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ENERGY INVESTMENT BANKING

MUSINGS FROM THE OIL PATCH

September 23, 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

Where Will The Future Of Crude Oil Prices Take Us?

The IEA announced it reduced its estimate for oil demand growth in 2014 by 150,000 barrels a day (b/d), leaving the projected annual increase at 900,000 b/d

We found it an interesting coincidence that on the 13th anniversary of 9/11 that caused a sharp drop in oil consumption, the International Energy Agency (IEA) announced it was cutting its forecast for global oil demand growth this year and next due to continuing weak global economic activity. It's not as if slow economic performance around the world, which has trimmed global oil demand growth has been a huge secret. The IEA announced it reduced its estimate for oil demand growth in 2014 by 150,000 barrels a day (b/d), leaving the projected annual increase at 900,000 b/d, putting daily demand at an estimated 92.6 million b/d of oil. At the same time, the agency said it was reducing its oil demand projection for next year to 93.8 million b/d, a gain of only 1.2 million b/d over 2014's estimate, and representing a cut of 165,000 b/d from the agency's prior monthly forecasted gain. We understand forecasting oil is a challenge, but this agency has extensive experience but still has problems.

The IEA went on to elaborate in its commentary that "While demand growth is still expected to gain momentum, the expected pace of recovery is now looking somewhat more subdued."

The IEA commented in its monthly report where it unveiled its oil demand cuts that "The recent slowdown in demand growth is nothing short of remarkable." That statement has received extensive media attention. However, we wonder whether it is really the slowdown in global oil demand or rather a lack of understanding about the inner workings of the global economy and the oil market by the agency. The IEA went on to elaborate in its commentary that "While demand growth is still expected to gain momentum, the expected pace of recovery is now looking somewhat more subdued." Putting that language into context, the IEA's latest demand cut for 2014 to only a 900,000 b/d increase reflects a reduction from the 1.1 million b/d increase it projected as recently as August. That forecast had already been trimmed by 300,000 b/d from the agency's June projection for 1.4 million b/d growth in demand for this year. Are we really seeing an oil demand collapse, or is it the inability of the IEA to

get in front of the trajectory of the demand decline, i.e., a poor forecasting model?

Seeing these multiple, meaningful downward revisions to its demand forecast during this past summer suggests that economic activity has been worse than the IEA had built into its oil demand forecasting model

The IEA traditionally has over-estimated global oil demand in its early forecasts for the following year, usually introduced during the July through September period. The timing of its initial forecast enables the IEA to account for winter demand, which often forces the agency to adjust its annual demand projection depending on just how hot or cold the winter months turn out to be. This adjustment can be made before the world and the oil market head into the traditionally weak spring demand months and before the hot summer weather arrives. Given this pattern, the IEA's forecasts are most likely to experience large adjustments during the early winter months and possibly again during the spring. Seeing these multiple, meaningful downward revisions to its demand forecast during this past summer, which for North America has reflected cooler-than-normal months, suggests that economic activity has been worse than the IEA had built into its oil demand forecasting model.

It would appear that the additional cost of this storage oil was too expensive for the Chinese economy

The IEA's comment about how remarkable the decline is, suggests that it did not have a grasp of the magnitude of the impact on oil demand from China's ending the filling of its oil storage tanks during the past few months in response to the country's growing economic weakness and financial stress. It would appear that the additional cost of this storage oil was too expensive for the Chinese economy and banking system to bear. Additionally, we believe the IEA's model assumed too generous an estimate for economic growth in Western Europe and North America during the second half of 2014.

In its latest forecast revision, the agency boosted its 2014 and 2015 oil supply estimates by 100,000 b/d, each

Compounding the errors in the oil demand forecasts is the IEA's underestimating non-OPEC oil supply growth. In its latest forecast revision, the agency boosted its 2014 and 2015 oil supply estimates by 100,000 b/d, each. That brings its supply growth projection for this year to 1.6 million b/d with an additional 1.3 million b/d of new supply arriving in 2015, Both supply forecast increases are largely dependent on the growth in American shale oil output that has boosted U.S. oil production to a 40-year high.

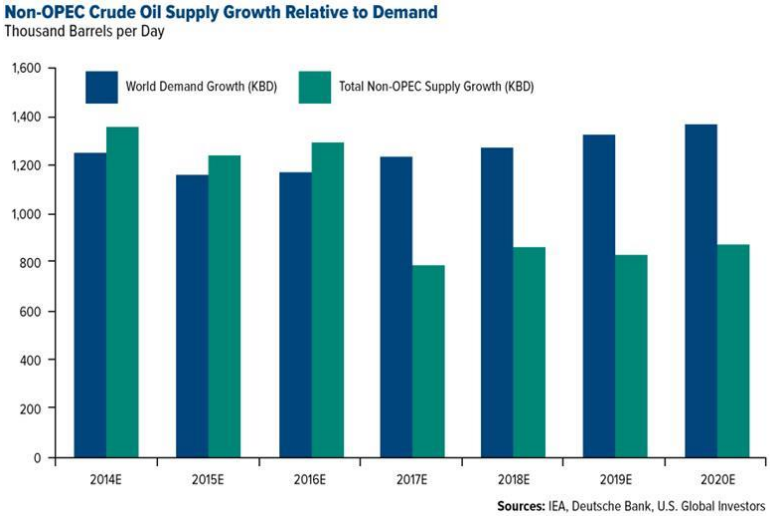
The 2014 and 2015 estimates do not reflect the IEA's recent downward revisions

We found the chart in Exhibit 1 (next page), published by U.S. Global Investors quite interesting for its step-change dynamic between oil demand and non-OPEC supply growth after 2016. The chart represents annual global oil supply and demand estimates for 2014 and 2015 based on the estimates published by the IEA with the later years' projections representing forecasts compiled by the oil investment analysts at Deutsche Bank. As the chart was published a few weeks ago, the 2014 and 2015 estimates do not reflect the IEA's recent downward revisions. If the chart were revised to reflect today's forecast, what you would see is that the demand bar would be lower while the supply one would be higher. We have no idea what that does to the analysts' forecasts for supply and demand in the out-years of the chart, but if we had to make a guess, there

As rising demand and limited non-OPEC supply growth clash, the result will be a tightened global oil market that will send prices higher, reward E&P producers with higher revenues and greater earnings, but more importantly, restore market power to the members of OPEC

probably wouldn't be any change as the conventional view of the long-term outlook for oil calls for accelerating demand growth with relatively static non-OPEC oil supply growth. Virtually every macro industry forecast projects oil demand growing due to world population growth and expanding middle classes in developing economies. The other conventional belief is that there is a limit to the growth in non-OPEC oil supply due to cost constraints and few new supply prospects. As rising demand and limited non-OPEC supply growth clash, the result will be a tightened global oil market that will send prices higher, reward E&P producers with higher revenues and greater earnings, but more importantly, restore market power to the members of OPEC. With OPEC firmly re-established in the driver's seat of global oil pricing, the risk of a price collapse becomes moot since high oil prices are necessary to support the budgets of most OPEC member countries. Any weakness in oil prices would be quickly offset by OPEC oil production cuts.

