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ENERGY INVESTMENT BANKING

MUSINGS FROM THE OIL PATCH

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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

What If The World Enters A New Global Cooling Period?

Recent mortality studies in a number of major countries around the globe show more people dying from extreme cold weather events than from heat waves

In our last issue of the *Musings* we commented on a *New York Times* column by personal health writer Jane Brody highlighting recent studies showing that cold temperatures cause more deaths than heat spells. One of the catastrophic scenarios popular among proponents of global warming is a surge in deaths due to extreme heat events. The problem is, as Ms. Brody pointed out, that recent mortality studies in a number of major countries around the globe show more people dying from extreme cold weather events than from heat waves. In light of this research, we found two recent articles, one dealing with the Environmental Protection Agency's (EPA) demand that Alaskan residents stop using wood-burning stoves for warming due to air pollution issues, while the author of the other article reported on a recently unveiled European scientific model presented at the National Astronomy Meeting in Wales predicting a "mini ice age" from 2030 to 2040 as a result of decreased solar activity.

Wow! With the media reporting either the warmest month or year in modern times (or at least since man started collecting temperature data), the idea that we might be actually heading back into another Ice Age is disturbing. However, if we were cynics, we would lean on the old axiom that when a trend is on the front page of the newspaper, it has peaked and we are on the way to an alternative scenario.

According to an article on *The Federalist* blog, Alaskan native John Daniel Davidson wrote about the absurdity of the EPA's move to restrict the use of wood-burning stoves based on his personal experience growing up in the nation's 49th state. Reports are that the EPA could soon declare the Alaskan cities of Fairbanks and North Pole, with a combined population of 100,000, to be in "serious"

noncompliance of the Clean Air Act early in 2017. (Anyone want to take odds it will happen before Inauguration Day, Jan. 20th?)

All options, including fining residents using them have been considered since being in non-compliance risks the loss of federal funds for transportation projects

In 2008, the EPA ruled that wide swaths of the most densely populated parts of Alaska were in "non-attainment" of federal air quality standards. This set off an initiative by Alaskan state and local government officials to find ways to cut down on the pollution from wood-burning stoves. All options, including fining residents using them have been considered since being in non-compliance risks the loss of federal funds for transportation projects. The problem is that there aren't any realistic options. Heating oil is very expensive and natural gas isn't available. Electric heat generated by wind and solar is also not a feasible alternative.

Part of the problem is that the smoke coming from wood stove fires is not like smog in large cities

In Fairbanks, the average low temperature in December is -13° F, which only gets colder in January (-17° F). The coldest days during the winter can see a high temperature of -2° F with lows in the -60° F range – killing conditions if heat is not maintained. Therefore, for most residents, and especially for lower-income residents, they keep their wood fires burning all day and night, even though they know it can be unhealthy. Part of the problem is that the smoke coming from wood stove fires is not like smog in large cities. The main problem for wood-fire smoke during the winter is that with these extremely cold temperatures there is a problem due to local inversions when the smoke falls rather than rises. Importantly, the areas impacted by inversions in Alaska are very small, such as a single street or city block, rather than an entire city.

These wood stoves are a problem, but the government isn't interested in working with the people to find an acceptable solution

Since the EPA's ruling, the effort to find a solution to the wood-burning stoves remains elusive. As the editors of the local Fairbanks newspaper put it, "The borough faces two unpalatable alternatives: More stringent restrictions on home heating devices that could impact residents' ability to heat their homes affordably, or choosing to stand pat and accept a host of costly economic sanctions and health effects to residents." Neither of those options is satisfactory. From the EPA's point of view, the official in charge says the agency isn't trying to make residents' lives more expensive or difficult, but the agency has an obligation to enforce the air quality standards set by the Clean Air Act. The bottom line is that these wood stoves are a problem, but the government isn't interested in working with the people to find an acceptable solution to the emissions challenge.

As for a new Ice Age, the Russian Academy of Science's Pulkovo Observatory in St. Petersburg, considered one of the world's most prestigious scientific institutions, recently issued a new study titled, "The New Little Ice Age Has Started." According to the study, the average temperature around the globe will fall by about 1.5° C (2.7° F) when the planet enters the deep cooling phase of this new Little Ice Age, expected in the year 2060. The study goes on to predict that after 2060 the Earth will experience four-to-six 11-year solar

cycles of cool temperatures before beginning the next quasi-bicentennial warming cycle around the turn of the 22nd century.

Habibullo Abdussamatov is the head of space research at Pulkovo and the author of the study. He has been predicting the arrival of another ice age since 2003, based on his study of the behavior of the sun's different cycles and the solar activity that then results. His model is based on data from the Earth's 18 earlier little ice ages over the past 7,500 years, six of them experienced during the last thousand years. Based on his model, he began predicting over a decade ago that the next little ice age would start between 2012 and 2015. Abdussamatov's models have been affirmed by actual data, including the rise of the oceans and the measurable irradiance sent earthward by the sun. Given the accuracy of his predictions, which have been demonstrated in numerous studies since 2003, he now predicts that we entered the 19th Little Ice Age in 2014-2015. This forecast would appear to fly in the face of climate change scientists pointing to 2015 and 2016 as being the warmest years on record – and forecasts that we will experience more record warmth in coming years.

