PPHB
ENERGY INVESTMENT BANKING

MUSINGS FROM THE OIL PATCH

July 4, 2017

Allen Brooks
Managing Director

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

Why Understanding What Is Driving This Cycle Is Important

The announcement on a slow summer Friday morning sent the financial media into a frenzy

On June 16th, the mega-retailer Amazon (AMZN-Nasdaq) announced an agreement to acquire the high-end grocery firm Whole Foods Market (WFM-Nasdaq) in a $13.6 billion deal, excluding the assumption of debt. The announcement on a slow summer Friday morning sent the financial media into a frenzy. It also caused many leading grocery concerns' share prices to drop as investors worried about the deal's impact on the $800 billion a year U.S. grocery business. *CNBC* commentator Jim Cramer went crazy immediately after the Amazon deal announcement, proclaiming it a "game-changer" for the food business and every company involved.

Clearly, it was a significant and surprising deal. No one expected it. In fact, a joke circulated online saying that Amazon CEO Jeff Bezos had actually asked his company's artificial intelligence app, Alexa, to: "Buy me something from Whole Foods." Alexa responded: "I bought you Whole Foods!"

Amazon reportedly has 49 million Prime customers, representing about 44% of all American households

One has to believe Amazon has bigger plans for its purchase than just owning a bricks-and-mortar grocery chain, even though it is an upscale grocer with important shopping data distilled from its customers who are likely among Amazon's Prime members. Amazon reportedly has 49 million Prime customers, representing about 44% of all American households.

So far, Amazon has struggled to grow its online food delivery service, and the belief is that Whole Foods offers an opportunity for Amazon to learn more about how to handle the distribution of groceries, while gaining pickup outlets for Prime purchases for members who want delivery quicker than next day, as well as more food distribution centers around the country. Still, combined, Amazon's food business and Whole Foods will represent only about

3.5% of U.S. grocery sales, leaving the company in fifth place nationally in the ranking of grocery chains.

Is this how an industry change occurs?

After listening to all the ranting about the significance of the Amazon/Whole Foods deal, we wondered – Is this how an industry change occurs? Did the Dow Chemical (DOW-NYSE) and E. I. du Pont de Nemours and Company (DuPont) (DD-NYSE) merger announcement in December 2015 mark a revamp of the chemical industry, or was it in response to recognizing fundamental shifts in the business? While this deal was significant for the global chemical industry, reports on chemical industry merger and acquisition activity prepared by Deloitte Development LLC show that the industry has been actively restructuring since the end of the 2008 financial crisis. Exhibit 1 taken from the Deloitte report shows that the number of M&A deals globally in the chemical industry has been at a high level since 2010. In its 2009 report, Deloitte reported that the chemical industry executed 450 M&A transactions for a total value of $15.6 billion. So, while Dow-DuPont is a significant and meaningful merger in the global chemical industry, it is one of just many meaningful deals in recent years.

Exhibit 1. Chemical Industry M&A Has Been Very Active

Source: Deloitte

In our opinion, the oil industry is in the early stages of adjusting to shifts in its basic fundamentals, the question is have managers deduced what those shifts mean for their strategies?

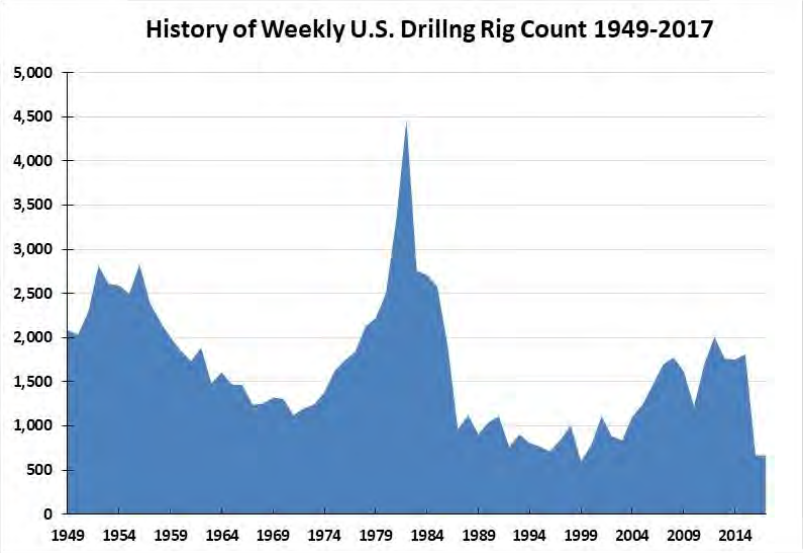
The point is that what drives major transactions in an industry is the recognition by company managers that they need to adjust their business strategies to deal with changing industry fundamentals. It often takes time for these business strategies to evolve, and likely even more time before appropriate M&A candidates become available that can facilitate the strategy adjustments. Identifying those key industry fundamental shifts altering an industry's structure is the challenge. The sooner those shifts can be identified, the quicker business strategy adjustments can be made. In our opinion, the oil industry is in the early stages of adjusting to shifts in its basic fundamentals, the question is have managers deduced what those shifts mean for their strategies?

As of June 23rd, the oil industry marked 23 straight weeks of drilling rig count increases. This is a record extending back to 1949, or since Hughes Tool, a predecessor to Baker Hughes (BHI-NYSE), began publishing weekly rig counts. This is impressive, considering the magnitude of the industry boom of the 1970s.

Since the rig count ceased falling 13 months ago, there have been only five out of 56 weeks when the rig count declined

How strong has this rig count rebound been? Since the rig count ceased falling 13 months ago, there have been only five out of 56 weeks when the rig count declined. Each decline was by only a low single-digit number. This means the industry rebound has actually been underway for nearly 13 straight months. The rig count bottom in 2016 came when the average WTI oil price was $48.91 a barrel. To put into perspective the significance of this drilling rig count run, Exhibit 2 shows the weekly rig count since the start of 1949. In the history of the industry, this 13-month rise in the rig count barely registers on the 68-year history of drilling.

Exhibit 2. Rig Count Recovery Barely Registers In History



Source: Baker Hughes, PPHB

The goal of the output cut was to shrink global oil inventories to the average of the last five years, which was expected to drive global oil prices to $60 a barrel

A concern for the oil industry is the future of oil prices. Since OPEC unleashed a free market for oil in late 2014, the oil price collapse engineered by OPEC's production increase, in particular for that of Saudi Arabia, killed the multi-year global drilling expansion that had been driven by multiple years of $100 a barrel prices. Between November 2014 and February 2016, crude oil prices tumbled from $80 to $26 a barrel. In November 2016, in response to the pain being felt by oil producers worldwide, Saudi Arabia enlisted Russia and a handful of other non-OPEC producers, to agree to cut global oil supply by 1.8 million barrels a day, or roughly 2%, for the first half of 2017. The goal of the output cut was to shrink global oil inventories to the average of the last five years, which was expected to drive global oil prices to $60 a barrel, or possibly even higher.