Exhibit 1. Non-OPEC Supply Fails To Meet Demand Growth



Source: U.S. Global Investors

The oil price bears suggest that global oil prices could sink as low as $50 per barrel

The counter to this bullish macro view for oil demand and oil prices is a belief held by a minority of analysts who suggest that global economic growth will remain anemic thus eliminating the need for dramatically increased oil supplies and thus higher prices necessary to induce that new supply to be developed. Due to weak oil demand growth, any reduction in the volume of Middle Eastern and North African oil currently held off the market due to geopolitical events will push oil prices down. Under this scenario, the oil price bears suggest that global oil prices could sink as low as $50 per barrel, although most think it is likely prices would begin to rebound once they reached the $70-$80 per barrel level.

Between June 20th and September 11th, the price of a barrel of West Texas Intermediate (WTI) fell from a peak of $107.26 to $90.53, a

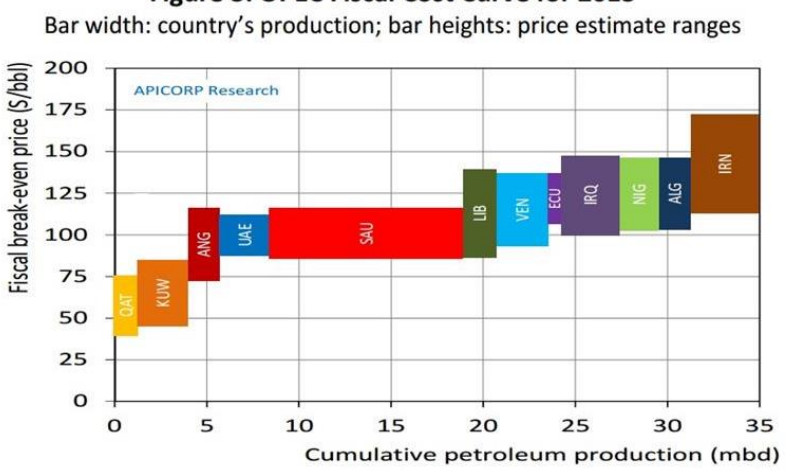
A 16% decline in a global commodity within a span of 90 days is a significant move reflective of changes in underlying macro trends

16% decline. Prices subsequently rebounded and have remained volatile within a range reflecting the daily news from the Middle East's war on terror, the level of tension between NATO member countries and Russia over the Ukraine and the value of the U.S. dollar versus other major currencies since oil is traded globally in U.S. dollars. A 16% decline in a global commodity within a span of 90 days is a significant move reflective of changes in underlying macro trends such as those cited above. But what are the bull and bear cases for oil, and does one case make more sense than the other?

By "fiscal cost" they mean the price for a barrel of oil that multiplied by the number of annual barrels produced yields income sufficient to cover the cost of running the country's government

Besides the accelerating demand growth against limited non-OPEC supply increase case, the bulls point to the growing cost to find additional oil supplies. They also point to the new dynamic for OPEC, which is the high fiscal cost of their oil output. By "fiscal cost" they mean the price for a barrel of oil that multiplied by the number of annual barrels produced yields income sufficient to cover the cost of running the country's government. That cost has risen sharply in a number of Middle Eastern and North African countries due to rapidly growing populations (these countries have some of the highest birth rates in the world) and the cost to mitigate social tensions associated with the ethnic struggles (Arab Spring) ongoing within most of these countries – what some of us might call political insurance. A number of analysts have crunched the budget numbers for these countries and created charts such as that below.

Exhibit 2. Oil Prices Needed By OPEC Members



Source: APICORP Research

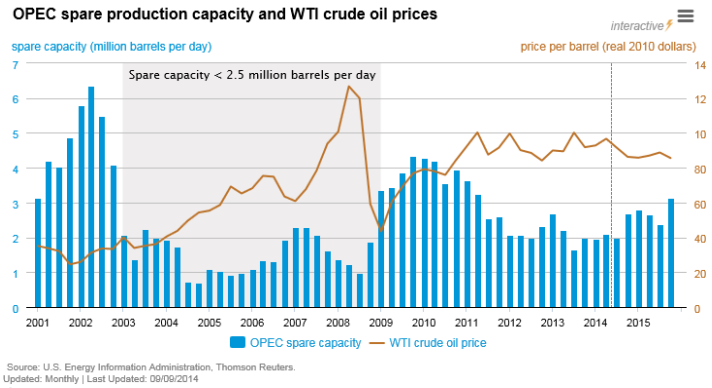
A substantial volume of OPEC production needs a price somewhere around $100 a barrel for the country to breakeven

What this chart demonstrates is that only Qatar and Kuwait among the OPEC members have fiscal breakeven prices of around $75 a barrel. A substantial volume of OPEC production needs a price somewhere around $100 a barrel for the country to breakeven, while another substantial amount requires prices in the $125 per barrel neighborhood.

The level of OPEC's spare output capacity has played a role in global oil prices since the early 1970's

Of course, it isn't just OPEC's breakeven price that matters when considering the impact of oil prices on global supply. OPEC today accounts for about 40% of world oil output, but more importantly it represents about 60% of the amount of oil traded worldwide. The other important consideration about the role of OPEC in setting global oil prices is that only a couple of its members – primarily Saudi Arabia and the United Arab Emirates (UAE) – have meaningful spare producing capacity. Saudi Arabia has historically maintained about 2-2.5 million barrels a day of spare productive capacity, which has been used in the past to both cool off rising oil prices and to offset the price spike from a cataclysmic supply disruption. The level of OPEC's spare output capacity has played a role in global oil prices since the early 1970's and is likely to continue to play a role for many more years.

Exhibit 3. Oil Prices Track OPEC Surplus Capacity Available



Source: EIA

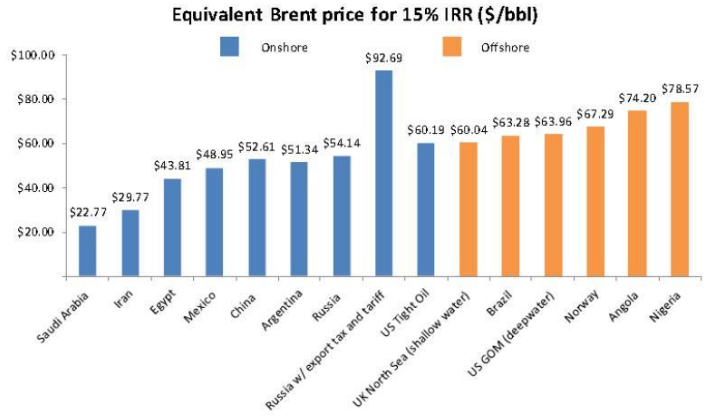
For the few quarters when spare capacity exceeded 2%, global oil prices fell

Exhibit 3 shows OPEC's spare capacity since 2001 and projected through 2015 and it demonstrates that whenever the safety margin fell to about 2%, oil prices tended to be high. The rise to peak global oil prices in 2008, immediately before the onset of the financial crisis that year, reflected both the dramatic demand growth from China that exploded onto the market in 2004, which led to an almost total exhaustion of spare producing capacity during 2004-2006, and the inability of OPEC to increase its spare capacity much above 2%. What is most noticeable about that period is that for the few quarters when spare capacity exceeded 2%, global oil prices fell. They then exploded to their peak in concert with the slide in OPEC spare capacity from 2% to slightly below 1%.

