricanes. Hopefully, we will not see the devastating hurricanes we experienced growing up in New England in the 1950s.

Exhibit 6. The Record of Hurricane Activity 2003-2014

Forecast Parameter and 1950-2010 Climatology (in parentheses)	2014	10-Apr 2014F	2013	2012	2011	2010	2009	2008	2007	2006	2005	2004	2003
Named Storms (12)	8	9	10	19	19	19	9	16	15	10	26	14	14
Named Storm Days (60.1)	35	35.0	32.3	99.5	89.8	88.3	30.0	84.8	34.5	50.0	116.0	90.0	71.0
Hurricanes (6.5)	6	3	2	10	7	12	3	8	6	5	14	9	7
Hurricane Days (21.3)	17.25	12.0	3.3	26.0	26.0	37.5	12.0	29.5	11.3	20.0	48.0	46.0	32.0
Intense Hurricanes (2.0)	2	1	0	1	4	5	2	5	2	2	7	6	3
Intense Hurricane Days (3.9)	3.5	2.0	0.0	0.3	4.5	11.0	3.5	8.5	5.8	3.0	16.8	22.0	17.0

Source: CSU, PPHB

Crude Oil: \$58; Next Stop \$40 Or \$100?

The speed of the price collapse caused the dean of Wall Street investment analysts, Laszlo Birinyi, to term it a “black swan”

Were investors merely content to ride the wave of a rising stock market, seemingly entrenched in a never-ending bull market that carried everything higher due to expectations for stellar corporate earnings growth?

As we write this article, the price of West Texas Intermediate (WTI) has fallen below \$60 a barrel; a level few people anticipated would be reached in the current oil price correction. The speed with which oil prices have fallen in recent weeks has shocked virtually everyone from oil company CEOs to stock market strategists; from commodity traders to the average Joe at the gas pump. The speed of the price collapse caused the dean of Wall Street investment analysts, Laszlo Birinyi, to term it a “black swan,” picking up on Nassim Taleb’s famous book about unforeseen financial events, or how these unanticipated events alter not only financial markets but the world in general. But as CNBC’s Joe Kernan, one of the hosts of the channel’s morning show Squawk Box questioned, how can it be a black swan when there actually were people who forecast the price collapse?

There is an expression on Wall Street that you don’t want to try to “catch a falling knife.” The implication is that the outcome will be bloody. In answering the question of whether people should be truly surprised by the collapse in oil prices, or that they just ignored the warning signs of crude’s demise, we are left with trying to understand their investment thinking. Were investors merely content to ride the wave of a rising stock market, seemingly entrenched in a never-ending bull market that carried everything higher due to expectations for stellar corporate earnings growth driven by an improving global economy, especially in the U.S.? Or were investors just hoping to exit energy stocks at the first signs of oil price weakness? The problem with the latter scenario is that energy experts couldn’t explain why oil prices were so high for so long given weak global demand, so why would they expect a sharp decline?

The American shale revolution ushered in the realization that the world was scratching the bottom of the proverbial barrel

Those who questioned the level of global oil prices for most of this year were often told that markets are always focused on the future so don't be concerned about current trends. The world is expanding; there are and will be more people in the world; people's living standards are increasing around the world; existing production is declining rapidly; therefore, energy demand has to grow faster in the future than it has in the recent past. These were the arguments supporting the sustainability of high oil prices.

Don't forget that the American shale revolution ushered in the realization that the world was scratching the bottom of the proverbial barrel. Shale formations are the source rock for oil and gas reserves. The challenges in tapping these hydrocarbon resources are significant: they require mastering the techniques of drilling wells horizontally and then using massive amounts of pressure to break open the shale rock with a mixture of water, sand and chemicals, which allows the hydrocarbon molecules trapped in the shale to be released. The costs of these efforts are high, meaning oil and gas producers need lots of money. Because shale exploitation is so expensive, tapping shale formations requires that oil prices be high and remain so for the foreseeable future if the producers and their investors are going to be rewarded for their work.

OPEC was happy to endorse \$100 a barrel as the "new normal" for oil prices

In recognition of the oil demand outlook and the cost to develop this new and expensive supply source, oil prices rose to the century mark in the early 2000's, and have maintained that level other than during the financial crisis of 2008-2009. This level seemed not to dampen the oil demand growth of the western world, or in those countries where it did, the drop-off was explained away as an anomaly. The member countries of the Organization of Petroleum Exporting Countries (OPEC) were happy to endorse \$100 a barrel as the "new normal" for oil prices – a level supposedly sufficient to allow economies to grow while producing the incremental oil supplies to meet this demand. Why not, they were getting lots of money that allowed them to buy social peace. Everyone was happy!

Any further decrease in supply due to geopolitical events would surely send oil prices higher

For the first half of 2014, oil prices remained at the \$100 a barrel mark. Unrest in the Middle East and North Africa had taken meaningful oil volumes off the market further contributing to the impression that global oil supply/demand was precariously balanced. Any further decrease in supply due to geopolitical events would surely send oil prices higher. Likewise, the acceleration of global growth, regardless of whether it came from the United States, Europe or Asia would send oil prices higher.

By the middle of 2014, oil prices began weakening, but the decline was modest so few people were concerned

The problem was that every geopolitical event this year failed to move the oil price needle. By the middle of 2014, oil prices began weakening, but the decline was modest so few people were concerned. But after Labor Day, oil prices began to fall faster – driven by the fear that supply was growing much faster than markets could absorb it – primarily in the United States. The American shale

Politicians, concerned about this surplus contributing to a slowing of petroleum activity within their states with negative impacts on employment growth and tax revenue generation, began lobbying to overhaul the export ban

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He said oil prices were “heading sharply lower, and the decline would take the price much lower than anyone anticipates.”

revolution had driven domestic oil production to nine million barrels a day - a level not experienced since the early 1970's. Full-throated cheers from oil industry executives, industry consultants and investment analysts about the success of the shale revolution led to claims the U.S. was on the road to self-sufficiency. “Saudi America” became a popular term to describe America's energy future.