What was missed by oil traders was the time OPEC and non-OPEC producers had to ship more oil before their production cut agreement kicked in

The expectations were high for OPEC's effort to lift oil prices. Higher oil prices, however, sparked increased U.S. shale oil drilling as producers cut their well breakeven prices to close to $40 a barrel, or, as some Permian Basin producers claimed, below that level. What was missed by oil traders was the time OPEC and non-OPEC producers had to ship more oil before their production cut agreement kicked in. While major OPEC producers were quick to comply with their new production quotas, Russia and other non-OPEC producers' compliance lagged. That meant additional supply was pouring into the market, and two OPEC members - Libya and Nigeria - who were exempted from output cuts, added to the supply. At the same time, U.S. oil production resumed growing.

Thus, from the start of the oil price downturn to March 2017, OECD oil inventories climbed by about 40 million barrels, or roughly 7.5% higher

OECD crude oil inventories that averaged 524.9 million barrels as of the second quarter of 2014 when crude oil prices peaked, had increased to an average of 555.1 million barrels by the end of 2016. At the end of 2017's first quarter, inventories had climbed to 564.5 million barrels. Thus, from the start of the oil price downturn to March 2017, OECD oil inventories climbed by about 40 million barrels, or roughly 7.5% higher. This spring, as OPEC and its non-OPEC partners negotiated a production cutback extension, expectations were for a nine-month extension. Oil traders lobbied for a deeper production cut, as the market grew concerned that global oil inventories were not falling sufficiently quick enough to achieve OPEC's $60 a barrel oil price target.

Based on the trend support line, oil prices could fall into the high $30s a barrel, although many oil traders are pegging support closer to $40 a barrel

Continued oil production growth plus concerns about a weakening in oil demand contributed to weakening oil prices. Exhibit 3, on the next page, shows how Brent oil prices have traded since mid-March. Based on the trend support line, oil prices could fall into the high $30s a barrel, although many oil traders are pegging support closer to $40 a barrel. Last week, oil prices rebounded by about 10% to the $45 a barrel range.

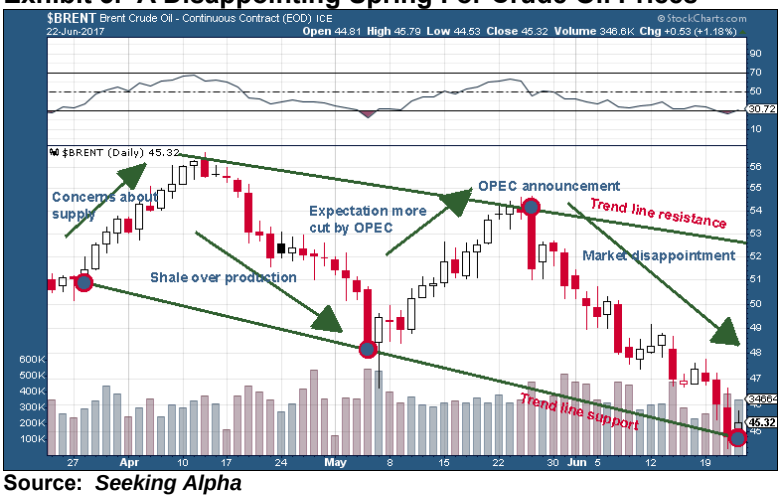
At the same time, China has recently cut back its oil-buying as it shut down about 10% of its refining capacity, represented primarily by small refineries referred to as "teapots"

Based on articles in the business press, there continues to be an overhang of too much crude oil, especially sitting in floating storage or in transit from production sites. A recent article a week ago pointed out Brent futures prices for December 2017 and December 2018 reflect a negative spread of just over $1 per barrel. That negative spread causes oil to be dumped on the market rather than held in storage to take advantage of higher future prices. The oil price glut has been driven by higher output from Libya, Nigeria, the U.S. and Canada, and now from Brazil. Much of this new supply is light crude oil, and largely concentrated in the Atlantic basin putting increased downward pressure on Middle Eastern oil prices. At the same time, China has recently cut back its oil-buying as it shut down about 10% of its refining capacity, represented primarily by small refineries referred to as "teapots." This sector of the nation's refining business has been steadily cutting utilization, dropping it below 60% in May as these refineries come under increased tax and import permit scrutiny from the government. Their cutback explains why

China's oil imports fell from 9.2 to 8.4 million barrels a day between March and April, and possibly as low as 8 million barrels a day now

China's oil imports fell from 9.2 to 8.4 million barrels a day between March and April, and possibly as low as 8 million barrels a day now. Later this year, China's two primary oil companies will add about 450,000 barrels a day to their refining capacity, but that doesn't help near-term demand for cargos of crude oil.

Exhibit 3. A Disappointing Spring For Crude Oil Prices



Source: ***Seeking Alpha***

As the market focuses on near-term factors that will either send oil prices higher or keep them under pressure, few people are focusing on addressing the question of whether current market trends signal permanent changes to industry fundamentals forcing companies to alter their strategies. Or is it possible this is just another transient downturn, albeit a very difficult one?

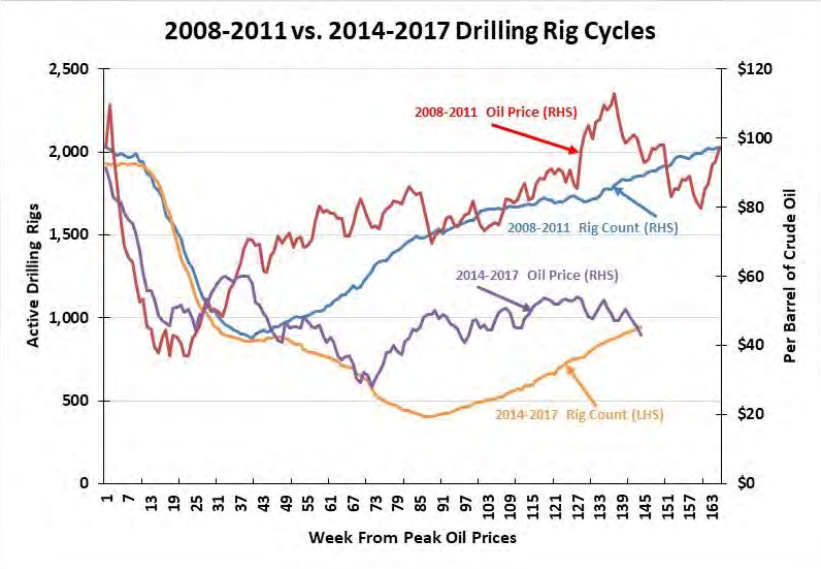
To try to address this question, we looked at the rig count's performance compared to that of the 1980s and 2008-2011 downturns. Each downturn reflected a significant, multi-year cycle that reflected important changes for the oil industry.