An oil price below $50 a barrel would eliminate all the plays except for the four least costly

Another way of looking at the cost issue for oil is to examine what price is needed for various producing plays to reach a 15% internal rate of return for the oil company. The chart shows that an oil price below $50 a barrel would eliminate all the plays except for the four least costly, while a $70 per barrel price would only eliminate the two most expensive offshore regions, excluding the unique case of Russian oil production with an export tax and a tariff.

Exhibit 4. Sensitivity Of Oil Plays To Level Of Oil Prices

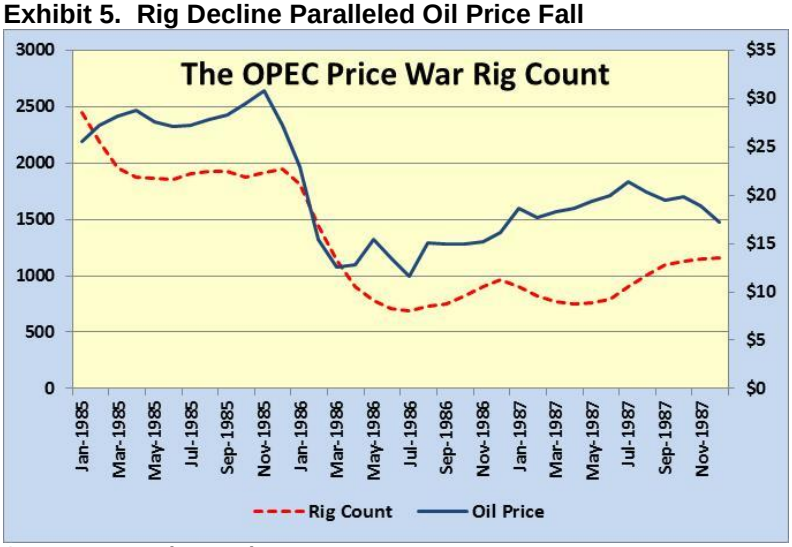


Source: IHS

Any meaningful decline in oil prices would be met both with disbelief and institutional paralysis

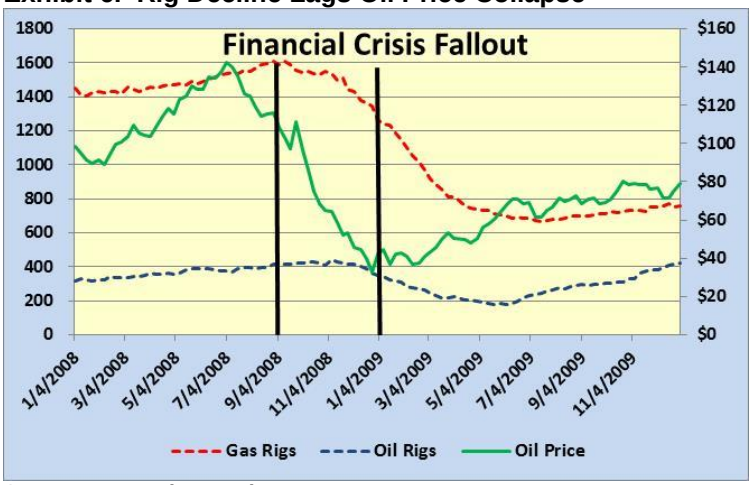
In assessing these price scenarios, it is important to understand how a drop in oil prices would impact drilling and potentially production. We have analyzed the relationship (Exhibits 5 and 6) between the U.S. drilling rig count and changes in oil prices during two periods of oil price collapses – in 1986 as a result of Saudi Arabia's boosting its production to teach its fellow OPEC members a lesson and in 2008 and 2009 following the global financial crisis that led to a global recession. In both cases there was a lag between when oil prices started falling and a decline in the drilling rig count. That lag reflected both an inability of the oil and gas companies to respond to their rapidly altered economics and often their disbelief about how bad things might get. This suggests that any meaningful decline in oil prices would be met both with disbelief from companies that prices could fall as far as analysts suggest and institutional paralysis that prevents a quick response to the deteriorating profitability.

Exhibit 5. Rig Decline Paralleled Oil Price Fall



Source: EIA, Baker Hughes, PPHB

Exhibit 6. Rig Decline Lags Oil Price Collapse



Source: EIA, Baker Hughes, PPHB

So far this year, the oil price decline has probably not been so meaningful as to seriously reduce future drilling activity

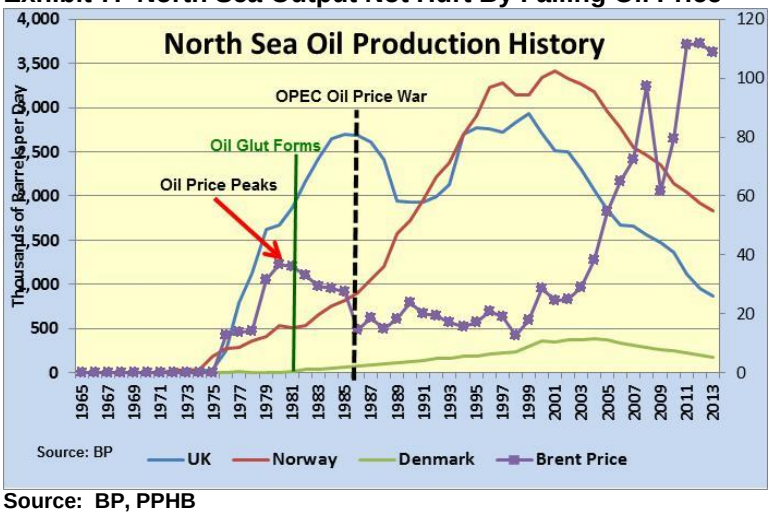
If the oil price collapse is relatively short in duration and prices rebound, it is likely that the rig count decline would be minimal. It is importantly to not, however, that the decline in drilling would lag the movement in oil prices so while we are concerned about the recent drop in the WTI price, any drilling falloff may not show up until 2015 or possibly later. So far this year, the oil price decline has probably not been so meaningful as to seriously reduce future drilling activity. The issue is whether oil prices fall meaningfully from current levels.