The explosion in natural gas output due to rapid growth in gas produced in association with the increasing volume of crude oil began to swamp the domestic market for liquid condensate. This natural gas liquids surplus led to efforts to export this near-oil after minimal treatment under existing federal government rules allowing for “refined” petroleum product exports. The debate about overturning the 40-year ban on exporting domestic crude oil intensified, especially as the petroleum industry began showing how the growing surplus of light oil was overwhelming the nation's refining capacity and leading to this highly-desirable crude oil being discounted in price. Politicians, concerned about this surplus contributing to a slowing of petroleum activity within their states with negative impacts on employment growth and tax revenue generation, began lobbying to overhaul the export ban. As the intensity of the export debate grew, the oil price slide accelerated.

Falling oil prices finally landed on the radar screens of investors in the past 60 days. Investors were shocked that oil prices could fall so fast and so low. Wasn't \$100 a barrel the price everyone had agreed was acceptable for both consumers and producers? Hadn't oil prices been steady at that level for years, except during the financial crisis? As concern about falling oil prices grew, investors and oil analysts became convinced OPEC would act at its Thanksgiving Day meeting in Vienna to reduce supply and end the oil price fall. The odds of this outcome were questioned when Saudi Arabia – the dominant producer within OPEC, and the supplier who traditionally has played the role of market balancer – said it was cutting its oil price for American and Asian customers. Concern morphed into fear when Saudi Arabia said it was willing to live with oil prices between \$70 and \$80 a barrel for up to two years. The flood gates were opened and crude oil futures collapsed. The analyst game of guessing Saudi Arabia's motivation began.

With oil prices in a free-fall after the Thanksgiving Day meeting, we remember Dennis Gartman, a recognized commodity trader (he publishes a well-known commodity newsletter), commenting during a CNBC interview that oil prices were “heading sharply lower, and the decline would take the price much lower than anyone anticipates.” How right he was! His comment, however, begs the question of where oil prices are heading next.

For most of the past month, the oil price narrative has focused on the oversupply of oil, primarily due to the growth in U.S. shale production. Investors and analysts have been convinced that Saudi

Is shale cheap or is it expensive?

Arabia was targeting shutting down U.S. shale producers. We have written in recent *Musings* about the wide range of estimates of the actual cost of shale production – with experts and industry players often suggesting widely different costs for the various oil shale basins. Is shale cheap or is it expensive? Who knows; it seems to depend on where producers are drilling in the formations and how one does the cost calculation.

The true global wildcard is China, where the latest economic data raises serious questions about its underlying growth

In the past week, the oil price commentary on financial broadcasts has shifted from too much supply to the absence of demand. We were heartened to see this shift as it fits with our long-standing argument that the global oil market's problems result from too little demand and too much supply and are not caused by it. Although recent economic statistics suggest the U.S. economy is starting to grow faster, data from most European countries suggests their growth remains anemic and numerous countries are slipping into recessions. Latin and South America appear to be a mixed bag of moderately healthy economies and very sick ones. Despite heroic stimulation efforts by its government, Japan has fallen into recession. But the true global wildcard is China, where the latest economic data raises serious questions about its underlying growth. Concern over China's growth is tied directly to questions about the health of the country's financial system.

Almost all the countries and regions have embarked on easy money policies designed to stimulate economic growth, but the flood of newly created bank deposits is finding its way to the United States

Problems confronting many of these countries are their demographic profile along with social policies that drain income from both citizens and companies. Almost all the countries and regions have embarked on easy money policies designed to stimulate economic growth, but the flood of newly created bank deposits is finding its way to the United States since we have ended our easy money experiment and are preparing to boost interest rates making America the only major financial market where investors can earn positive returns. With foreign money flooding into America, the value of the U.S. dollar is rising, which acts to drive oil prices down.

Exhibit 7. Consumers Big Winners In Crude Oil Price Drop

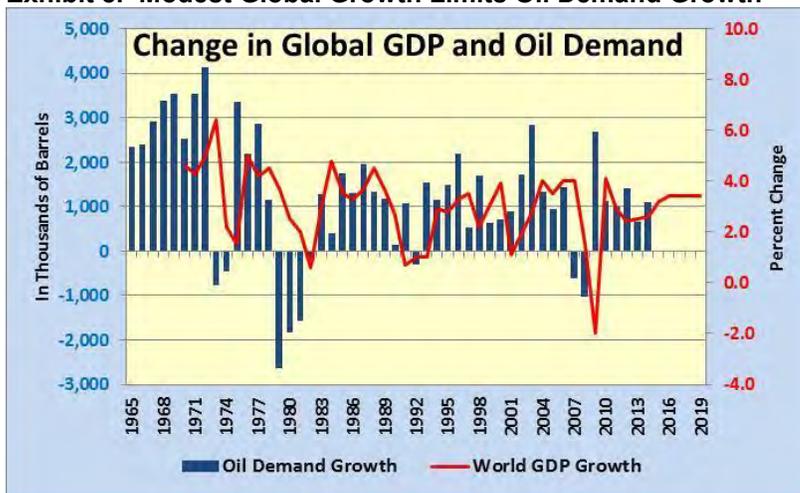


Source: *Globe and Mail*

In the early years (1960's and 1970's) economic growth was generally greater than in later years (1990's and 2000's) and annual oil demand changes mirrored those levels of economic growth

We think it is interesting to examine long-term trends relating oil demand to global economic growth and oil prices. Exhibits 8 and 9 show these relationships. We have used the historical world economic growth data series published by the International Monetary Fund (IMF), which allows us to use the organization's forecasts out to 2019. The point of that chart is to show that in the early years (1960's and 1970's) economic growth was generally greater than in later years (1990's and 2000's) and annual oil demand changes mirrored those levels of economic growth. The economic forecasts through 2019 assume that all the current economic problems are resolved and world economies perform at their maximum capabilities. However, global growth is only projected to be moderate, at best. This means we are likely looking at a continuation of modest global oil demand increases. This is especially true as the new IMF projection for 2015 is lower than the estimate used in the chart, which came from an earlier forecast.