Many investors and analysts often compare the current industry cycle to that of 2008-2011, because that is the history they are most familiar with. In contrast, the 1980s rig count downturn lasted much longer and reflected substantial pain and suffering for the industry following the extended boom of the 1970s.

The rig count recovery pace in 2008-2011 was faster than during the current cycle

As Exhibit 4 (next page) shows, the oil price and rig count drops were comparable in the initial sharpness and speed of declines. In both declines, in the first weeks of the oil price recovery, the rig count continued declining, before beginning to climb higher. Overall, the rig count recovery pace in 2008-2011 was faster than during the current cycle. Some of that improvement reflects the faster recovery in oil prices in the earlier period. If we were to superimpose the current upturn on the earlier recovery, that cycle would suggest that there is significant room for more working rigs in the future, ignoring

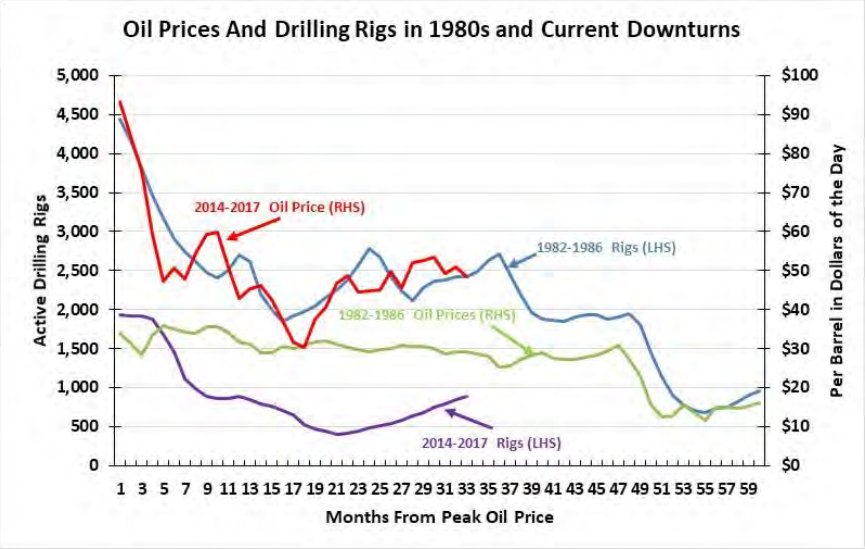
Exhibit 4. Current Rig Cycle vs. 2008-2011 Downturn



Source: Baker Hughes, PPHB

the question of whether there are sufficient idle rigs producers desire to use. Possibly there needs to be another rig-building phase to support higher drilling activity.

Exhibit 5. Current Rig Cycle vs. 1982-1986 Downturn



Source: Baker Hughes, PPHB

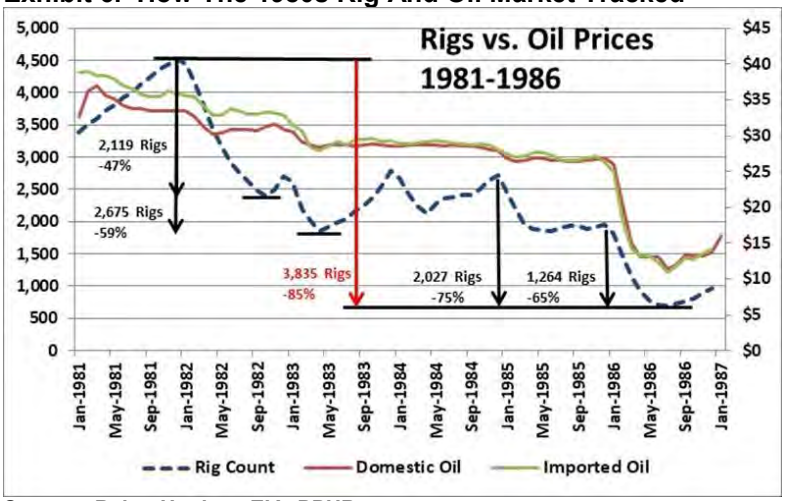
Many people break the 1980s downturn into two cycles

The comparison of the current downturn versus the 1980s cycle presents an interesting contrast. Many people break the 1980s downturn into two cycles. We would argue that fundamental industry changes were already underway by the time oil prices peaked at the end of 1981 and it took until the mid-1980s before

The rig count fell much more sharply in the early part of the cycle than would have been expected given how shallow the first oil price decline was

their impact became evident in OPEC's disarray. Crude oil prices dropped sharply in early 1982, but then recovered before starting on a slow, steady downward slope, which was finally interrupted with the 1985 Saudi Arabia oil price war that collapsed oil prices to $10 a barrel. The rig count fell much more sharply in the early part of the cycle than would have been expected given how shallow the first oil price decline was. (If we put 1982-1986 oil prices in current dollars, we would see a price pattern much more similar to that of the rig count, see Exhibit 11, page 12.) Exhibit 6 shows how oil prices and the rig count progressed during the 1980s downturn.

Exhibit 6. How The 1980s Rig And Oil Market Tracked



Source: Baker Hughes, EIA, PPHB

From the peak in the rig count at the end of 1981 to the cycle's low during the summer of 1986, the U.S. drilling industry lost 3,835 working rigs, or 85%

From the peak in the rig count at the end of 1981 to the cycle's low during the summer of 1986, the U.S. drilling industry lost 3,835 working rigs, or 85% of the active fleet. The first decline cost the industry 2,119 active rigs, after a brief recovery, the industry lost another 556 rigs. At that point there was a brief recovery that lasted through most of 1983.

That drilling recovery was helped by two factors: 1) higher natural gas prices; and 2) the opening of the offshore market via the introduction of area-wide lease sales in the Gulf of Mexico

That drilling recovery was helped by two factors: 1) higher natural gas prices; and 2) the opening of the offshore market via the introduction of area-wide lease sales in the Gulf of Mexico. Higher natural gas prices came as a result of efforts to deregulate the industry that also decontrolled prices in an effort to stimulate natural gas drilling to help boost supply. These two changes came at a fortunate time as the opening of leasing in the Gulf of Mexico arrived just as higher natural gas prices drove gas exploration and development drilling offshore.