The best example of the limited impact from falling oil prices on oil production is the experience in the North Sea during the mid-1980's

The second question about falling oil prices is whether there is an impact on existing oil production, at least for the more expensive oil output. Historically, there hasn't been much impact on oil production following an oil price drop, almost no matter how large the decline. The reason why that is true is that lifting costs are generally low relative to even low oil prices, while the deferred costs of finding and developing the oil production that contribute to the profitability analysis reflect non-cash expenses. The best example of the limited impact from falling oil prices on oil production is the experience in the North Sea during the mid-1980's when OPEC's oil prices collapsed. We vividly remember the debates within the Wall Street oil analyst community about what price would cause North Sea oil production to be shut down. In reality, no oil production was shut down due to falling prices. This fact is shown clearly in Exhibit 7 on the next page.

While these historical reviews would suggest that weak oil prices are not likely to impact oil production, other than through conscious decisions by OPEC members – primarily Saudi Arabia – to cut production in order to support oil prices in the $100 a barrel neighborhood, we believe that the growing concern over an imminent collapse in oil prices is unwarranted. That doesn't mean that prices cannot decline further, but we believe the volatility in oil prices is actually picking up and may help explain price movements.

Exhibit 7. North Sea Output Not Hurt By Falling Oil Price



Source: BP, PPHB

There are many steps governments can take to offset the financial impact on their budgets from weak prices

It must be understood, however, that even though the fiscal breakeven oil price for OPEC members is indicated to be very high, there are many steps governments can take to offset the financial impact on their budgets from weak prices. Actions may include drawing down cash balances held by the government, by requesting that national oil companies send more money more frequently to the government rather than investing in new drilling and production projects, and adjusting energy subsidies paid to the citizens.

A few analysts now believe that the United States may be gaining power to influence global oil prices through its growing oil output

The important fact about falling oil prices is that they tend to self-correct fairly rapidly due to the limited number of players who can influence the oil market. Most analysts believe that only Saudi Arabia can play that swing producer role, but when it comes to helping drive down oil prices, a few analysts now believe that the United States may be gaining power to influence global oil prices through its growing oil output. These production optimists believe that by allowing U.S. oil exports, domestic oil prices will rise, thus encouraging producers to produce even more. If that occurs, these optimists see a steady decline in oil prices and growing production. The question is how low prices could fall. The answer to that question may depend on whether the U.S. government loosens its oil export restrictions.

In his view, without an increase in crude oil exports, given his conservative view about oil consumption growth, domestic oil prices will be pressured by rising inventories

One of the oil supply optimists is Ed Morse, head of commodities for Citi Research. His current forecast for the domestic oil market in 2020 sees crude oil and natural gas liquids output climbing from 10.1 million barrels per day (mmb/d) in 2013 to potentially 16.5 mmb/d. Including refinery gains and other liquids, total U.S. liquids supply could reach as high as 18.8 mmb/d by 2020. In his view, without an increase in crude oil exports, given his conservative view about oil consumption growth, domestic oil prices will be pressured by rising inventories. Therefore, under this scenario he sees oil prices declining from the $97/barrel level at the end of 2014 to

$64/barrel in 2018. With the allowance of oil exports beginning in 2015, Mr. Morse sees oil prices falling from $99/barrel at this year-end to $82/barrel in 2018, a considerably better outlook for domestic oil producers than his forecast under a "no oil export" scenario.

Baring a pick-up in global economic activity, any reduction in geopolitical tensions could bring significant supply back into the market, thus putting downward pressure on oil prices

Geopolitical events have kept a substantial volume of world oil supplies off the market. That has lifted oil prices sufficiently that when coupled with the success of tight oil exploration technologies, has enabled U.S. oil output to grow to a 40-year high. It is likely high oil prices will stimulate increased oil production elsewhere in the world. As a result, baring a pick-up in global economic activity, any reduction in geopolitical tensions could bring significant supply back into the market, thus putting downward pressure on oil prices, at least until key suppliers such as Saudi Arabia act to reduce their production to help restore market equilibrium. While we believe the long-term trend in global oil prices is higher, we do not rule out a visit to lower price territory before then.

Good News Doesn't Sell Papers, Especially If It's O&G News!

Scary news stories always seem to get the greatest attention

Journalists are taught that dog bites man stories don't sell newspapers but man bites dog stories will. As newspapers struggle to find new business models in today's world of 24-hour news cycles, Internet blogs and declining readership among our youth, they have to focus on what will drive readership, or news-purchases. Therein lies the point that people are attracted to sensationalism and, apparently, cataclysmic scenarios. Scary news stories always seem to get the greatest attention whether they involve merely local events or mankind survival issues. Environmental disaster scenarios provide great fodder for selling news.

Natural gas, a fuel that produces fewer carbon emissions than the crude oil and coal it is replacing has been promoted as the bridge fuel to the future

One of the popular environmental disaster stories has been the role of hydraulic fracturing in unlocking the tight oil and natural gas trapped in the huge shale formations that underlie large swaths of the United States. The success of those efforts has changed the outlook for the domestic oil and gas business, and in turn has contributed significant value in a multitude of ways to the nation's economy. Natural gas, a fuel that produces fewer carbon emissions than the crude oil and coal it is replacing has been promoted as the bridge fuel to the future when the world will be powered exclusively by carbon-less renewables. It certainly helped that in the early years of this century U.S. natural gas sold at very high prices – nearly triple current gas prices – that made expensive renewable energy power projects more cost-competitive.

When natural gas prices collapsed, as a result of the success of the American gas shale revolution in which horizontal drilling and hydraulic fracturing drove gas prices to extremely low levels - $2-$3 per thousand cubic feet, the economics of renewables were severely undercut. Soon, environmentalists shifted into attack mode against

Pictures of people lighting on fire the water coming from their kitchen faucets made for spectacular and scary photos

natural gas as just another dirty fossil fuel. They seized on situations where people living in the gas shale regions discovered gas in their water supplies. Sensationalism in the form of documentaries, films and print stories populated the view that horizontal drilling and fracking (as hydraulic fracturing was described) were the cause of these gas-in-drinking-water scandals. Studies were undertaken by government agencies and academics, often with environmental agendas, to either establish or disprove the linkage. Pictures of people lighting on fire the water coming from their kitchen faucets made for spectacular and scary photos. We have followed this issue closely, reading many of the reports and understanding many of their shortcomings. [Full disclosure, I am a director of a company that provides hydraulic fracturing services.]

This team of scientists developed a new method of geochemical forensics in order to trace how methane gas migrates throughout the earth

A new study was published in the recent issue of the *Proceedings of the National Academy of Sciences.* The study was conducted by a team of scientists headed by a professor from Ohio State University along with professors from Duke, Stanford, Dartmouth and the University of Rochester. [We have not read the complete study but are relying on an article about it in *Science Daily* and the authoritative standing of the organization that published the study.] This team of scientists developed a new method of geochemical forensics in order to trace how methane gas migrates throughout the earth, and importantly, a method that relies on solid science and can be employed anywhere in the world.