Given the accuracy of his predictions, which have been demonstrated in numerous studies since 2003, he now predicts that we entered the 19th Little Ice Age in 2014-2015

Mr. Abdussamatov's views stand in opposition to the conclusions of climate models, as he has tied his forecast of a prolonged cooling spell to solar, not man-made, factors. The recent disappearance of sunspots from the face of the sun, which also occurred during the Little Ice Age in the late 1600s, has made Mr. Abdussamatov's contention no longer an isolated view. In fact, organizations such as the National Astronomical Observatory of Japan and the Riken research foundation have reached similar conclusions. The battle over whether man-made or natural forces are the primary driving force behind global warming and climate change will likely become more contentious in the next few years. The key point is that the world's population is at greater risk of serious harm from colder temperatures rather than warm temperatures, which seems to be ignored by government officials and the media. We guess, cold and ice doesn't lend themselves to as spectacular disaster scenes as heat-related weather events.

The world's population is at greater risk of serious harm from colder temperatures rather than warm temperatures

"The world must start preparing for the new Little Ice Age right now," warns Mr. Abdussamatov. "Politicians and business leaders must make full economic calculations of the impact of the new Little Ice Age on everything — industry, agriculture, living conditions, development. The most reasonable way to fight against the new Little Ice Age is a complex of special steps aimed at support of economic growth and energy-saving production to adapt mankind to the forthcoming period of deep cooling."

"The world must start preparing for the new Little Ice Age right now"

In his conclusion, Mr. Abdussamatov states, "The upcoming climate change will be the most important challenge and a priority issue for the world and define the main events in politics, the economy, and the most important areas of the whole of humanity in the coming

If the science of climate change were truly settled, we wouldn't be having these debates

decades. It's time we took the threat of climate change — of the real climate change — seriously." His message of the dangers of underestimating and failing to prepare for another Ice Age is as ominous as that of the climate change supporters who rue the disastrous risks we are running by not preparing for an overheated planet. If the science of climate change were truly settled, we wouldn't be having these debates, but the absence of sun spots and its correlation to the Little Ice Age is a fact. It seems that only a few in the media are willing to point out the serious risks to the human population from global cooling. Is it possible to prepare the world for both scenarios at the same time?

Energy Themes Of 2017 Will Mirror Those Of 2016

We also possess an additional year's worth of life's experiences to draw upon

Flipping the calendar from one year to the next often brings a different perspective about the future. Yes, we are one year older, but we also possess an additional year's worth of life's experiences to draw upon. The question quickly becomes wondering about whether our optimism for the yet-to-be-experienced future is little more than a misjudged view of how bad our immediate past was or whether it really is based on a better outlook.

Most forecasters are tied to models that essentially are linear extensions of the recent past

Athletes are trained to mentally envision their future success as a tool for driving their training. On the other hand, most forecasters are tied to models that essentially are linear extensions of the recent past. Science fiction writers and futurists seem to be the most likely sources of future outlooks that are radically different from anything we can imagine, since most of our views tend to be merely extrapolations of a better or worse past and present.

For those involved in the energy business, turning the calendar page from 2016 to 2017 has generated a much greater sense of optimism than at any time in the past two years. Why? Primarily because those people with the greatest power to influence the economics of our industry have decided that they were tired of the financial pain they had willed on themselves two years ago in an effort to teach various "out-of-line" participants across the globe a lesson about fossil fuel economics. Is this act an admission of failure or just a smug view of success?

Will the outcome of 2017 match the level of current optimism?

This newfound optimism for better industry economics reflects the new era of co-operation among OPEC's members and a handful of large non-member oil exporters, something not experienced in nearly a decade. Will the outcome of 2017 match the level of current optimism? Probably not.

The answer to our question is unknown. What we believe, however, is that the major headwinds that have restricted the industry's recovery are diminishing. The global crude oil oversupply is shrinking as the two-year decline in drilling has taken its toll on

Will force us to re-examine our assumptions about the long-term growth rate for the fossil fuel industry

output, sending production lower in most regions of the world. Although global oil demand growth has not suffered in recent years, it hasn't responded as much to the sharp fall in global oil prices as many initially expected. That may reflect the success we have had in educating people about the cyclicality of the oil industry and petroleum prices such that any price decline quickly becomes an expectation game about how long before prices go back up – and likely even higher. It is also possible we are witnessing the early signs of changes in the underlying drivers for energy demand, which will force us to re-examine our assumptions about the long-term growth rate for the fossil fuel industry.

Both scenarios represent minor tweaks to the underlying primary drivers of energy demand, which are world population growth and rising living standards

It is often difficult to separate short-term from long-term issues impacting energy because the differences are often merely slight variations of larger dynamic trends. The variations often largely result from the timing of where we are in our economic cycles. For example, when the global economy is recovering from a recession, or a slow-growth period, prospects for increased energy consumption are high. That generally translates into higher commodity prices. Likewise, as we teeter on the brink of an economic recession, the future for energy demand growth seems less promising, putting downward pressure on oil prices. Both scenarios represent minor tweaks to the underlying primary drivers of energy demand, which are world population growth and rising living standards. They mean more energy is needed. This is one reason why, when we examine long-term energy forecasts – those to 2035 or 2040 – prepared by oil companies, government agencies, think tanks or investors, the lines on the charts always appear to be smooth trends either rising or falling depending upon what is being measured. On the contrary, short-term oil industry forecasts often reflect much greater movement (volatility in the measures plotted) due to assumptions about the specific timing for economic recoveries or declines.