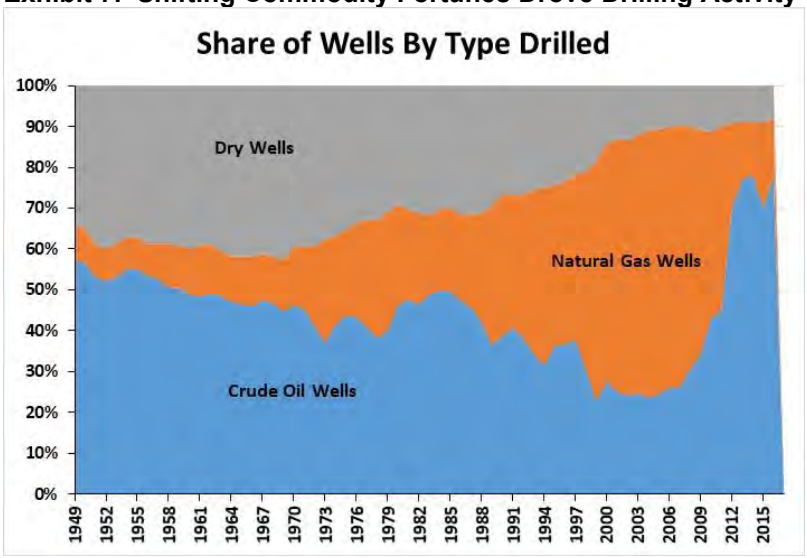
The Gulf of Mexico rig market proved to be quite volatile during the 1980s. In January 1982, there were 361 offshore drilling rigs at work, but the count fell to 283 by the end of 1983 as the initial shock of the oil price correction was felt. The offshore rig count bounced

back to 298 by the end of 1984, but subsequently fell to 232 at the end of 1985, and to only 111 active rigs as 1986 ended. To put the numbers into perspective with how severely offshore drilling has been impacted by the current oil price downturn, today there are only 22 rigs working in the Gulf of Mexico.

Since the start of the post-World War II era, drilling for crude oil steadily declined, despite the U.S. remaining a leading global oil supplier, until oil production peaked in 1971

To better understand macro trends at work in the oil industry today versus those in 2008-2011 and 1982-1986, we turn to several charts. First is a chart (Exhibit 7) showing the percentage distribution of wells drilled by type. It shows that since the start of the post-World War II era, drilling for crude oil steadily declined, despite the U.S. remaining a leading global oil supplier, until oil production peaked in 1971. The other observation from this chart is the growth in natural gas drilling, which began increasing rapidly in the late 1980s when the commodity's price was decontrolled. The need for gas pipelines during that time to shore up their supplies aided the gas drilling surge. As the commodity market began speculating that natural gas demand, due to its environmental qualities (50% of the greenhouse gas emissions of crude oil), would force prices to remain very high (double digit) to incentivize producers to drill for greater supplies. That market driver collapsed when natural gas supplies started growing rapidly and prices fell to single-digit levels. Thank gas shale extraction technology for the price drop. That technology was successfully applied to crude oil formations and has contributed to the current oil price decline.

Exhibit 7. Shifting Commodity Fortunes Drove Drilling Activity



Source: EIA, PPHB

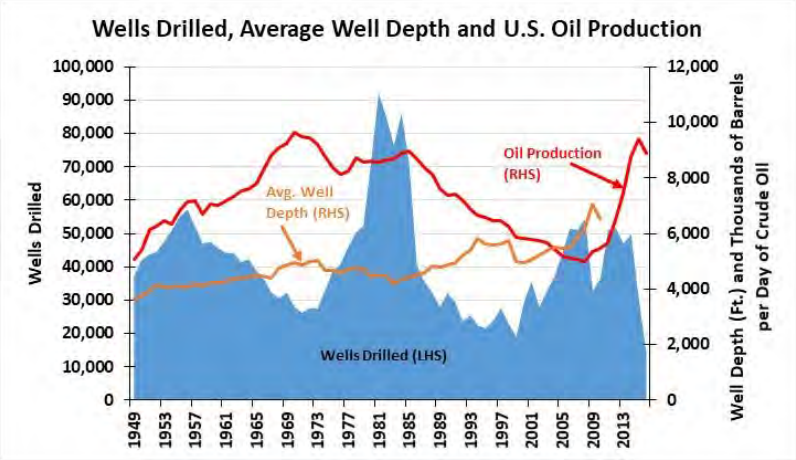
Exhibit 8, next page shows the history of U.S. wells drilled, average well depth and oil production. Unfortunately, the data necessary to bring the average well depth line current was not available after 2010. Regardless, the upturn since 2000 coincides with the

increase in the percentage of well drilled seeking natural gas that tend to be at deeper depths. We would suggest that it is possible that average well depth has not grown due to the shift to increased drilling for crude oil and the growth of horizontal drilling in shale formations that emphasizes drilling longer laterals rather than deeper wells.

What is amazing today is to see how oil output is nearing its 1970 peak, but with a substantially reduced number of wells being drilled

The other important takeaway from the chart is the history of U.S. crude oil production and wells drilled. When oil output peaked in 1970 and began declining, the reaction, combined with the shift in global oil price control from the U.S. to OPEC and disruptive geopolitical events in the 1970s, was a surge in U.S. drilling. That drilling surge helped U.S. oil output to retrace about half of its decline. What is amazing today is to see how oil output is nearing its 1970 peak, but with a substantially reduced number of wells being drilled. That speaks to the impact of improved drilling and completion technology that has opened up U.S. shale reservoirs, and how much more productive these wells are. That phenomenon is shown in Exhibit 8.

Exhibit 8. The Oil Industry Is More Efficient Than In The 1970s



Source: EIA, PPHB

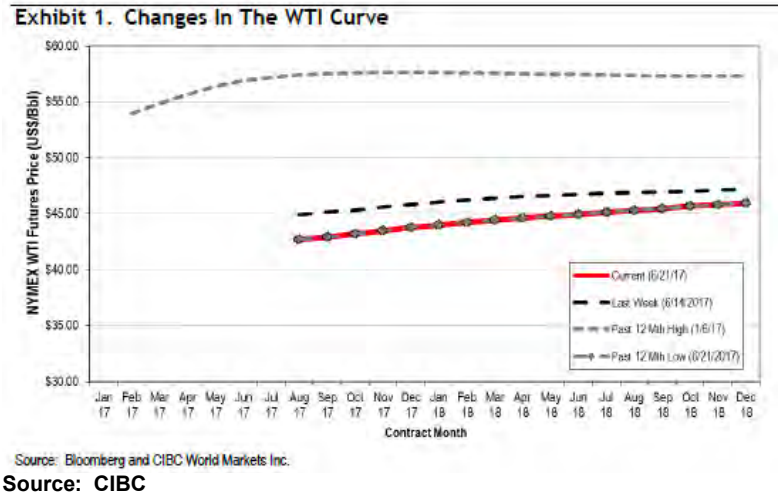
The higher price was assumed by the IEA when it predicted a month ago that U.S. oil output would grow by 920,000 barrels per day by the end of 2017, and add an additional 780,000 barrels per day in 2018

The near-term question is whether producers can continue to grow their output with oil prices in the low $40s a barrel compared to estimates that prices at this point would be in the mid $50s. The higher price was assumed by the International Energy Agency (IEA) when it predicted a month ago that U.S. oil output would grow by 920,000 barrels per day by the end of 2017, and add an additional 780,000 barrels per day in 2018. What will U.S. supply growth be now, given current oil prices? Although oil prices have declined, one should not ignore the large volume of hedges put in place by producers earlier in the year when oil prices were substantially higher. These hedges insure producers of greater cash flow than suggested by current oil prices.