These properties allow the researchers to determine the source of fugitive methane and the mechanism in which it arrived in the drinking water aquifer

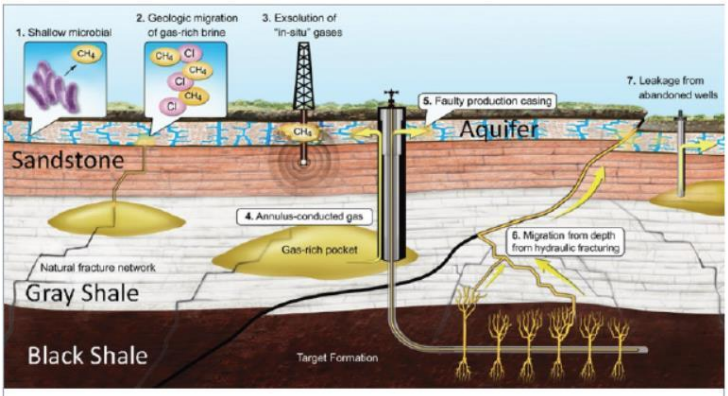
The forensic method employed relies on the physics of noble gases such as helium and neon that leak out along with methane. These gases are unique because they do not react much with other chemicals even though they mix with natural gas and can be transported with it. When released underground, these gases can travel long distances without being altered by microbial activity or chemical reactions. What is important is their atomic mass, which determines how their ratio changes as these noble gases migrate along with natural gas. These properties allow the researchers to determine the source of fugitive methane and the mechanism in which it arrived in the drinking water aquifer. Given this science, the researchers were able to distinguish between the signatures of naturally occurring methane and stray gas contamination from shale gas drilling.

"There is no question that in many instances elevated levels of natural gas are naturally occurring, but in a subset of cases, there is also clear evidence that there were human causes for the contamination"

The study focused on eight clusters of wells in the Marcellus shale in Pennsylvania and the Barnett shale in Texas. Many of these wells had been tested and studied before. The testing for this study was conducted in 2012 and 2013. The *Science Daily* article contained quotes from several of the researchers about the findings and their implications. According to Thomas Darrah, assistant professor of earth sciences at Ohio State, "There is no question that in many instances elevated levels of natural gas are naturally occurring, but in a subset of cases, there is also clear evidence that there were human causes for the contamination. However our data suggests

that where contamination occurs, it was caused by poor casing and cementing in the wells."

Exhibit 8. Solving Drinking Water Contamination Issue



As researchers study hydraulic fracturing, a team led by Thomas Darrah at The Ohio State University has identified a key source of groundwater contamination (labeled 5, center right) caused by faulty well casings.

Credit: Image courtesy of Thomas Darrah, The Ohio State University

Source: ***Science Daily***

"These results appear to rule out the migration of methane up into drinking water aquifers from depth because of horizontal drilling or hydraulic fracturing, as some people feared"

"Many of the leaks probably occur when natural gas travels up the outside of the borehole, potentially even thousands of feet, and is released directly into drinking-water aquifers" said Robert Poreda, professor of geochemistry at the University of Rochester. The importance of the study's results, as highlighted by Avner Vengosh, professor of geochemistry and water quality at Duke, is that "these results appear to rule out the migration of methane up into drinking water aquifers from depth because of horizontal drilling or hydraulic fracturing, as some people feared."

If the development of shale formations, not only here but also abroad, is to proceed and expand, eliminating, or at least mitigating, residents' fear of drinking water contamination from hydraulic fracturing will be an important issue for the oil and gas industry

The good news from this study is that in most cases the potential problem can be avoided by improving the integrity of wells when they are drilled. Also, producing wells probably need to be inspected more frequently for any well cement and casing deterioration that could allow natural gas flows to migrate into drinking water aquifers. That will likely require establishing new rules and regulations that most likely will be fought by the oil and gas industry as an undue burden. If the development of shale formations, not only here but also abroad, is to proceed and expand, eliminating, or at least mitigating, residents' fear of drinking water contamination from hydraulic fracturing will be an important issue for the oil and gas industry. The cost of an insurance program designed to provide peace of mind to the landowners of gas shale wells will be small compared to the cost of growing legal and political attacks and the erections of barriers to further limit development. Industry leaders should bear in mind Benjamin Franklin's admonition that "an ounce of prevention is worth a pound of cure" when considering this issue.

The U.S. Natural Gas Market Is Like Ol' Man River

If this season continues to track 2003's pattern, the industry should reach 3,427 Bcf of storage – a very comfortable level heading into the 2014-15 winter

The domestic natural gas market "just keeps on rollin' along." Last week's storage injection of 90 billion cubic feet (Bcf) essentially matched the guestimates of the experts (91 Bcf) and brings the total volume of gas in storage to 2,891 Bcf. The gas injection rate continues to closely follow our forecasting model that is based on the weekly injections during 2003. If this season continues to track 2003's pattern, the industry should reach 3,427 Bcf of storage – a very comfortable level heading into the 2014-15 winter. As we have pointed out before, barring a repeat of the severe winter of 2013-14 with its several polar vortex extreme Arctic temperature events, virtually any other winter experienced during the past 20 years would leave the industry with close to 1,000 Bcf of gas in storage at the end of the heating season.

So far this year, the industry has injected 2,069 Bcf of gas into storage reservoirs, which is within 100-150 Bcf of the total injected during most of the "large" storage-build years

What is quite interesting is that based on either the weekly storage injections of last year or the 2003 season the industry will wind up with virtually the same volume of gas in storage. The difference between the two outcomes is that by following the 2003 pattern, the industry would wind up 21 Bcf ahead of merely matching last year's remaining weekly injection volumes. So far this year, the industry has injected 2,069 Bcf of gas into storage reservoirs, which is within 100-150 Bcf of the total injected during most of the "large" storage-build years. Importantly, the industry is within 350-425 Bcf of matching the record injection volumes achieved during the past 20 years - those years being 2001 and 2003. As there are seven weeks still left in the injection season, surpassing the vast majority of the large injection years would seem to be a reasonable goal. Depending on the early fall weather, it is quite possible that 2014 might attain the crown for being the largest seasonal storage injection since 1994.

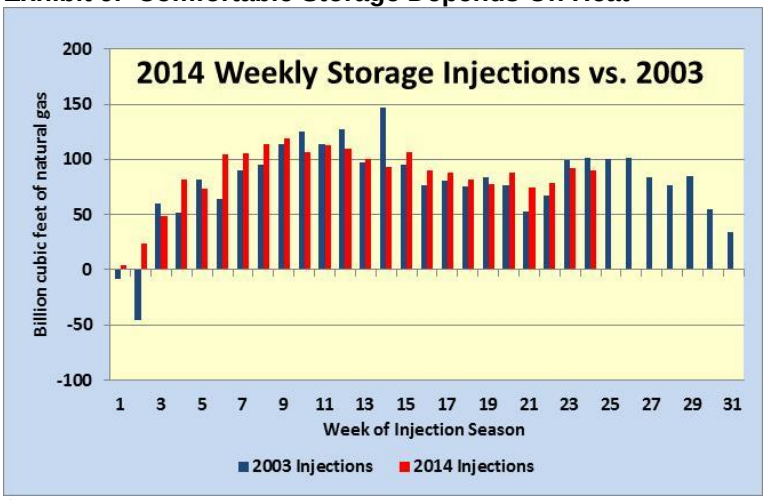
We attribute the industry's success rebuilding gas storage volumes to a cool summer and the continued high growth in natural gas production

Given the high level of concern existing at the end of last winter questioning the ability of the gas industry to rebuild storage, what the industry has accomplished so far this year has been remarkable. We attribute the industry's success rebuilding gas storage volumes to a combination of a cool summer throughout most of the populous regions of the country and the continued high growth in natural gas production as a result of the shale revolution.