In general, we believe the primary issues that shaped the discussion about energy's future throughout 2016 will be the same ones influencing our views about 2017's future. We have listed ten such issues that we classify as primary drivers for energy use, including the mix of fuels powering our economy and what may happen to their prices. Many of these issues are multifaceted making it difficult to adequately frame the debate surrounding them, or to even be in a position to say that this list is all-encompassing. In the course of this article, we expect to touch on most, if not all, of these items, recognizing that each one is worthy of its own in-depth article.

1. Rebalancing global oil market and the future for oil prices
2. Global economic health and oil demand growth
3. Increasing use of natural gas
4. Environmental impact on fossil fuel use and development
5. Improved economics of oil and gas

6. Changing geopolitical landscape for energy use and supplies
7. Shifting from peak oil supply concerns to those of peak oil demand
8. Shifting geopolitical framework in Middle East
9. Beyond petroleum being revisited by the industry?
10. Where are we in the natural transition toward our next source of energy supply

We face a major challenge in recognizing and understanding how important any shifts taking place in our energy usage today are

Item 10 offers one of the more interesting prospects because the scope of the issue encompasses all the themes set forth in the previous nine questions, and then some. That "some" is the answer to the question of what will be our next energy source. All previous energy transitions throughout the history of man have required extended periods of time, and how significant these changes were only became evident with hindsight. This suggests we face a major challenge in recognizing and understanding how important any shifts taking place in our energy usage today are. More importantly, we face the challenge of knowing whether the changes are leading us to a new energy dynamic or are little more than a fine-tuning of our use of the current slate of energy sources available. This becomes clear when we examine the push by environmentalists for a non-carbon energy future based on harnessing wind, solar and wave energy, which are really a return to our past energy use when America and the world were primarily agrarian-based societies.

Where are we in our transition to the next energy source to power the world? In exploring this issue, we will touch on many of the other issues raised above, but probably not in the depth a separate examination of each would require. We believe there are three overriding trends at work defining our energy future, although maybe not for our generation but rather for future generations. Those trends are improvements in the use of our current slate of energy sources, including boosting their performance while reducing their impacts on our climate; the successful development of a new energy source with limited harmful impacts on the planet but which possess greater energy per pound of fuel, in keeping with the history of energy transitions; and a reorganization of our society and global economy that improves the lives of those who are currently energy-deprived and reduce the stresses of everyday life today.

This division comes, in our view, from a lack of intellectual curiosity and knowledge of history

One thing we have observed about our current energy situation and the ongoing debates over its future direction is how polarized the discussion has become. The energy world has been divided into those with white hats and who, unfortunately, only see everyone else wearing black hats. This division comes, in our view, from a lack of intellectual curiosity and knowledge of history. We have always been guided by a quotation by former British Prime Minister Winston Churchill who said, "The farther backward you can look, the farther forward you can see." This quotation may not be as famous as his quotes dealing with history repeating itself, but we find it an

excellent guide for understanding the various paths for the future open to us. Much of the examination of history will show how often something new is actually something old.

It helped that the road infrastructure was so poor that vehicle trips were limited in distance

For example, in reading articles about the history of the early automobile industry we were surprised to find that electric vehicles occupied such a dominant position as the industry evolved in its early days. Our examination of the automobile history was driven by our being overwhelmed by articles highlighting the latest electric car model being introduced by automakers and how it will revolutionizing the transportation business. What is driving the electric car revolution today has as much to do with automakers sensing market demands with attendant profit opportunities as the automobile pioneers at the turn of the 19th century sensed. Then, it was the prospect that the technology of batteries was ahead of that for internal combustion engines (ICE) and provided a superior vehicle trip experience. It helped that the road infrastructure was so poor that vehicle trips were limited in distance. Whether those limitations were governed by the infrastructure or the vehicle, most people seldom traveled very far in their lives.

These technical improvements came at the same time the hassles and limitations for vehicles utilizing batteries grew

Over time, with improved roads enabling cars to travel longer distances, the limitations of batteries became a significant headwind for this segment of the automobile fleet. Additional headwinds came from the efforts of automobile engineers to improve the starting and driving of ICE-powered cars. The invention of the electric starter eliminated the need to crank-start the engine, which was a challenge for many men and virtually impossible for female drivers. Easier gear-shifting further improved the driving experience, eliminating the muscle-power requirement for early ICE vehicles, or the need to stop to change gears when different road conditions were encountered. These technical improvements came at the same time the hassles and limitations for vehicles utilizing batteries grew. When networks of gasoline stations sprung up across the country, the future of ICE vehicles was assured while at the same time diminishing the attractiveness of battery- and steam-powered cars, the Petroleum Age was born.