How the current oil price strip had fallen in one week, but more importantly how much the price curve has fallen since the beginning of the year

A chart from a CIBC report shows how the current oil price strip had fallen in one week, but more importantly how much the price curve has fallen since the beginning of the year. At that time, the oil price futures curve was boosted by expectations of rapid market improvement due to the recently enacted OPEC/non-OPEC production cut.

Exhibit 9. Current Oil Price Futures Are At Year Low

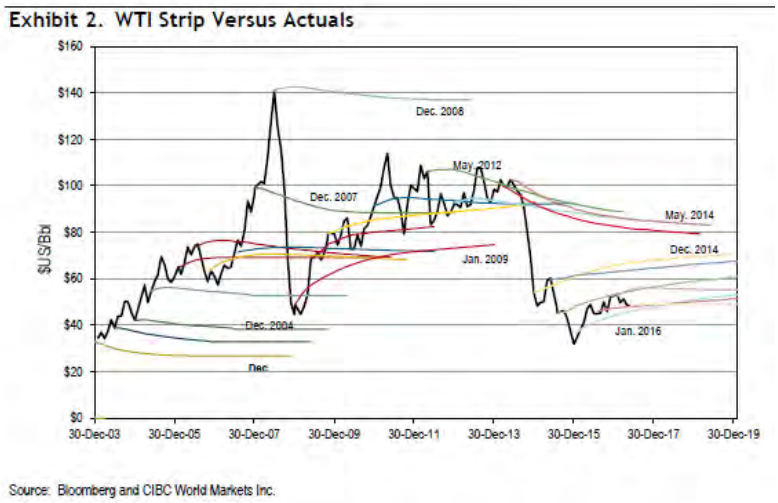


Source: CIBC

Market sentiment and forecasters' expertise often are wrong, and spectacularly wrong!

The CIBC report included another chart that delivered a subtle message that one should be cautious in believing the predictive value of the oil price futures forward curve. As the chart shows, one might have been disappointed if he had acted on its future shape. In other words, market sentiment and forecasters' expertise often are wrong, and spectacularly wrong!

Exhibit 10. Reality Is That Futures Prices Often Are Wrong



Source: CIBC

To a large degree, the current oil price forecasting game is a distraction from the industry fundamental changes currently unfolding. In 2008-2011, the world's financial markets were hit by a global crisis in collateralized debt obligations (CDOs) related to home mortgages. This crisis, and its collateral fallout, brought down several leading investment firms, and called into question the financial viability of the leading banks of the world. The surprise was how quickly the crisis developed and the pressure it put, not just on financial markets, but also on governments to provide economic and monetary stimulus to keep world economies running. What started as a relatively isolated event with the surprising demise of the revered but highly-leveraged investment bank, Lehman Brothers, quickly turned into a global liquidity crisis. Oil demand collapsed as economic activity slowed and future activity appeared imperiled. More importantly, the initial reaction of corporate managers facing a liquidity crisis is to stop spending money. The drilling rig count plummeted. However, once the liquidity crisis eased in response to government efforts to shore up the global financial sector, people realized that world economies would continue to function and grow, meaning they would need more energy. Thus, the world's oil market rebounded rapidly.

However, once the liquidity crisis eased in response to government efforts to shore up the global financial sector, people realized that world economies would continue to function and grow, meaning they would need more energy

While many analysts look at the performance of the oil industry and the drilling rig count in the 2008-2011 period as a model for the current downturn, they may be overlooking the liquidity crisis aspect behind the rapid rig count and oil price drops and subsequent rebounds. Therefore, we would argue that what drove the 2008-2011 downturn and recovery were a set of conditions that is not similar to events driving oil industry activity now.

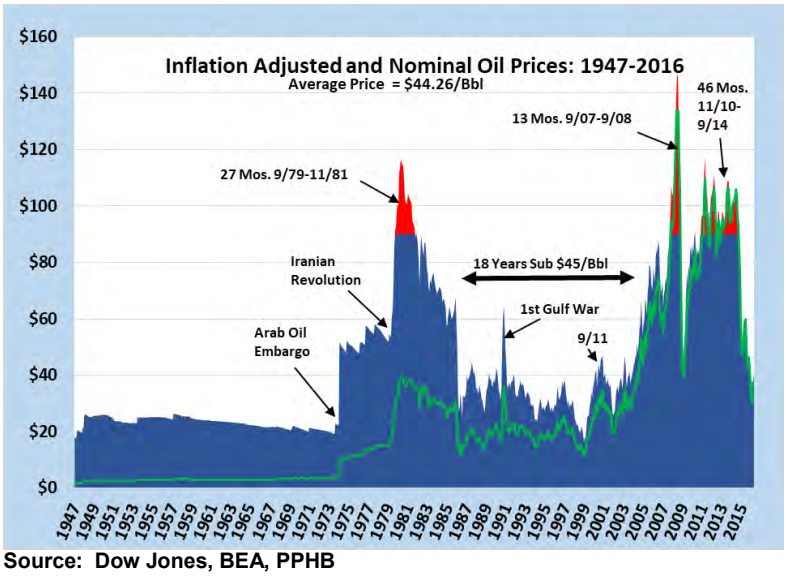
We would argue that what drove the 2008-2011 downturn and recovery were a set of conditions that is not similar to events driving oil industry activity now

In our view, today's downturn has more similarities to the 1982-1986 downturn than the 2008-2011 cycle. In the 1980s cycle, the world was coming off two explosions in oil prices – 1973 and 1979 – due to geopolitical events. The oil price spikes, combined with the apparent physical shortages of crude oil, evident in gasoline station lines, and in the U.S. natural gas market, created an environment extremely receptive to Malthusian theories explaining inadequate supplies of commodities to meet global demand. Highlighting that phenomenon, Exhibit 11 (next page) shows inflation adjusted oil prices and nominal prices since 1947. The point of the chart is that in 2016 dollars, the 1970s experienced an equivalent environment as the industry experienced in 2009-2014. During that latter period, oil prices spent 59 months averaging above $90 a barrel compared to about half that time (27 months) during 1979-1981.