Exhibit 8. Modest Global Growth Limits Oil Demand Growth

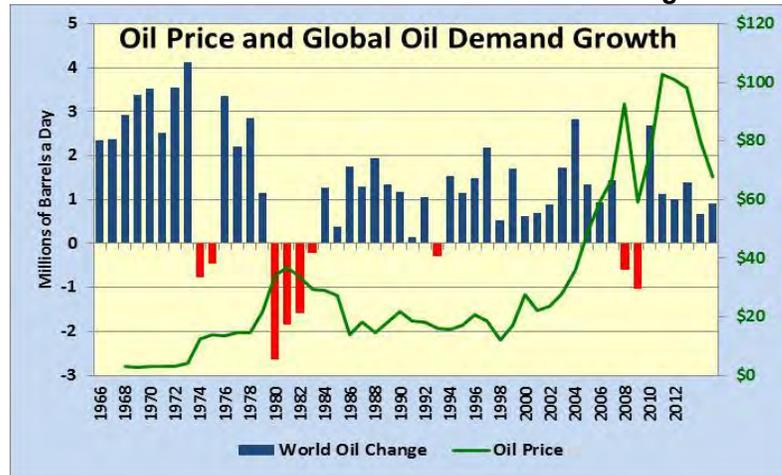


Source: BP, IMF, PPHB

The EIA is now forecasting an average price for world crude oil next year of \$68 a barrel, down from last month's forecast of nearly \$84

The impact of the slowing global economic growth despite the recent fall in oil prices is reflected in the most recent 2015 oil demand and price forecasts of OPEC, the International Energy Agency (IEA) and the Energy Information Administration (EIA). The IEA reduced its demand estimate for the fourth time in the past five months. It cut 2015 demand by 230,000 barrels a day to an increase of 900,000 barrels a day. OPEC cut its demand forecast for both 2014 and 2015, with the latter being reduced by approximately 100,000 barrels a day. The EIA is now forecasting an average price for world crude oil next year of \$68 a barrel; down from last month's forecast of nearly \$84. The domestic oil price is now forecasted to be \$63 a barrel, compared to November's projection of \$78. Given the dynamics of the global economy and world oil markets, many people wonder whether even these estimates will prove to be too high.

Exhibit 9. Oil Prices Track Global Oil Demand Changes

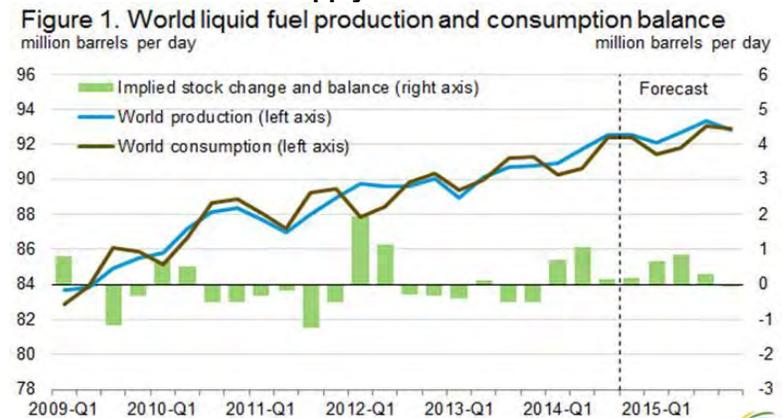


Source: BP, EIA, PPHB

What concerns many analysts and industry executives is the inability of the petroleum industry to reign in supply growth in the face of rapidly falling oil prices

What concerns many analysts and industry executives is the inability of the petroleum industry to reign in supply growth in the face of rapidly falling oil prices. For example, the EIA is now forecasting that U.S. oil output for 2015, which was previously projected to reach 9.4 million barrels a day, will now fall 0.1 million barrels a day short of that target due to the fall in oil prices. More oil supply on the market, especially in the first half of 2015, means oil prices will be under greater downward pressure during that time. This phenomenon is shown in the EIA chart in Exhibit 10. In the chart, the blue line reflects the agency's estimate for world oil production, which for most of the year is above the agency's estimate for global consumption. That means there will be downward pressure on oil prices. The big question is whether the EIA's estimates for this year's fourth quarter production and consumption are right because they become the starting point for the agency's growth projections.