Electric vehicles are often presented as a recent phenomenon even though they represented over a third (37.5%) of total vehicle sales in the United States in 1900

Electric vehicles have been resurrected in recent years as the preferred solution for addressing the perils created by increased carbon emissions from burning fossil fuels used to power the world's vehicle fleet. Electric vehicles are often presented as a recent phenomenon even though they represented over a third (37.5%) of total vehicle sales in the United States in 1900. In fact, at that time there were more electric automobiles on New York City streets than cars powered by gasoline.

Electric vehicles were first developed in England and France in the late 1800s. It wasn't until 1895 that Americans paid attention to them and began to offer innovations that increased their popularity. In 1897, the first commercial application of electric vehicles took the

form of a fleet of taxis in New York City as a precursor for a plan to create a nationwide monopoly of electric taxi companies throughout the major cities of the United States.

The taxis were leased, and 13 were operating in New York City in 1897

The history of the Electric Vehicle Company proved Icarus-like. In 1897, the company was founded as a holding company by Isaac Rice who subsequently acquired the Electric Carriage & Wagon Company operated by Henry Morris and Pedro Salom, two engineers who created the Electrobats, the first truly electric automobile in the U.S. Rice's company created a taxi business using electric vehicles and a service station network for quick changes of depleted batteries and other minor vehicle repairs. The taxis were leased, and 13 were operating in New York City in 1897. Before its ultimate demise the company had built over 2,000 taxis, trucks and buses and its factory in Hartford, Connecticut was the largest electric vehicle assembly in the world.

In 1899, the Electric Vehicle Company was taken over by a syndicate organized by William Whitney, a street car tycoon, playboy and former Secretary of the Navy. The syndicate envisioned creating a taxi cab monopoly in every major city in America, with New York City the start. The initial fleet of 13 electric taxis grew as Whitney added 200. The idea of the taxis returning to a central battery storage facility on Broadway in order to have the worn-out batteries replaced with freshly charged ones was designed to enable the taxi to run all day with only brief stops for new batteries - thus overcoming battery charging and vehicle travel limitations.

Whitney's downfall was his desire to grow rapidly

Whitney's downfall was his desire to grow rapidly as he ordered 1,600 more electric taxis, but did not expand commensurately his stock of extra batteries. As a result, the taxi fleet struggled with under-charged or uncharged batteries limiting the performance of the fleet. Poor performance crimped revenues while expenses escalated due to worsening maintenance practices. As with most of the industrial syndicates in those days, their financial leverage could not withstand the income glitch. By 1901 the company's regional operations were shut down and by 1907 the Electric Vehicle Company was completely out of business. A combination of overly optimistic growth expectations coupled with poor business operating performance ran into the financial constraints of high financial leverage. These conditions resulted in the rapid demise of the company, not an unheard of scenario in the modern business world.

What we learned about the early automobile industry was that for some period of time there were multiple competing technologies – each with its own technological strengths and weaknesses – that had to fight it out in the marketplace. As technological innovations helped improve the main technologies, social attitudes and governmental policies also helped to reshape the business landscape providing an easier path to critical mass and financial success that ultimately separated the winners from the also-rans.

Public policy played less of a role in this competition than it is in our current energy technology battles

For the automobile industry, there were clearly three technologies dominating the business at the turn of the 19th century – steam, electric and internal combustion. The internal combustion segment was further divided among various fuel sources including gasoline, ethanol and diesel. What drove the internal combustion engine's success was the innovations that made its strengths overwhelming versus its competitors. Public policy played less of a role in this competition than it is in our current energy technology battles.

One of the major inhibitors to ICE vehicles was the difficulty drivers encountered when shifting gears. But that problem was further complicated by the issues of vibration, fuel smell and noise for ICE vehicles. Steam-powered vehicles did not have the problem with gear shifting, but they suffered from long start-up times of up to 45 minutes during cold weather. Steam cars also suffered from range limitation due to the fact they had to stop periodically to add water. What tipped the scales in favor of ICE vehicles fueled by gasoline was a confluence of both technical and social developments.

The most revolutionary developments were the electric starter and the revolutionary drive train employing a clutch, a 3-speed sliding gear transmission and chain-driven axle. The electric starter eliminated the hand crank used to manually start the engine. The new drive train system, the basis of all transmissions throughout the 20th century, eliminated the shaft and pulley arrangement with leather belts that engaged ring gears on the driving wheels, and required a complete stop and change in order to gain increased power for climbing hills rather than greater speed for flat roads.

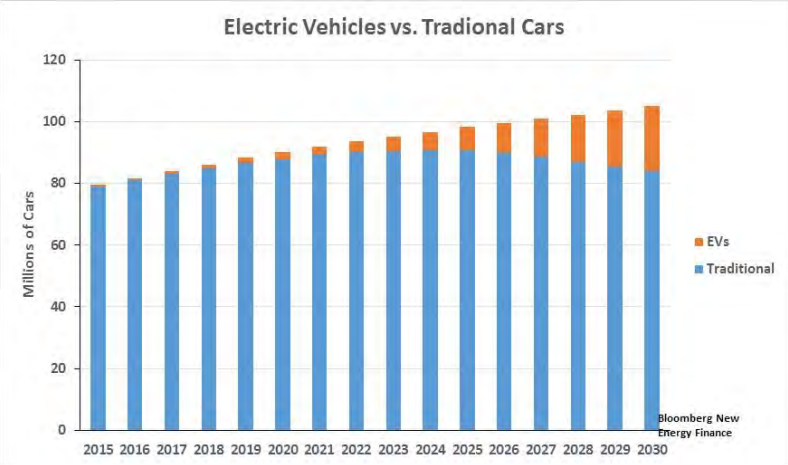
The discovery of oil in Texas led to reduced gasoline prices making ICE cars more affordable