During that latter period, oil prices spent 59 months averaging above $90 a barrel compared to about half that time (27 months) during 1979-1981

What did that historical period of extraordinarily high oil prices mean for the global oil industry? It did what basic economics would suggest – it generated new oil supplies and choked off oil consumption. The following two charts demonstrate those points.

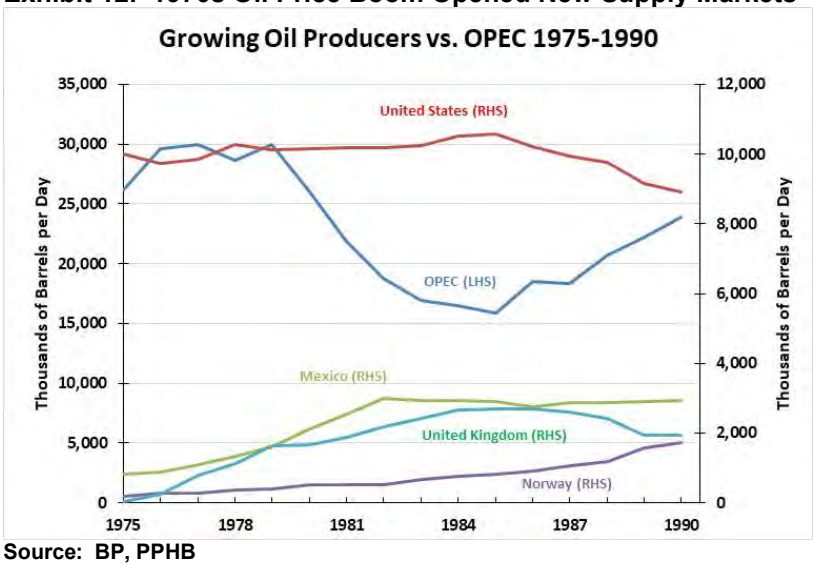
Exhibit 11. Real Oil Prices Similar In 1980s and 2010s



Source: Dow Jones, BEA, PPHB

Assuming that the initial oil price spike in late 1973 would take some time to show its impact, we tracked oil production from North America, Europe and Mexico for 1975-1990, compared to what happened to OPEC's output. Exhibit 12 shows U.S., Mexico, Norway and the United Kingdom production versus OPEC.

Exhibit 12. 1970s Oil Price Boom Opened New Supply Markets

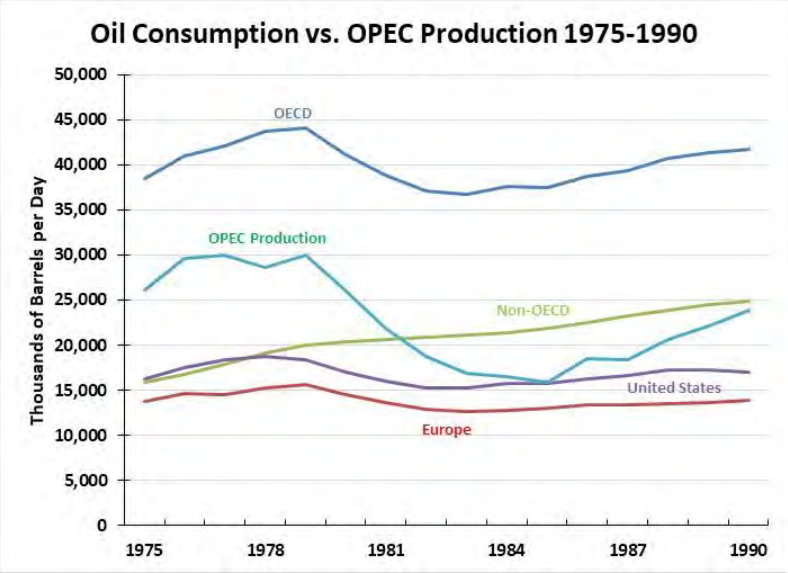


Source: BP, PPHB

While U.S. production grew slightly in 1978, and then remained stable until 1983 before once again growing. The emergence of the North Sea as a significant new oil supply basin (UK and Norway) as well as Mexico's offshore oil success demonstrated the power the

sustained higher oil prices had on creating new supplies. The impact of new supplies contributed to OPEC's collapse.

Exhibit 13. Demand Suffered From 1970s High Oil Prices



Source: BP, PPHB

At the same time oil supply outside of OPEC started growing, oil consumption in the developed world (OECD) fell

At the same time oil supply outside of OPEC started growing, oil consumption in the developed world (OECD) fell, which is demonstrated by the United States and Europe consumption curves in Exhibit 13. Those two regions are the key part of the OECD. Non-OECD consumption continued growing. As the chart shows, the demand reduction was significant, and was key to crippling OPEC's pricing power as was the growth in new oil supplies.

Demand will continue to grow for the foreseeable future, but the annual rate of growth is likely to continue to slow until it eventually goes negative

As we look at the factors helping to reshape today's oil market, environmental pressures, especially the potential impact of electric vehicles, coupled with the impact on oil demand growth that will come in response to efforts by countries to decarbonize their economies, can be considered the equivalent of the 1970s oil price shock to global oil demand. Demand will continue to grow for the foreseeable future, but the annual rate of growth is likely to continue to slow until it eventually goes negative. Lower demand is coming at the same time oil companies are reducing well breakeven prices insuring more supplies in the future. These improved E&P economics is broadly similar in impact to the opening of new oil supply basins that occurred in the 1970s and 1980s. Just as the opening of new supply basins had a long-term impact, the reduced well breakeven prices will also have a long lasting impact. We can argue about how long the impact will last, but it is likely to last much longer than we expect.

History does not repeat, but it does rhyme, as suggested in the famous quote. In our view, the current oil industry downturn is

The oil companies will need to keep their staffing lean, employ the best drilling and completion technologies available, and manage their balance sheets appropriately to succeed in the future

rhyming more with the 1982-1986 cycle than with the 2008-2011 one. If that is true, then the industry may be looking at an extended period of low oil prices just as the industry experienced following the 1981 oil price peak. That span extended for 18 years as oil prices averaged below $45 a barrel, or the very long-term average of inflation adjusted oil prices, with the brief exceptions of the First Gulf War and 9/11. BP plc CEO (BP-NYSE) Robert Dudley's comments in early 2015 that the industry needed to learn to live in a "lower for longer" environment seem to be proving accurate. That means the oil industry must continue adjusting its cost structure. The oil companies will need to keep their staffing lean, employ the best drilling and completion technologies available, and manage their balance sheets appropriately to succeed in the future. This environment doesn't mean that there is no future for the oil industry. It means that corporate strategies must constantly be reassessed within a broader energy industry panorama subject to external pressures that will only grow in the future.