The key to where the industry ultimately winds up on storage volumes will depend on how it does compared to the weekly injections of either 2003 or 2013. When we compare the weekly injections against our favorite 2003 bogey, we notice that in recent weeks, despite very strong injections that have actually matched or even outperformed the analysts' consensus estimates, 2014 has trailed slightly. The next two weekly injection results will be comparing against 100 Bcf injection weeks in 2003, a level we have not witnessed since early in this injection season. Therefore, for

2014 to outperform our model, it will take stronger weekly injections during the latter few weeks of the injection season.

Exhibit 9. Comfortable Storage Depends On Heat

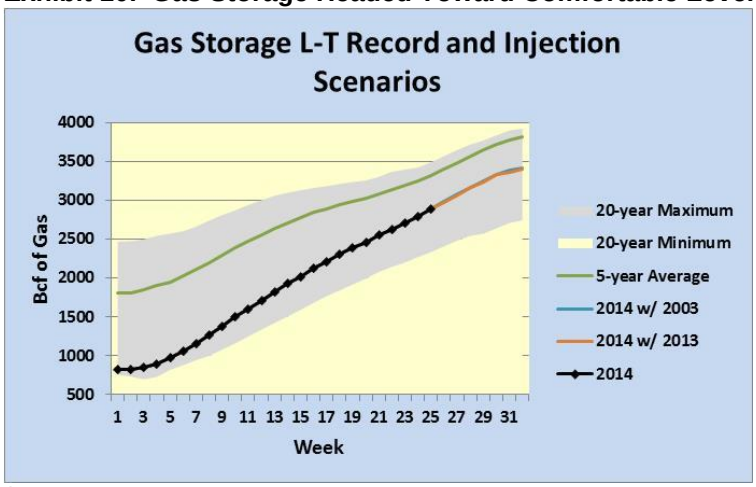


Source: EIA, PPHB

If 2014's gas storage volume attains our target, it will wind up slightly above the mid-point of the 20-year minimum and maximum range, a significant accomplishment given that it started at almost exactly the 20-year minimum volume

If the remainder of the injection season tracks either 2013 or 2003, we can see that this year will have made a significant gain in closing the gap between where storage volumes started and the average of the past five years. While the industry won't meet that average, it is noticeable how the 5-year average is fairly close to the 20-year maximum, demonstrating the impact of the warm winters during the past few years that have significantly skewed the short-term average. If 2014's gas storage volume attains our target, it will wind up slightly above the mid-point of the 20-year minimum and maximum range, a significant accomplishment given that it started at almost exactly the 20-year minimum volume.

Exhibit 10. Gas Storage Headed Toward Comfortable Level



Source: EIA, PPHB

The key questions for the gas market moving forward are what sort of winter we will experience and if we will have an early and severe cold wave

Natural gas prices continue to bounce around between $3.75 and $4.00 per thousand cubic feet based on the latest projections for weekly weather and temperatures. This price range reflects the market's comfort that there will be adequate supply heading into winter, which has negated the need for high prices to shed gas demand. The key questions for the gas market moving forward are what sort of winter we will experience and if we will have an early and severe cold wave. After that, gas price questions quickly become ones about the longer term outlook for natural gas supply and demand, and in particular, how much liquefied natural gas (LNG) export will occur, what happens to the fuel mix for powering the nation's electricity, will the anticipated industrial revival tied to using natural gas actually materialize and, importantly, what is the gas supply outlook. Over the next few issues of the *Musings* we plan to examine these longer term questions.

Challenges Of Shale-Driven Boom - Will It Last For Long?

Two items crossed our desk last week that drove us to look closer at what is happening in the North Dakota oil shale boom. One was a set of Bakken and Three Forks shale formation production data in the state and the other was the announcement of plans to spend $800 million to improve infrastructure and overcome social issues.

Exhibit 11. Where The Bakken Formation Lies

Source: Department of the Interior

The Bakken oil shale boom ranks as one of the most impressive successes in the history of the American oil and gas business. The

Bakken output growth has grown to over one million barrels of oil per day now from less than two thousand barrels per day in December 2004

shale formation lies within the broadly defined Williston Basin, a long-standing oil and gas producing region that covers parts of North Dakota, South Dakota and Montana, and extends across the border into Canada's Saskatchewan and Manitoba provinces. The Bakken production is largely concentrated in North Dakota and Montana as well as Saskatchewan. Bakken output growth has grown to over one million barrels of oil per day now from less than two thousand barrels per day in December 2004, when North Dakota was a minor oil producing state ranking only ninth in output. The state now ranks as the number two oil-producing state behind Texas.

North Dakota has created 75,000 new jobs over the past three years, but still has 25,000 job openings and the lowest state unemployment rate at 3%

The oil and gas boom that has exploded in North Dakota has been the subject of many mainstream media articles because it has produced amazing economic data-points and human interest stories that make for heady news copy. For example, the state has created 75,000 new jobs over the past three years, but still has 25,000 job openings and the lowest state unemployment rate at 3%. North Dakota's economy is growing at five-times the national average. In 2012, the state ranked 43rd in the number of millionaire households, but last year was up to 29th and continues climbing in the rankings. Workers with no college degrees but willing to work in challenging oilfield positions can earn six-figure incomes. Of course, the cost of living is high as two-bedroom apartments that used to rent for $500 a month now cost $2,500 if available. Affordable housing is one of the major challenges for workers and families. Wages in low-skilled positions such as line workers at McDonald's are being paid $14 an hour plus a bonus to sign on, while at Walmart they are paying $19.28 per hour for shelf-stockers. Some women can earn up to $2,500 per shift in strip bars, assuming that is their choice of an occupation. With the boom, however, come social problems such as alcoholism, suicide, depression and homelessness, to name a few.

The state's Republican legislature has just unveiled an $800 million investment plan to help municipalities

One of the problems for North Dakota has been the cost of dealing with the surging population of oilfield workers and their families and the impact on communities. In response, the state's Republican legislature has just unveiled an $800 million investment plan to help municipalities. The money will come from North Dakota's Strategic Investment and Improvement Fund that is partly funded by oil and gas taxes and currently has over $1 billion of funds. The plan calls for $475 million to be paid to the counties and cities impacted by the oil boom. The three oil patch hub cities – Minot, Dickinson and Williston – are to receive $140 million, while $35 million will flow to county schools stressed by the population explosion related to the oil boom. Lastly, $150 million of the funding will be allocated to road projects outside of the oil patch area.