From a social perspective, the improvement in the nation's system of roads connecting cities encouraged longer distance traveling by cars. The discovery of oil in Texas led to reduced gasoline prices making ICE cars more affordable, while the mass production of autos on assembly lines such as those pioneered by Ransome Olds and Henry Ford significantly cut the price of autos making them affordable for a very large segment of the American population. The combination of developments tipped the scales in favor of gasoline-powered cars over steam or electric powered ones.

Today, electric vehicles are "succeeding" because of government mandates, incentives and capturing social attitudes

What separates the success of electric vehicles at the turn of the 19th century versus today is that the earlier electric cars possessed commercial advantages over their competitors. Today, electric vehicles are "succeeding" because of government mandates, incentives and capturing social attitudes, which have combined to create a niche business that is projected to become a dominant force sometime in the next decade, based on forecasts. *Bloomberg New Energy Finance* projects that in the early 2020s, conventionally-powered vehicles will cease growing, leaving all the global automobile fleet growth to electric vehicles. By 2030, according to the forecast, electric vehicles (EVs) will account for about 20% of total global fleet new vehicle sales.

Exhibit 1. Electric Cars Will Become More Important



Source: Bloomberg New Energy Finance, PPHB

EVs will only represent 7.2%, while conventional vehicles will account for 92.8% of all cars sold

This forecast suggests significant changes on the horizon for both the automobile manufacturers, their suppliers and the petroleum industry. However, when we examine the *Bloomberg New Energy Finance* forecast in greater depth, we find its EV growth scenario less scary. Over the period 2015-2030, there will be 108.2 million EVs sold, but that compares with 1,387.7 million conventionally powered vehicles. In other words, if we assume that all the vehicles sold during this 16-year span constitute the total global vehicle fleet, EVs will only represent 7.2%, while conventional vehicles will account for 92.8% of all cars sold. Since the number of EVs in the world fleet as of 2015 is a minuscule number, the world vehicle fleet is going to need substantial volumes of gasoline and diesel fuel for decades, despite the rapid growth in the number of EVs sold.

Raising the cost of gasoline and diesel fuel in these countries will impact consumption

That outlook doesn't mean that gasoline consumption won't be impacted, but the magnitude may depend on other variables besides merely the growth in the number of EVs in the fleet. In light of the collapse in global oil prices over the past two years, a number of countries have been forced to cut back on their generous fuel subsidies for their citizens. Raising the cost of gasoline and diesel fuel in these countries will impact consumption. Another variable impacting consumption is the fuel-efficiency of the future fleet. While the United States is in the forefront of improving vehicle fuel-efficiency, those gains can be offset by drivers traveling greater distances. For many years, U.S. vehicle miles traveled were flat or down, but in the past two years they have begun rising suggesting that people are treating the lower gasoline pump prices as a license to drive more, thereby muting the impact of more fuel-efficient vehicles in the fleet.

The health of economies and the demographics of the citizens will also have an impact on vehicle miles traveled. The one long-term trend in place that may have the strongest impact is the aging

What we know about older people is that they are less active, meaning that they often retire their vehicles, no longer commute and often don't take long car trips

demographic. Data from McKinsey & Co. shows that the proportion of Americans 65 and older will rise steadily from 15% today to nearly 25% by 2060. Similar increases among aging segments of their populations will be experienced throughout Europe, China and Japan. In fact, Japan is the world's "oldest country" with 25% of its population 65 or older. That proportion is projected to rise to 36% by 2040. What we know about older people is that they are less active, meaning that they often retire their vehicles, no longer commute and often don't take long car trips. They are also greater consumers of alternative transportation such as taxis, ride-sharing and relying on friends and relatives for their travel needs.

Some of the concerns and opportunities for the energy business were captured in a year-end interview in *Barron's* with Shawn Driscoll, the portfolio manager of the T. Rowe Price New Era fund (PRNEX-Nasdaq). The New Era fund was created in January 1969 and focuses on natural resource investments. Over the years we have had the pleasure of dealing with several of its portfolio managers, although not with Mr. Driscoll. We found his view about energy, OPEC and today's similarity to history of great interest. Quoting from the interview:

"Barrons: We've just seen non-OPEC and OPEC producing countries agreeing to production cuts. How significant are these?

"Driscoll: They're significant in the short term, but our longer-term view is that we're in a secular bear market for oil and the rest of the commodity complex.

"Q: Has the OPEC move already been priced into the market?

"A: Yes. We think this bear market is very similar to the '80s and '90s—actually, we think it is worse—and OPEC was pretty ineffective except over very short time frames during that period. That's because capital efficiency is getting so much better so quickly. Like any commodity, you take some supply offline for a short period of time, it will matter. But the supply response is always underestimated and a lot quicker than people realize when you are going through a period of technological disruption, and that's what's going on right now.