Exhibit 10. EIA Sees Supply/Demand Imbalance To End 2015



Source: U.S. Energy Information Administration, December Short-Term Energy Outlook. eia

Source: EIA

The fact that the VMT trend started rising before gasoline prices began falling, although they were lower in the first half of 2014 than in the first half of 2013, one has to wonder whether the dour outlook previously ascribed to the attitude of Millennials toward driving might have been over-done

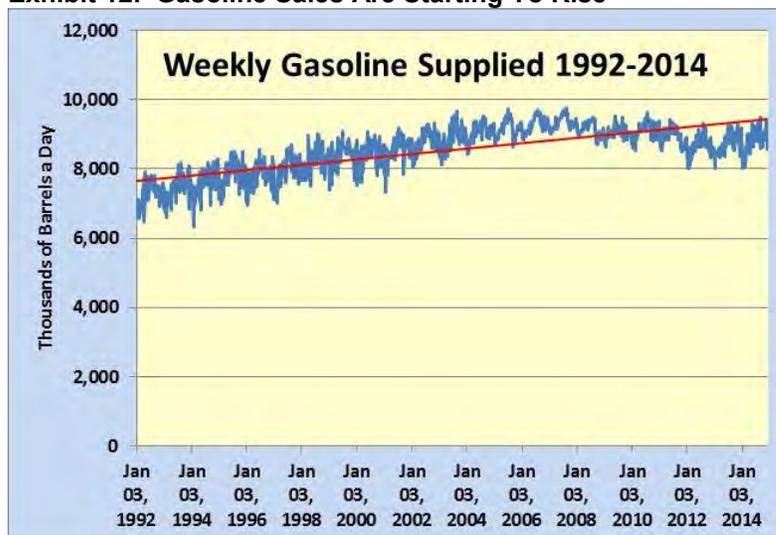
While it appears that global oil demand will be weak next year, an interesting development in the U.S. that has not received much attention is the pickup in gasoline demand largely in response to an up-tick in vehicle miles traveled (VMT) as shown in Exhibit 11. In a previous *Musings*, we had pointed out that the 12-month moving average of VMT had begun to rise. Even with an improvement in the fuel-efficiency of new vehicles sold in this country, gasoline consumption is growing (Exhibit 12). The fact that the VMT trend started rising before gasoline prices began falling, although they were lower in the first half of 2014 than in the first half of 2013, one has to wonder whether the dour outlook previously ascribed to the attitude of Millennials toward driving might have been over-done. Or, is it possible that improvement in the U.S. labor market, as reflected in a falling unemployment rate even though most of the jobs created are part-time, has more to do with the VMT increase than a change in Millennials' attitudes? If unemployment has been the demand driver, then we should worry that the VMT rise may be temporary as there is a limit to what improvement in the unemployment rate we can expect. Mitigating that scenario is the fact that falling gasoline prices has contributed to a sharp increase in the sale of less fuel-efficient pickup trucks and sport utility vehicles, meaning overall fleet gas consumption improvement may slow or possibly even decline. In the near-term, the improvement in a "below the radar" driver of oil consumption should be viewed as a positive in the petroleum industry's outlook. This will be especially true if gasoline prices drop in sync with falling oil prices.

Exhibit 11. 12 Month Rolling Average Vehicle Miles Traveled



Source: St. Louis Federal Reserve Bank

As oil supply continues to grow, at least through the first half of 2015, barring a significant event, the weak demand outlook suggests crude oil prices will remain under pressure for much of next year. What we know from past industry cycles and are witnessing

Exhibit 12. Gasoline Sales Are Starting To Rise

Source: EIA, PPHB

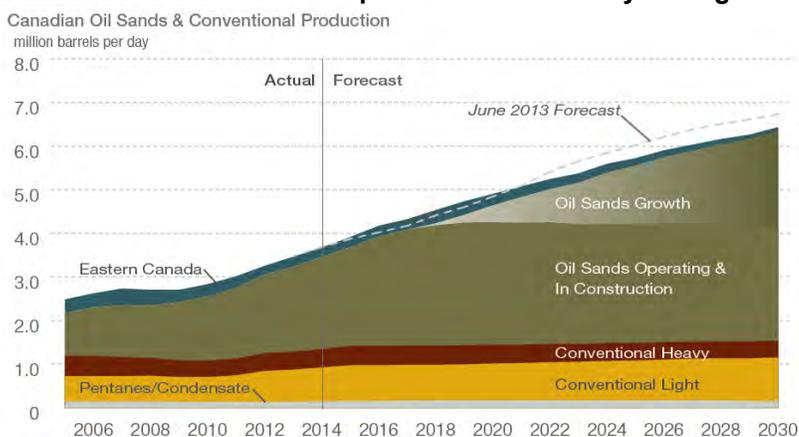
Estimates are that the industry will likely cut about 20% of its planned record \$700 billion of spending in 2014 from 2015's budgets

There is a school of thought developing that, much like what happened in 2009, the faster oil prices fall the faster they will rebound

currently is that producers are reassessing their capital spending plans for 2015 in light of the low oil price. Not all companies are cutting their spending, but most are. Not all the cuts are price driven. Estimates are that the industry will likely cut about 20% of its planned record \$700 billion of spending in 2014 from 2015's budgets. A cut of this magnitude will have an impact on the path of future oil supply growth. Lower oil prices will, over time, work their traditional magic on economic growth. The new factors shaping the amount of oil consumed in the future are demographics, renewables, regulations and reservoirs. Each of them will impact the trajectory of demand growth and oil prices. One cannot lose sight of the fact that the petroleum industry is cyclical and what cures periods of weak demand and low prices are low prices, while periods of high demand and high prices are stopped by extended periods of high oil prices.

There is a school of thought developing that, much like what happened in 2009, the faster oil prices fall the faster they will rebound. Those ascribing to that view believe that low prices will rapidly cut shale oil development and we will see a quick supply response in the United States. We are already seeing many offshore oil projects being delayed or cancelled. Lastly, we know that the low oil price being paid for heavy oil in Canada, around \$43 a barrel early last week, is already leading to in-situ developments being postponed. So will oil prices be on the rise by the second half of 2015 as oil supply forecasts show lower output in 2016?