While North Dakota politicians are reacting to the problems and challenges of managing the impact of the oil boom on their state, the production data from the state's Department of Mineral Resources (DMR) that was sent to us reflected what the sender referred to as "squirrelly." He was referring to the column of data in Exhibit 12

The trend in daily oil production per well is also trending lower in the two most recent years (130 and 134), yet the number of new wells remains high – the 1700-1800 range

reflecting net oil production added per well. It shows that while historically volatile, the total appears to have dropped dramatically into the 113 range in the past two years from the levels of 130-170 in prior years. The trend in daily oil production per well is also trending lower in the two most recent years (130 and 134), yet the number of new wells remains high – the 1700-1800 range. An interesting side note about the activity level is the growth in the number of uncompleted wells in recent years. This growth reflects the industry's drilling proficiency and high rig count versus the time and resources required to hydraulically fracture and complete the wells.

Exhibit 12. Bakken Production Data Raises Questions

Bakken Oil Production (September to August for each year, plus September 2013 to April 2014)*

Year (To August)	Wells (August)	New Wells	Daily Oil Production	Daily Added Production	Daily Production Per Well	Net Added Per Well	Uncompl. Wells
2005	201		2750				
2006	258	57	5838	3088	23	54.2	
2007	382	124	22,342	16,504	58	133.1	
2008	701	319	83,072	60,730	119	190.4	
2009	1184	483	151,522	68,450	128	141.7	
2010	1799	615	255,579	104,057	142	169.2	
2011	2749	950	379,371	123,792	138	130.3	
2012	4469	1720	638,187	258,816	143	150.5	340
2013	6314	1845	847,690	209,503	**134**	**113.6**	520
To July 2014	8065	1751	1,047,044	199,354	**130**	**113.9**	630

Source: North Dakota DMR

94% of the state's output is from the Bakken formation

After considering the data sent to us, we decided to examine the data provided by the DMR's Oil and Gas Division web site. Data is presented for the state's total oil production along with statistics for just the Bakken formation. The difference between the two production volumes is about 63,000 barrels per day, suggesting how important the Bakken is to the state's overall output. In fact, the September 12th Director's Cut, which is an early snapshot of monthly statistics about oil and gas activity in North Dakota, shows that 94% of the state's output is from the Bakken formation.

95% of all drilling rigs are targeting the unconventional Bakken and Three Forks formations

The monthly report is a wealth of data about current trends and the status of oilfield activity in North Dakota. With respect to drilling, the average drilling rig count has grown from 190 in June to 192 in July and 193 in August, but as of early September it is up to 198. According to the report, 95% of all drilling rigs are targeting the unconventional Bakken and Three Forks formations. The peak in the state's drilling activity of 218 active rigs came in late May 2012. The 9% decline in the overall rig count from the peak may suggest a more active drilling effort outside of the core areas of the Bakken as the top five most active counties have experienced declines ranging from 5% to 29%.

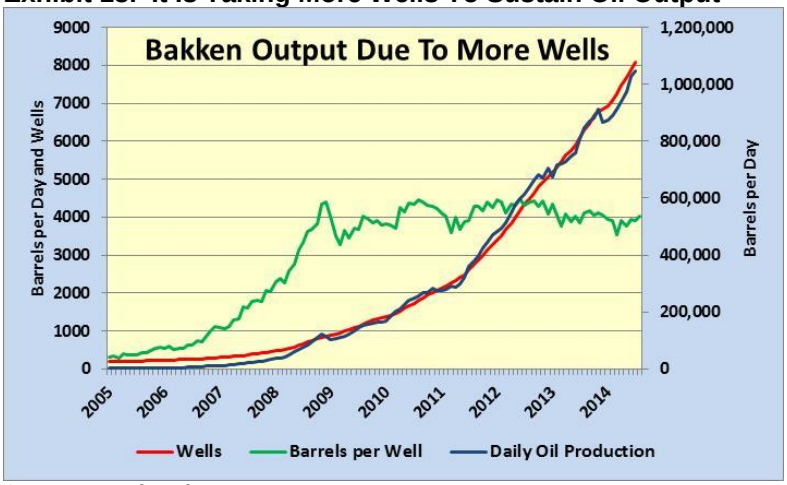
An interesting point about the state's wells is that unconventional Bakken and Three Forks wells represent 70% of the total while 30% are producing from conventional formations

An interesting point about the state's wells is that unconventional Bakken and Three Forks wells represent 70% of the total while 30% are producing from conventional formations. This disparity demonstrates how significant the Bakken wells are since 70% of producing wells account for 94% of the state's total oil production. The number of well completions increased from 188 in June to 197 in July, the latest month available. The report mentioned that there had not been any rain in July to upset completion activity, but it pointed out that there were 4-5 days in the month when winds were in excess of 35 miles per hour that prevented completion work from proceeding, obviously due to the wind's impact on the mast of completion rigs. Another important data point was that the number of drilled but uncompleted wells increased by 45 between June and July, which shows how proficient drillers have become.

Are we reaching a point where the "treadmill" effect is beginning?

Although drilling activity is down from its peak, the industry is still operating at a high level. That is what makes the well data our friend sent troublesome. Are we reaching a point where the "treadmill" effect is beginning? By that we mean the point at which the industry must drill more wells merely to maintain production. Since 2005, the growth in Bakken output has matched the increase in the number of producing wells. Exhibit 13 also shows how output per well has remained essentially stable since mid-2008 to now.

Exhibit 13. It Is Taking More Wells To Sustain Oil Output



Source: North Dakota DMR, PPHB

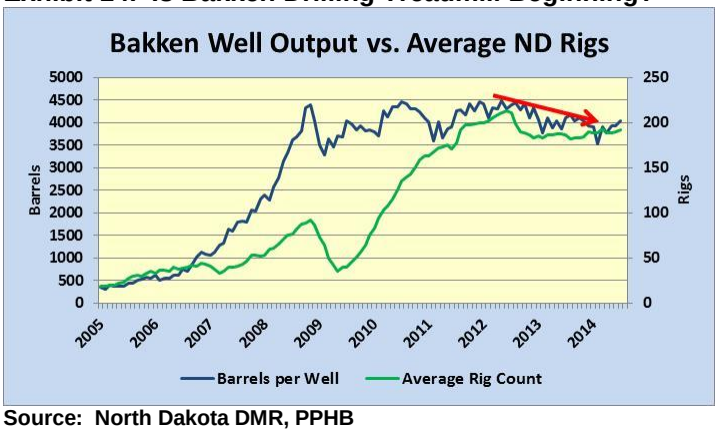
When the drilling rig count peaked in 2012, so did the average well's output

While we did not have the actual number of active drilling rigs targeting the Bakken formation, we utilized the history of average monthly drilling rigs for all of North Dakota as representative since 95% of its drilling rigs are currently targeting unconventional formations. When we plotted the history of Bakken well output against the North Dakota drilling rig count, we noticed a point of concern. When the drilling rig count peaked in 2012, so did the average well's output. Since then, there has been a decline in the rig count along with a decline in well output. In the past few months,

Average well output also may be boosted by the completion of those drilled but uncompleted wells, depending on where they are located

the average well output has risen, so with the drilling rig count beginning to rise, the question is whether these represent permanent changes in the trends. It is possible that well output may continue increasing if the wells currently being drilled are in field locations within the core of the basin. Average well output also may be boosted by the completion of those drilled but uncompleted wells, depending on where they are located. On the other hand, if future drilling activity targets less productive parts of the Bakken formation, the treadmill needs to be cranked up.