"Q: So we're going to see a lot more supply?

"A: There is a wave coming. It has already started. U.S. oil production bottomed in September, in our view. We think U.S. fracking recovery rates are still just 10%.

"Q: How long will this bear market go on?

"A: Ten to 15 years.

"Q: Ouch. You've been a very good prognosticator on prices. Where do you see them going in the next year?

"A: The sugar rush is going to continue in 2017, but only for a short time. The International Energy Agency made the case that we were undersupplied for '17, but we're not. We have a million barrels a day over [demand], and the missing piece in everyone's model is how quickly and how big the U.S. comes back, and I still think that is being massively underestimated. My guess is we peak out some time in the first quarter and then by the time we exit 2017 we're back in the soup—sub-$50-a-barrel oil—and then at some time in '18 we dip below $40 a barrel."

Maybe Mr. Driscoll's analysis has put his finger on the several industry driving forces that are acting similarly to how they did at the end of the 1980s and 1990s – namely, a surge in new oil supplies and at lower costs

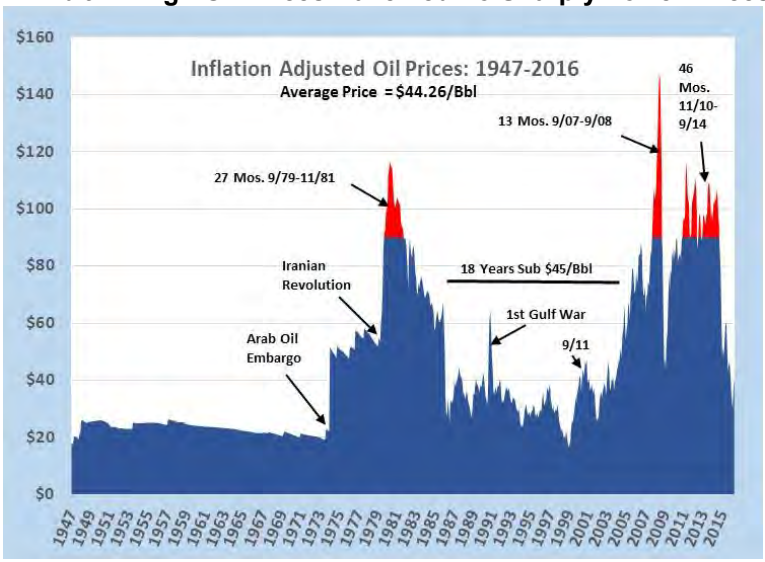
Mr. Driscoll's view is certainly not in line with the growing optimism expressed in the offices of E&P and oilfield service companies, nor on Wall Street where the analysts have become uniformly bullish about the earnings outlook for the energy stocks they research and recommend. Maybe Mr. Driscoll's analysis has put his finger on the several industry driving forces that are acting similarly to how they did at the end of the 1980s and 1990s – namely, a surge in new oil supplies and at lower costs. In our last *Musings* we wrote about forecasting oil prices and BP plc's (BP-NYSE) CEO Bob Dudley's prediction at the end of 2014 about having to learn to live in a world governed by "lower for longer" oil prices. Although he has said that the worst is behind the industry and he has BP in an expansionary mode, he never defined "lower" as to the oil price that equated to, or for how long the price would hang in that range, which addresses the "longer" part of his phrase.

In that *Musings* we published the chart in Exhibit 2 showing oil prices from 1947 to 2016 in current dollar terms with the periods of time when the price was above $90 per barrel marked in red. After the 27 months of extraordinarily high prices during the end of the 1970s and the start of the 1980s, we lived through a span of 18 years with oil prices remaining below $45 a barrel in current dollar terms. To be exact, with the exception of the First Gulf War and the reaction to the 9/11 attacks, for a combined eight months, oil prices stayed below $45 a barrel.

Despite OPEC's best efforts to lift oil prices it has proven ineffective regardless of good or poor economic years

There was a reason why oil prices remained low for such a long period, and it reflects a point Mr. Driscoll made that "the supply response is always underestimated." In the 1970s and 1980s, it was new and greater supplies from the North Sea, Mexico, Canada, West Africa and Southeast Asia. All those basins initiated prolific new production that checked OPEC's supply management efforts even though U.S. oil output continued to slide after Alaskan output began in 1977. The retooling of the global economy to reduce energy consumption in response to the oil price shocks, coupled with the new oil supplies, created a new era for OPEC's relations with its oil buyers. Despite OPEC's best efforts to lift oil prices it has proven ineffective regardless of good or poor economic years.

Exhibit 2. High Oil Prices Have Led To Sharply Lower Prices



Source: EIA, BEA, PPHB

We are in a different world than the 1970s through the 1990s

One needs to question whether 27 months of extraordinarily high oil prices is what produced 18 years of sub $45 per barrel oil prices. If so, then how many years in a $45-$55 a barrel oil price-world are we destined to live after having spent 70% of the seven-year time span of 2007-2014 enjoying oil prices above $90 a barrel? Could Mr. Driscoll's forecast that the energy bear market will last for another 10-15 years prove correct? Based on history, which he refers to in his answer to *Barron's* question, he may prove correct. What could make him wrong? We are in a different world than the 1970s through the 1990s.