The future of Canada's oil industry is its heavy oil and oil sands developments as shown in Exhibit 13 (next page). The chart shows the Canadian Association of Petroleum Producers' (CAPP) 2014 forecast with its 2013 outlook superimposed. The new forecast shows slightly higher output in the early years with reduced output

Exhibit 13. Canada's Oil Output Forecasts Already Falling

Importantly, the output changes between the 2013 and 2014 forecasts do not reflect lower oil prices but rather the impact of rising development and operating costs on project economics

Saudi Arabia disclosed to the media it was cutting its oil price shortly after the European Union ruled that Canada's oil sands bitumen was not "dirty" oil

Initial well production has increased significantly over the period, but the rate of well decline has also accelerated

later due to delays in new projects. We suspect that when CAPP produces its 2015 forecast, the trajectory of future output will be down from the 2014 estimate due to low oil prices delaying new projects – both mining and in-situ ones. Importantly, the output changes between the 2013 and 2014 forecasts do not reflect lower oil prices but rather the impact of rising development and operating costs on project economics. Less work should lead to lower cost increases in future projects.

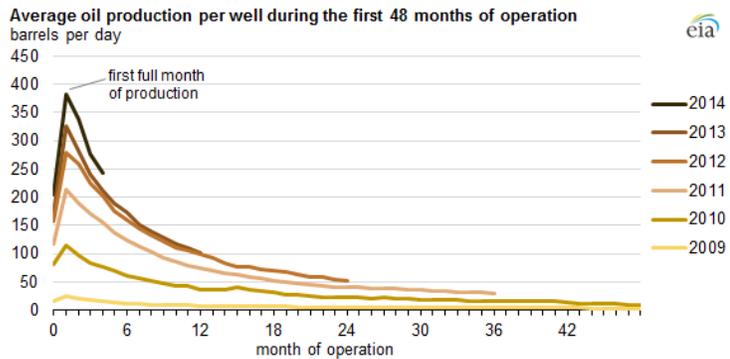
Cutbacks in oil sands developments are important for OPEC and Saudi Arabia. Since Saudi Arabia has little else to sell to the world than crude oil, it needs assurance that it will have a robust global oil market to sell into. Stopping these long-lived oil sands and heavy oil projects is important. As we have pointed out previously, Saudi Arabia disclosed to the media it was cutting its oil price shortly after the European Union ruled that Canada's oil sands bitumen was not "dirty" oil. That decision insured that Canadian oil could be sold in Western Europe, potentially restricting how large that market could be for Saudi oil. As oil sands output lasts for upwards of 40 to 50 years, the loss of Western Europe's oil market would be devastating for Saudi Arabia's long-term future.

Saudi Arabia has also been watching the performance of the shale revolution with its potential impact on global oil supply. A chart from the EIA shows average oil production per well during the first 48 months of operation on a yearly basis between 2009 and 2014. What Exhibit 14 on the next page demonstrates is that initial well production has increased significantly over the period, but the rate of well decline has also accelerated. This performance improvement helps explain the rapid growth in shale output, but it begs the question of whether the newer shale wells will actually produce more oil than earlier wells or whether the new wells will just recover the same volume sooner. The difference in the production profile has an impact on well profitability, but it also impacts overall future

That scenario argues that we will be back to high oil prices, but maybe not \$100 a barrel, sooner than some suspect

market supply. We will have more oil sooner but a quicker decline than if the wells were to produce like those with production profiles similar to 2010 or 2011. The new well production profile has encouraged some geologists to suggest that the success of the shale revolution merely provides us with more years of oil supply, thus giving us more time to find our next source of energy to power the world. That scenario argues that we will be back to high oil prices, but maybe not \$100 a barrel, sooner than some suspect.

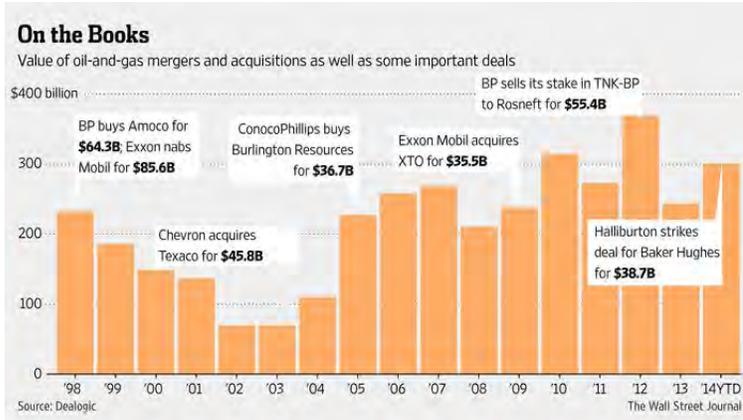
Exhibit 14. Are We Getting More Shale Oil Or Just Sooner?



The history of low oil prices is associated with periods of major industry restructuring

Another phenomenon beginning to generate speculation is whether the stress, both operationally and financially, results in a restructuring of the oil and gas industry. The history of low oil prices is associated with periods of major industry restructuring. The chart in Exhibit 15 tracks the timing of a number of energy deals by year and transaction value. While the chart was prepared to highlight the recently announced Halliburton (HAL-NYSE) and Baker Hughes (BHI-NYSE) deal, the history is primarily of integrated oil company (IOC) deals. Speculation has already begun about a number of the large IOCs that may be involved in deals. We won't rule them out, but then again we won't engage in speculation.

Exhibit 15. Will Oil Market Turmoil Drive Consolidation?



Source: *The Wall Street Journal*

The dynamics of the energy business have revved up with the dramatic decline in crude oil prices. This will bring to the forefront underlying trends already at work to change the nature of energy subsectors. We will be following and writing about these trends and how they may help alter the future of the energy business and the companies participating in it.