Are Electric Vehicles As CO2 Friendly As We Think?

The study's key conclusion is that battery manufacture emits a significant volume of greenhouse gases

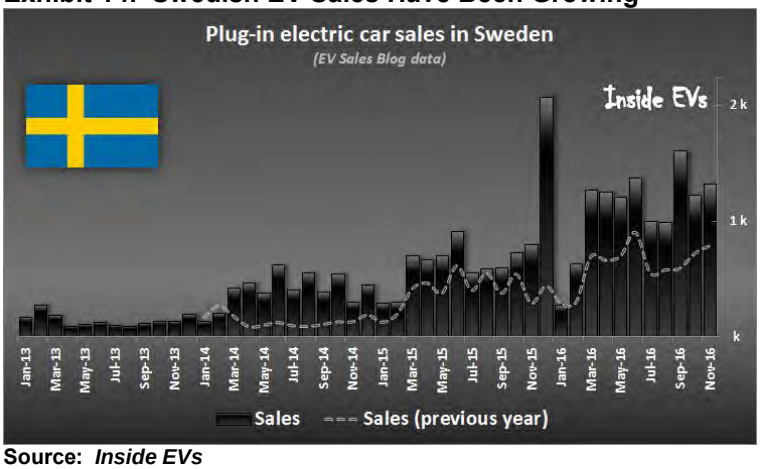
As neighbors Norway and Denmark assess the financial cost of government subsidies for electric vehicles (EVs) sold, Sweden has just released a study exploring the carbon emissions associated with EV battery manufacture. The study's key conclusion is that battery manufacture emits a significant volume of greenhouse gases, and the amount is directly tied to the size of the batteries. Another aspect of battery CO2 emissions is how the manufacturing plants are powered.

For 2016, slightly over 13,200 EVs were registered in Sweden, a 52% year-over-year increase, according to Inside *EVs*

The study, sponsored by the Swedish Energy Agency and the Swedish Transport Administration, addressed issues about EV battery pollution as Sweden decarbonizes its transportation system. Sweden has been an active supporter of EVs, as well as other eco-vehicles, through its tax system. As a result, the number of EVs sold has grown in recent years. For 2016, slightly over 13,200 EVs were registered in Sweden, a 52% year-over-year increase, according to *Inside EVs*. For the entire European Union, of which Sweden is a member, fourth quarter 2016 EV sales totaled about 17,600 cars, down 11.4% from 2015's fourth quarter. The EU decline was driven by a 74% drop in sales in Denmark, a 25% fall in Germany, a 28% decline in the UK, and 75% and 21% drops in Greece and Portugal, respectively. Sweden's EV sales in the fourth quarter were up 30%, as 904 EVs were sold.

As the chart in Exhibit 14 on the next page shows, Swedish EV sales increased noticeably starting in 2014. The growth was driven by the Sweden's subsidy program that started in 2012, which provided a subsidy of 40,000 kr ($4,678) per car for the purchase of EVs and other "super green cars" with ultra-low carbon emissions

Exhibit 14. Swedish EV Sales Have Been Growing



Source: ***Inside EVs***

(below 50 grams of carbon dioxide per kilometer). EVs are also exempt from the annual car tax for the first five years of their first registration.

As of July 2014, the government subsidy fund was exhausted. BIL Sweden, the national association for the automobile industry, requested an additional 100 million kr ($11.7 million) for subsidies for EV and super clean cars sold between August and December 2014. The government actually appropriated 215 million kr ($25.2 million), which also covered retroactive subsidy payments for cars registered in the last half of 2014, besides EV sales going forward.

Beginning in 2016, only zero emissions cars are entitled to receive the full 40,000 kr premium

The government increased the super green car rebate by 132 million kr ($15.4 million) for 2015, and by 94 million kr ($11.0 million) for 2016, but beginning in 2016, only zero emissions cars are entitled to receive the full 40,000 kr premium, while other super green cars, plug-in hybrids, receive half that subsidy. The five-year car ownership tax exemption remains in effect.

There are numerous examples of government subsidies for EVs being eliminated by states in the U.S., with negative fallout on EV sales

While we cannot be sure, it would appear that part of the justification for sponsoring the study is Sweden's observing what has happened in Denmark after a cost/benefit analysis led to that government eliminating EV subsidies. Now that debate has arisen in Norway. There are numerous examples of government subsidies for EVs being eliminated by states in the U.S., with negative fallout on EV sales. All of these subsidy pullbacks are driven by the cost to governments and the disproportionate benefit awarded to wealthy residents at the expense of middle- and low-income residents.

With respect to the Swedish study, it showed there are substantial CO2 emissions coming from the manufacture of the EV batteries. Importantly, the volume of pollution rises in a linear relationship with battery size, a trend driven by EV manufacturers working to extend their EVs' range to ease consumer "range anxiety" concerns.

What the study found is that much of the research is suspect due to it not being sufficiently transparent to enable researchers to examine how the numbers were calculated

The Swedish report was a meta-study examination of all the studies conducted on CO2 emissions related to EVs in recent years. In this case, however, the study focused exclusively on battery manufacture and not EV driving. What the study found is that much of the research is suspect due to it not being sufficiently transparent to enable researchers to examine how the numbers were calculated. Additionally, most of the studies were based on hypothetical plants rather than actual manufacturing data. To offset that bias, the study's authors relied more on those studies that employed actual manufacturer data.

The study concluded there were 150-200 kilograms (330-440 pounds) of CO2 emissions for every kilowatt hour of battery storage

The study concluded there were 150-200 kilograms (330-440 pounds) of CO2 emissions for every kilowatt hour of battery storage. To arrive at this estimate, the study examined numerous studies examining the make-up of batteries used in EVs. This involved considering the chemistry of battery cells, as well as that of the cathodes and anodes needed to extract the power in batteries. Importantly, as shown in Exhibit 15, the battery case is a major source of pollution because it is composed of metal, accounting for roughly 30% of a battery's weight, and requiring extensive power to manufacture.