In contrast to the 1980s and 1990s, there are few unexplored regions around the world

Over the 36 years since 1980, global oil consumption has risen by 60%. At 96 million barrels a day of oil use, that requires a significant amount of effort to find, develop, produce, ship, refine and distribute petroleum to the consuming world. In contrast to the 1980s and 1990s, there are few unexplored regions around the world. Yes, we will find new large supplies in existing basins, such as we have seen offshore Israel and Guyana, but the best hope for new large supplies lies in those inhospitable locations that are costly to explore if even allowed by governments – think the Arctic and ultra-deepwater. So more demand and a challenging supply outlook demanding large amounts of new capital argue strongly for higher oil prices. We will watch and comment on this unfolding environment in future *Musings*.

2016 Was Quite A Year For Crude Oil And Natural Gas Prices

As we move forward during the early days of 2017, commodity markets are being buffeted by issues such as winter temperatures, the daily strengthening or weakening of the value of the U.S. dollar,

The issue is whether the genie that was released from the bottle can be put back in

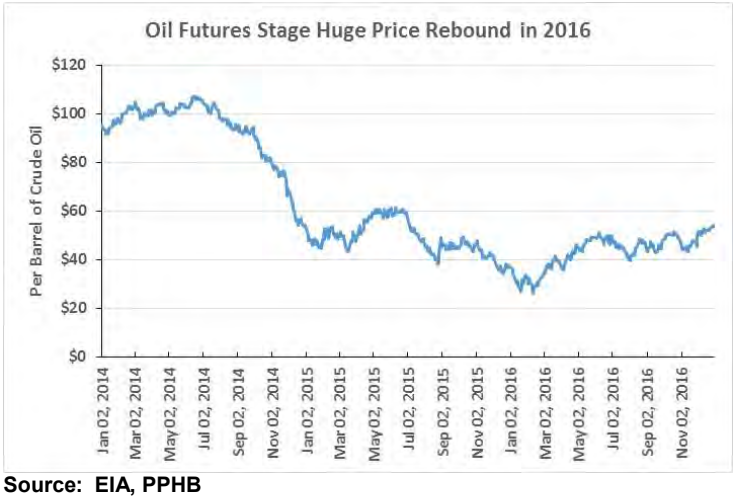
and Wall Street traders' views about how closely OPEC and its allies will adhere to their November 30th agreement's terms to cut their collective crude oil production by 1.8 million barrels per day. The OPEC agreement was reached exactly two years after Saudi Arabia shocked its fellow OPEC members by abandoning the country's traditional role of supporting oil prices by adjusting its production and letting market forces determine oil prices while the country pumped increasingly large volumes of oil. In a matter of 24 months, the global oil market went from one with some controlling forces to a free-for-all and now back to quasi control. The issue is whether the genie that was released from the bottle can be put back in.

Oil market sentiment as swung from extreme optimism about compliance with the agreement to great skepticism

Since the recent agreement, oil market sentiment has swung from extreme optimism about compliance with the agreement to great skepticism. These mood swings were evident during the first several trading days of the new year as oil prices dropped sharply last Tuesday after having risen in the final days of 2016, but then bounced back up in the following days. For the balance of January, oil industry analysts and the business media will be furiously digging into the oil shipping industry and oil trading data seeking confirmation that oil production of OPEC members and their non-OPEC country allies have been reduced in concert with the terms of the agreement. The statements by officials in Iran and Saudi Arabia that they were implementing their agreed-to production cuts were the reason oil prices rebounded last Wednesday and Thursday.

While it will be impossible to really know what is happening now and how much impact it will have on global oil supplies, we think understanding the significance of what happened last year is worthy of review. U.S. crude oil futures prices closed trading on December 30, 2016, at $53.72 per barrel. As a result, for all of 2016, U.S. crude oil prices climbed by 45% from the January 1st price of $37.04 per barrel. That was the sharpest price hike in years.

Exhibit 3. Oil Prices Have Rebounded With OPEC Deal



Source: EIA, PPHB

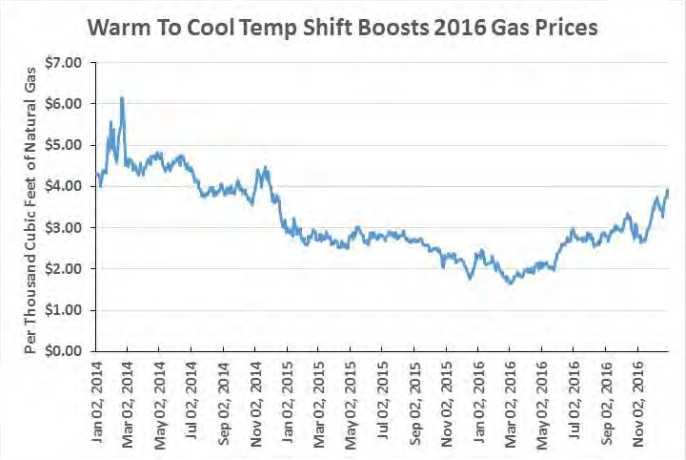
The Baker Hughes U.S. drilling rig count closed 2016 at nearly the same number of working rigs as were working at year-end 2015 - 658 total rigs versus 698 rigs