Exhibit 14. Is Bakken Drilling Treadmill Beginning?



Source: North Dakota DMR, PPHB

Some of that bright light will disappear as natural gas is captured and placed into pipelines rather than being burned

The disturbing aspect about the outlook in North Dakota is the impact of the need to control drilling as the industry addresses capturing associated natural gas output that is currently being flared. The impact of the high level of drilling and gas flaring has been captured in a picture from space. Some of that bright light will disappear as natural gas is captured and placed into pipelines rather than being burned. The near-term impact, however, according to the state's governor, will be a decline in drilling as this

Exhibit 15. Flares And Drilling Rigs Light Up Bakken

Source: *skytruth.org*

transition is accomplished. Unfortunately, he did not quantify what that decline might be, how long it would last or when it would start.

Underlying this issue, however, is whether we effectively utilize the energy/economic advantage shale has given the U.S. before the rocks begin to fail

The shale booms of the Bakken, Marcellus/Utica and Eagle Ford formations have created both good and bad things for the nation and their regions. Responsible development of our shale oil and gas resources is important for the health of the U.S. economy, but the industry must pay attention to the social and unintended consequences of that development activity. Underlying this issue, however, is whether we effectively utilize the energy/economic advantage shale has given the U.S. before the rocks begin to fail. When that might happen is unknown, but the current data points in the Bakken oilfield raise troubling questions for which no one has an answer. Without considering the potential end to this boom we risk making a huge misallocation of national resources. This is an issue that needs to be constantly examined.

Massachusetts Justice And The Dog That Didn't Bark

Holmes deduced from the fact that the dog didn't bark meant the thief was someone well known to the dog

Most people, we assume, are familiar with the famous London fictional detective, Sherlock Holmes, created by British writer Sir Arthur Conan Doyle. What we don't know is how many readers are familiar with his short story "Silver Blaze" published 122 years ago in 1892, in his book Memoirs of Sherlock Holmes. Briefly, the story deals with the theft one night of a race horse and the fact that no one heard the guard dog bark. Holmes deduced from the fact that the dog didn't bark meant the thief was someone well known to the dog. This story came to mind when we read about the recent resolution of a potentially highly-charged environmental case in Massachusetts.

They planned to employ a defense that had never been used before in a case such as this and that would have put the issue of climate change front and center in the legal system

The case was on our radar screen because the two environmentalists charged with blocking a coal shipment to New England's largest coal-fired power plant in 2013 acknowledged their guilt. However, they planned to employ a defense that had never been used before in a case such as this and that would have put the issue of climate change front and center in the legal system. Environmental activists Ken Ward and Jonathan "Jay" O'Hara were charged with crimes stemming from their decision in May 2013 to anchor a 32-foot lobster boat in the path of a freighter hauling 40,000 tons of Appalachia-mined coal that was heading to the Brayton Point Power Station in Somerset, Massachusetts. The two men positioned their boat near the power plant's pier, dropped a 200-pound anchor and raised two banners – one declaring #coalissstupid and the other displaying the logo of the environmental group 350.org. By doing so, the two men – one the former president of the National Environmental Law Center and the other a sailmaker – were preventing the 700-foot freighter, Energy Enterprise, from delivering its cargo.

The two gentlemen were charged with disturbing the peace, conspiracy, failure to act to avoid a collision and negligent operation of a motor vessel. It took the combined efforts of the U.S. Coast Guard, area police departments and a commercial salvage boat most of the afternoon to raise the anchor and move the boat. The next day the Energy Enterprise was able to dock and unload its coal cargo.

The men were prepared to argue that the "urgency and necessity of dramatic steps to curb carbon pollution to mitigate the global climate crisis" justified their actions

The men were prepared to argue that the "urgency and necessity of dramatic steps to curb carbon pollution to mitigate the global climate crisis" justified their actions. The case became moot when Bristol County District Attorney Sam Sutter announced he had reached a deal to dismiss or downgrade the charges against the two activists because of the need to address climate pollution. The defendants agreed to pay $2,000 each in restitution to the local police department to offset the time and expense for removing the anchor and boat.

Exhibit 16. Government Drops Case On Climate Change

Source: National Journal from LobsertBoatBlockage.org

Mr. Sutter declared, "Climate change is one of the gravest crisis [sic] our planet has ever faced"

The media scene was amazing as the District Attorney, an unsuccessful congressional candidate in 2012, used the deal to position himself as tough on the environment. He delivered what was described as a passionate speech against the dangers of climate change. Holding up a copy of *Rolling Stone* magazine featuring an article written by Bill McKibben, a Middlebury College professor, environmental activist and leader of the environmental movement 350.org, Mr. Sutter declared, "Climate change is one of the gravest crisis [sic] our planet has ever faced." He went on to say, "In my humble opinion, the political leadership on this issue has been sorely lacking. I am heartened that we were able to forge an agreement that both parties were pleased with and that appeared to satisfy the police and those here in sympathy with the individuals who were charged."

The "necessity" defense is most often used for trespassing charges

The "necessity" defense is most often used for trespassing charges when a person is avoiding greater harm such as jumping into someone's yard to avoid being hit by a car climbing the sidewalk. In Massachusetts, according to an article written by a Harvard law student, the courts require that defendants prove "clear and imminent danger" that the actions "would be effective in directly reducing or eliminating the danger," and that there was "no legal alternative which would have been effective" to combat the danger.

Was it possible Mr. Sutter wanted to use the "dog didn't bark" logic to elevate himself personally as a champion of climate change, which is rapidly becoming a high-profile campaign issue in Massachusetts?

The defense was planning on having Mr. McKibben, along with former NASA scientist and global warming activist, James Hansen, testify during the trial. One has to wonder why, if the district attorney agreed with the defendants about the danger from climate change, he waited to the very last minute to settle the case. Or was it possible Mr. Sutter wanted to use the "dog didn't bark" logic to elevate himself personally as a champion of climate change, which is rapidly becoming a high-profile campaign issue in Massachusetts? Mr. Sutter used his press conference to also announce that he planned to participate in the climate change march in Washington scheduled for this past Sunday.

So many and so serious were the errors that the judge ordered the sponsors of the movie to prepare a correction and show that to the British schoolchildren

We also wonder whether Mr. Sutter felt he couldn't present a case against the climate change defense, or he just didn't want to. This case potentially could have been extremely interesting. The only other trial over the claims about climate change that we are familiar with was the British trial over Al Gore's movie, *An Inconvenient Truth*. In that case, the British judge found numerous factual errors in Mr. Gore's presentation. So many and so serious were the errors that the judge ordered the sponsors of the movie to prepare a correction and show that to the British schoolchildren.

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