Questioning Environmental Claims Dangerous To Reputation

Long-time climate scientist and meteorologist Herbert E. Stevens is being bashed by local supporters of Senator Sheldon Whitehouse (D-RI) over his challenge to the senator's claims about climate change

Long-time climate scientist and meteorologist Herbert E. Stevens of Rhode Island is being bashed by local supporters of the state's junior senator, Sheldon Whitehouse, over his challenge to the senator's claims about climate change. Sen. Whitehouse offered his views in a rebuttal to an op-ed authored by Tom Harris and Bob Carter who are associated with the Heartland Institute, a think-tank known to question climate science. The op-ed by the two Heartland Institute-affiliated scientists was in response to an even earlier Sen. Whitehouse diatribe about global warming and its impact on sea levels and how devastating that may be for the state of Rhode Island. Mr. Stevens didn't weigh into the battle until after Sen. Whitehouse authored his op-ed published by *The Providence Journal* on October 30th.

Sen. Whitehouse is incensed that *The Providence Journal* would carry op-eds and articles that refute the gospel of climate change

Sen. Whitehouse, who is nearing the end of his tenure as chairman of the Senate's Environment and Public Works Subcommittee on Clean Air and Nuclear Safety and who delivers a weekly speech on the Senate floor about the dangers of global warming and climate change, is incensed that *The Providence Journal* would carry op-eds and articles that refute the gospel of climate change. He is especially incensed that they would print op-eds authored by people associated with the Heartland Institute, an organization he calls "a polluter-funded front group most notorious for billboard advertising linking climate scientists to the Unabomber." Maybe Sen. Whitehouse should listen to the rhetoric of his buddies James Hansen, retired National Aeronautics and Space Administration (NASA) scientist, and Professor Bill McKibben of 350.org.

Dr. Stevens points out that any increase in sea level would be on top of the storm surge and would not be multiplied by the surge

In his op-ed, Sen. Whitehouse claimed there was plenty of reason to fear a rise in the sea level in Rhode Island. He says that the sea level is up 10 inches at the tide gauge at Naval Station Newport since the 1930s. He then goes on to claim, "Look at old pictures of the Hurricane of 1938, and visualize 10 extra inches of sea, times an X factor for storm surge, and tell me that increase isn't already dangerous." The problem with this point, as Dr. Stevens points out, is that any increase in sea level would be on top of the storm surge and would not be multiplied by the surge.

Sen. Whitehouse goes on to state that the rate of sea level increase in Rhode Island is "measurably accelerating...consistent with published conclusions of the Intergovernmental Panel on Climate Change." But Dr. Stevens points out that relying on IPCC

Data collected from the ARGO network of ocean buoys around the world indicates that sea surface temperatures of the world's oceans have warmed at a rate of only .02° C (0.04° F) per decade

What we know is that at least two-thirds of that rise is due to subsidence of the surrounding land

As Mr. Stevens highlighted, in NOAA's "State of the Climate" issued in 2008, the agency said that "15 years or more without warming would indicate a discrepancy between models and measured reality."

conclusions is "risky business" since its predictions of sea level rise published in 1990 have been wrong on the high side by a multiple of five! He further points out, in refuting Sen. Whitehouse's claims about global warming, that the planet has not warmed in 18 years and that even the head of the IPCC has admitted to this pause and the fact that scientists cannot explain it.

One of the environmental claims is that the heat is being absorbed by the oceans, especially the deep ocean regions where it is particularly hard to measure. But Mr. Stevens points to a study published in October by the National Aeronautics and Space Administration and the Jet Propulsion Laboratory that concluded that the deep oceans have not warmed measurably since 2005. Furthermore, the data collected from the ARGO network of ocean buoys around the world indicates that sea surface temperatures of the world's oceans have warmed at a rate of only .02° C (0.04° F) per decade. As he goes on to point out, consistent with the laws of thermodynamics, that degree of warming would be the limit to which the oceans can warm the atmosphere.

Mr. Stevens pointed to a paper published this fall in *Ocean Science* showing that satellite records indicate that the rate of rise of sea levels has greatly decelerated since 2002 and is now at a rate of less than seven inches per century. While Sen. Whitehouse referenced the sea level at Newport, other attackers of Mr. Stevens referenced the sharp rise in the sea level at Norfolk, Virginia. What we know is that at least two-thirds of that rise is due to subsidence of the surrounding land, something that is happening in numerous areas around the U.S. and the world that makes the sea level rise seem more dramatic.

Amidst all the debate about this year being the warmest, the temperature data shows on average only a tenth or two of difference compared to the average for 1998, an insignificant measurement. Importantly, the Remote Sensing Systems satellite data confirms the heating pause as well as the data from the Hadley Center for Climate Prediction and Research and the University of East Anglia's Climate Research Unit. The temperature data from the National Oceanic and Atmospheric Administration (NOAA) would be more comparable had the scientists there not removed the urban heat island adjustment impacting all its temperature data for the past century. As Mr. Stevens highlighted, in NOAA's "State of the Climate" issued in 2008, the agency said that "15 years or more without warming would indicate a discrepancy between models and measured reality." Therein lays the major problem for climate science. Much of it is based on the expected outcomes projected well into the future from computer models that attempt to explain how our climate works, yet because so much is not known about the climate many assumptions are made that often produce the scary results the scientists want and need in order to secure more funding for further research. Fear is a great financial motivator.

According to Mr. Stevens, the 1821 storm would have produced a storm surge several feet higher than Sandy's, had it arrived at a full moon and high tide, as Sandy did

The problem with most climate models is their sensitivity to an increase in carbon dioxide in the atmosphere. According to Mr. Stevens, a recent paper by Herman Harb in the *Open Journal of Atmospheric and Climate Change* concludes that a doubling of carbon dioxide would result in a change of 0.43° C (0.77° F), seven times less than the IPCC claims.