In February 2016, when oil prices sank to $26.21 a barrel, down 29.2% from the start of the year, fear was rampant then that global oil prices were headed lower and the demise of the global oil industry was at hand. At that time, few people would have believed that oil prices could more than double in the next ten months. With the rebound in oil prices, producer economics improved, leading many companies to step up their drilling and well completion activity. In fact, the Baker Hughes U.S. drilling rig count closed 2016 at nearly the same number of working rigs as were working at year-end 2015 - 658 total rigs versus 698 rigs. The overall decline in working rigs for 2016 was 5.7%, with the oil rig count falling by only 2.1% (525 vs. 536) while active rigs targeting natural gas fell by 18.5% (132 vs. 162). The recovery in the rig count has contributed to increased optimism about further rig count gains in 2017.

For the entire year, gas prices increased by 60% as the huge natural gas storage volumes created by the weak demand due to the warm winter of 2015-2016 began shrinking

Optimism in the natural gas sector is also running high given the sharp rebound in gas prices due to higher demand and falling output. From the March 3, 2016, low price of $1.639 per thousand cubic feet (Mcf), natural gas prices rebounded by 128.2% by the end of 2016 to $3.74/Mcf. For the entire year, gas prices increased by 60% as the huge natural gas storage volumes created by the weak demand due to the warm winter of 2015-2016 began shrinking rapidly as the first month of the 2016-2017 winter was much colder than anticipated. The supply decline was further helped by greater demand from electric power generated by natural gas rather than coal and the supply decline due to lower drilling activity, especially oil wells that produce associated natural gas.

Exhibit 4. Gas Price Recovery Helped By Cold Temps

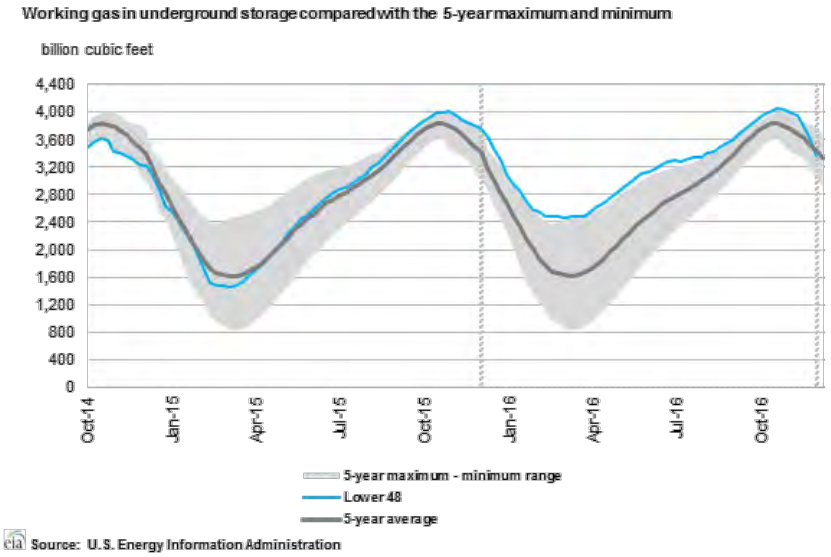


Source: EIA, PPHB

The outlook for the natural gas business appears to be improving rapidly as demonstrated by the weekly chart published by the Energy Information Administration (EIA) showing the volume of gas in storage compared to the 5-year high and low volumes as well as the 5-year average weekly volume. As the chart shows, the latest

weekly gas storage volume has now fallen sharply from above the 5-year average high volume to almost below the 5-year average. If the cold temperatures continue through January, we could see our supplies at or below the 5-year average low inventory level, which would likely cause natural gas prices to spike higher.

Exhibit 5. Cold Temps Have Driven Gas Supply Sharply Lower



Source: EIA

While everyone is focused on what happens to crude oil prices in 2017, the surprising market this year may turn out to be natural gas. We have been making this point for a number of months, as we believed the impact of reduced oil drilling during 2015 and 2016 would eventually lead to less associated natural gas production. That scenario has actually come to pass.

A more normal winter – one similar to those that occurred prior to the recent warm winter caused by the huge El Niño weather event – coupled with constrained supply growth and higher electricity demand should support gas prices at higher levels than experienced in the past 18 months

The growth in natural gas-fired electricity generation will further add to temperature-related gas demand. Continue to watch the winter weather, as gas traders were beginning to build in expectations for a colder than normal winter, and thus sharply higher gas prices. As the near-term temperature outlook is moderating, gas prices are falling, but that could change with the next bout of cold temperatures. A more normal winter – one similar to those that occurred prior to the recent warm winter caused by the huge El Niño weather event – coupled with constrained supply growth and higher electricity demand should support gas prices at higher levels than experienced in the past 18 months. That could lead to increased natural gas drilling during a time of a strengthening oil drilling market. This would be a welcomed environment for the oilfield service industry – assuming the companies can find enough staff to operate an increased number of drilling rigs.

This *Musings* was written while we were traveling half way around the world, which is why it has a slightly different format and content.

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