One of the points Sen. Whitehouse raised was the impact of Sandy and how it is really a precursor of future climate disasters from the combination of a warmer planet and higher sea levels. Mr. Stevens, as a well-trained meteorologist (in fact, he was one of the first on-air meteorologists at *The Weather Channel*), leaned on his training to seek analog storms as a guide for the future. Mr. Stevens runs his own weather forecasting service and he commented that eight days before Sandy landed in New York City he had alerted his clients to the storm's dangerous potential. He pointed to the fact that three times in the past a hurricane had turned northwest and slammed into the city. To find them he had to do his research, which uncovered the storms of 1816, 1821 and 1893 – all of which had made northwest turns before hitting the New York metropolitan region. According to Mr. Stevens, the 1821 storm would have produced a storm surge several feet higher than Sandy's, had it arrived at a full moon and high tide, as Sandy did.

Climate change has become more of a religion than a science among its most passionate supporters

Mr. Stevens, to his credit, acknowledged that the criticism of the Heartland Institute's billboard ad was appropriate. On the other hand, he feels that the climate change proponents who describe those questioning the climate change science as "deniers" are only thinly masking their desire to brand them as similar to those disgraced people who deny the existence of the Holocaust. Civility in the debate over climate change science would be welcome. However, climate change has become more of a religion than a science among its most passionate supporters. Therefore, those supporters have no problem relying on inquisition-type tactics to challenge those on the other side of the issue.

Renewables Battle For Opportunities And NE Is Ground Zero

The article focused on how much a now-favored offshore wind project has relied on lobbyists and political connections to move from the least- to the most-favored new electricity supply project being considered

A new battle is brewing in New York over which renewable energy source should be favored for new electricity power projects. *Newsday*, a Long Island newspaper, recently broke a story about the competition between solar and wind electricity projects to supply power to the region. The article focused on how much a now-favored offshore wind project has relied on lobbyists and political connections to move from the least- to the most-favored new electricity supply project being considered.

Deepwater Wind, an offshore wind developer that is majority-owned and funded by the D.E. Shaw Group, a \$34 billion New York hedge fund with several of its managers sitting on the wind-farm company's board of advisers, has proposed a \$1.5 billion wind farm to be

located 30 miles east of Montauk on the tip of Long Island. Deepwater ONE would be a 150-200 wind turbine farm located on two ocean parcels consisting of 256 square miles of federal offshore acreage leased by Deepwater Wind in the federal lease sale in July 2013. Deepwater Wind anticipates this wind farm would, over time, supply power to multiple New York and New England energy projects. The wind project's distance from the tip of Long Island puts it "over the horizon" so it would not be visible from any point on the island.

Exhibit 16. Site Of Deepwater Wind's Super Wind Farm



Source: Deepwater Wind

According to *Newsday*, the staff of LIPA had been leaning against the proposed 35-turbine wind farm due to its cost

“Offshore wind is still 50 percent more expensive on a levelized cost basis” than the cheapest solar project offered to LIPA

According to *Newsday*, the staff of the Long Island Power Authority (LIPA) had been leaning against the proposed 35-turbine wind farm due to its cost. On November 17th, Deepwater Wind was notified by LIPA that it was one of the finalists for the project and that it had until December 5th to submit a final proposal.

The head of one of the non-finalists, Bill Moore, who is president of Hudson Energy, which worked with another firm to propose a 103-megawatt solar array on the island, commented, “certainly it’s disturbing as a bidder into the LIPA process to see the lowest-cost bids set aside for the highest cost bid for reasons that are unclear.” He went on to say, “offshore wind is still 50 percent more expensive on a levelized cost basis” than the cheapest solar project offered to LIPA. Mr. Moore is a former chief executive officer of Deepwater Wind, so clearly he is someone with deep knowledge of both wind and solar technologies and the economics of renewable energy projects.

The politics and impact of the lobbying effort cannot be underestimated. Deepwater Wind has spent \$120,000 a year on lobbyists to advocate for the project with legislators in Albany, New York, capitol of the state. The company also has many former government officials on its payroll and its founder has been a major donor to the election campaigns of New York Governor Andrew Cuomo and President Barack Obama. He also has ties to many

local politicians. In November, Suffolk County (NY) Executive Steve Bellone, who had opposed a LIPA-endorsed wind farm project while he served as the supervisor [mayor] of Babylon, N.Y., appeared at a press conference with labor officials to promote the estimated 300 construction jobs that would be created by the Deepwater Wind project.

Exhibit 17. Rally In Support Of LI Offshore Wind



Source: *Long Island Press*

A News12 Long Island television station poll found that Long Islanders favored the Deepwater Wind project by 83% to 17%

Estimates are that the Deepwater Wind/LIPA contract, assuming it is selected, would add, at a minimum, \$4 per month to the electricity price of a typical residential customer

On October 30th, a Rally for Renewables was held outside the LIPA offices. Gordian Raacke of Renewable Energy Long Island spoke in favor of the Deepwater Wind project. During the event, his organization turned over to LIPA a petition with 20,000 signatures supporting the wind project. A News12 Long Island television station poll found that Long Islanders favored the Deepwater Wind project by 83% to 17%.

Under the Deepwater Wind proposal, LIPA is required to purchase all the power the wind farm would produce at a first-year cost of just over 18-cents per kilowatt-hour (kWh), which would be 6.4-cents/kWh below the price negotiated for the company's 5-turbine wind farm offshore Block Island, Rhode Island. More importantly, the first-year power price would escalate over the 20-year life of the contract. If we assume that Deepwater Wind seeks the same escalation structure as in its Rhode Island contract, the LIPA price would increase by 3.5% per year for the term of the contract. At the time Deepwater Wind negotiated its power purchase agreement (PPA) with National Grid (NGG-NYSE) in Rhode Island, the cost of power in that state was 14.5-cents/kWh. Since then, natural gas, which powers close to 90% of the power supplied to Rhode Island customers has declined in priced. Estimates are that the Deepwater Wind/LIPA contract, assuming it is selected, would add, at a minimum, \$4 per month to the electricity price of a typical residential customer.

According to ISO-NE, the region produced nearly 2%, or approximately 1,800 gigawatt-hours, of its energy, from wind capacity in 2013

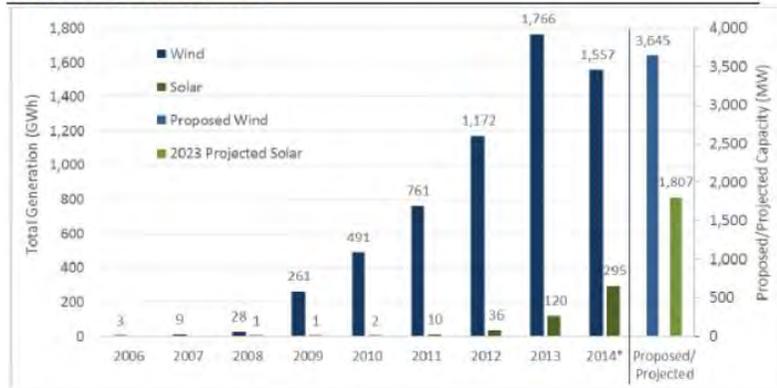
There is also the difficulty in siting large wind farms and transmission projects across multiple jurisdictions, meaning that offshore wind projects that are closer to the power needs of customers become more attractive, despite their higher cost

While it looks like offshore wind may overwhelm solar for renewable energy on Long Island, the battle between the two renewables continues throughout New England. According to the New England Independent System Operator (ISO-NE), the region produced nearly 2%, or approximately 1,800 gigawatt-hours, of its energy, from wind capacity in 2013. There is currently approximately 720 megawatts (MW) of installed capacity with Maine accounting for 53%. Maine also has 84% of the region’s 3,645 MW of proposed wind capacity.

A challenge for wind farms in Maine is the high costs associated with the transmission lines to bring the power to other New England states. There is also the difficulty in siting large wind farms and transmission projects across multiple jurisdictions, meaning that offshore wind projects that are closer to the power needs of customers become more attractive, despite their higher cost. After 15 years of planning and permitting, the Massachusetts Cape Wind project in Nantucket Sound may be getting close to moving forward to construction. Likewise, the 5-turbine project offshore Block Island, Rhode Island has received all its permits and expects to begin construction during 2015, making it potentially the first U.S. offshore wind farm to become reality. Add to those two projects, the Deepwater ONE offshore wind farm that could supply meet New York and New England renewable power needs, and the area offshore Massachusetts and Rhode Island could become an active wind energy center.

Exhibit 18. The Growing New England Renewable Market

Figure 2 – New England Utility-Scale Wind and Solar Generation, Proposed Wind, 2023 Projected Solar



Source: Enerknol analysis of ISO-NE Data. *Through October

Source: Enerknol Research

As the New England region may be exhausting its potential onshore wind farm locations, the states are hoping to meet some of their mandatory renewable portfolio standards (RPS), which vary from a low of 10% by 2017 for Maine to a high of 27% by 2020 for Connecticut, with solar power. Most of the state RPS requirements are between the mid-teens to low 20's percent for the other four

At the present time, Massachusetts leads the region with nearly 700 MW of installed solar capacity and is poised to see that grow

states by no later than 2025. At the present time, Massachusetts leads the region with nearly 700 MW of installed solar capacity and is poised to see that grow with the recently-enacted RPS solar carve-out of 1,600 MW by 2020. If Massachusetts meets its requirement and the other New England states meet ISO-NE projections, the region could exceed 3,000 MW of installed solar photovoltaic capacity by 2023, nearly five times the amount currently installed in California.

At the present time, the wind and solar project economics rely on the renewable energy certificate markets and federal investment tax credits and production tax credits

At the present time, the wind and solar project economics rely on the renewable energy certificate (REC) markets and federal investment tax credits (ITC) and production tax credits (PTC). State RPS compliance is mostly completed through REC purchases. One REC equates to one megawatt-hour of produced renewable energy from RPS-qualified sources and represents the environmental attributes of the produced electricity, separate from the physical electricity. RECs are tradable and provide a second revenue stream for renewable energy project owners and thus help support the development of these projects. RECs may become more important for renewable energy developers if the federal ITC and PTC are not extended. Based on the latest information we have learned, it looks like the PTC will be extended through 2015, and we expect the ITC for renewable projects will also be extended.

The battles over expanding natural gas pipelines to bring more supply into New England will make it tougher for utilities to meet the region's future power needs

As we watch the New England, and now Long Island, regions move aggressively forward with wind, offshore wind and solar energy projects at substantially higher costs for power customers, the state utilities are moving to build more gas-fired power plants both to supply base-load power as aging coal- and nuclear-fired plants are shuttered and to provide back-up power for when renewable power is not available. The battles over expanding natural gas pipelines to bring more supply into New England will make it tougher for utilities to meet the region's future power needs. As a result, electricity customers will be facing escalating power bills and potential power brownouts and blackouts. That will further challenge the health of the economies of the New England states. The huge electricity rate increases just enacted for the upcoming winter months in Massachusetts and Rhode Island are being challenged by politicians and customers, but the increases are only the tip of the financial iceberg for residents going forward.

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