Exhibit 15. How A Battery's Make-up Impacts CO2 Emissions

Cell component	Wt% of total battery pack
The active material in the cathode	20%
The active material in the anode	10%
Separator	1-3%
Aluminium substrate (cathode)	2-3%
Copper substrate (anode)	8-13%
Electrolyte	9-12%
Battery management system	3%
Cooling	4%
Packaging	30%

Source: IVL Swedish Environmental Research Institute

The data shows that pollution scales directly with battery size

One question the study addressed was pollution related to the scaling of EV batteries. The data shows that pollution scales directly with battery size. The authors see this as an area where new technology, in the form of new battery chemistry, could offset increased pollution as battery size grows in order to gain greater storage capacity. Exhibit 16 (next page) shows the authors' calculations demonstrating how as battery storage ramps up, so does the total CO2 emissions.

Exhibit 16. CO2 Emissions Ramp Directly With Battery Size

Vehicle application	kWh energy storage	kg CO_2/ kWh	kWh increase (previous pack as ref)	CO_2 total increase
PHEV	15	270	-	-
PHEV	40	266	167%	163%
PHEV/BEV	80	258	100%	94%
BEV	200	254	150%	146%
BEV	250	253	25%	25%

Source: IVL Swedish Environmental Research Institute

The thrust of the report was designed to answer a series of questions dealing with short-term and long-term issues with battery manufacture and carbon emissions. Short-term, the report addressed the amount of carbon emissions from battery manufacture, as well as where the bulk of the pollution comes from (50% from manufacture and little from the mining and refining of lithium-ion), as well as the pollution impact from plant locations. It also addressed whether CO2 emissions scale with larger batteries.

There isn't a battery recycling industry that could harvest the raw materials in a usable form to reduce the pollution from mining and refining

From a long-term perspective, other than improvements in addressing the short-term issues through new battery chemistry and locating plants in more environmentally-friendly locations rather than in low wage cost areas, there isn't a battery recycling industry that could harvest the raw materials in a usable form to reduce the pollution from mining and refining.

Not surprisingly, this report has become highly controversial due to its suggestion that EV batteries start live with a significant CO2 deficit that will only be worked off compared to an internal combustion engine (ICE) car over time due to EVs' advantage in driving-related pollution. That analysis prompted the controversy.

Mr. Lombog's Twitter comment on the original posting was: "Tesla battery emits 17.5tCO2 in production. Equivalent to driving gas car 8.2 years. Only THEN you might emit less CO2."

The study was published initially in Swedish, but later translated into English. An article dealing with the report was published on *NyTeknik* and republished in English on *Tallbloke's Talkshop*, a climate blog. The article generated numerous comments, including one from Bjorn Lomborg, a Danish author and visiting professor at the Copenhagen Business School as well as President of the Copenhagen Consensus Center. He is famous for his 2001 book, "The Skeptical Environmentalist," along with an extensive op-ed output questioning the dire forecasts from climate change and the costly recommendations for fighting it. Mr. Lombog's Twitter comment on the original posting was: "Tesla battery emits 17.5tCO_2 in production. Equivalent to driving gas car 8.2 years. Only THEN you might emit less CO_2." As a result of that comment, the title to the article on *Tallbloke's Talkshop* became: "Study: Tesla car battery production releases as much CO2 as 8 years of driving on petrol."

Elon Musk weighed in the following day with a Tweet stating: "Calling this cueless [*sic*] would be generous. Much less energy

Mr. Musk's comment was that making the Model 3 will produce "a lot" less CO2 than it takes to make a $35,000 gas car

required for lithium-ion batteries & Gigafactory is powered by renewables anyway." When questioned about data for Tesla's batteries, Mr. Musk declined to provide any information. His comment was that making the Model 3 will produce "a lot" less CO2 than it takes to make a $35,000 gas car. When asked whether the Tesla battery data was available as a tool to fight these negative "activist" articles, Mr. Musk responded: "That's because the accurate articles are boringly obvious, so they get no press attention." They must be very boring since they didn't appear in the study. Maybe the authors did an incomplete search, but based on their methodology, which was clearly set out in the report, as well as the list of universities and institutes where the research on EVs was conducted (see Exhibit 17), we suspect the studies Mr. Musk is referencing may not be publicly available, making his reluctance to disclose Tesla data interesting. Is that data really a competitive secret, or covering up the issue?

Exhibit 17. Location Where EV Battery Research Conducted

University/Institute	Researchers	Active in the area (based on assessed reports)
Argonne National Laboratory, USA	Dunn, Gaines, Kelly, James, Gallagher	2000 -
Chalmers University of Technology, Sweden	Nordelöf, Tillman, Ljunggren Söderman, Rydh, Kushnir	2005 -
Karlsruhe Institute for Technology, Germany	Peters, Baumann, Zimmermann, Braun, Weil	2016 -
Norwegian University of Science and Technology, NTU, Trondheim, Norway	Majeau-Bettez, Ellingsen, Singh, Kumar Srivastava, Valöen, Hammer Strömman	2011 -
Swerea IVF, Sweden	Zackrisson, Avellán, Orlenius	2010 -
United States Environmental Protection Agency, US-EPA, USA	Amarakoon, Smith, Segal	2013
University of California	Ambrose, Kendall	2016

Source: IVL Swedish Environmental Research Institute

The comment was a criticism of the climate blog's report title, which was based on Mr. Lomborg's tweet and his calculation

What further generated controversy about the article were comments posted by *Popular Mechanics* on its web site: "That Tesla Battery Emissions Study Making the Rounds? It's Bunk. No, making a Tesla battery does not equal eight years of driving an internal combustion car." The comment was critical of the climate blog's article title, which utilized Mr. Lomborg's tweet and his calculation. We have no idea how he reached his estimate. The point of the controversy, though, is that it is all about something not stated, or even implied, in the Swedish study. Tesla and Nissan Leaf batteries were cited, but not analyzed. *Popular Mechanics* accepted the estimate of the 17.5 tons of CO2 emissions from a Tesla-size battery stated in the study. *Popular Mechanics* only challenged how long it would take driving a gasoline-powered car to offset the pollution legacy. Based on Environmental Protection Agency fuel-efficiency data for an Audi A8 4.0 car, *Popular Mechanics* calculated that the Tesla battery CO2 emissions would be overcome in less than three years of driving, and not Mr. Lomborg's eight year time frame.

Forget the controversy over Mr. Lomborg's tweet. The facts are, as the Swedish study documents, there is a significant carbon

That pollution legacy will only grow as the push for larger EV battery packs continues

emissions legacy that comes with every EV. That pollution legacy will only grow as the push for larger EV battery packs continues. Even a 2015 report by the Union of Concerned Scientists acknowledged the higher emissions associated with battery electric vehicle manufacturing, but suggested that over the life-cycle of EVs they are still cleaner than ICE vehicles. Taking steps to overcome the pollution sinkhole should be high on the agenda of EV manufacturers and the governments promoting their use.

Nevada Reboots Rooftop Solar Power, But Why?

This subsidy was eliminated by the Nevada PUC in December 2015 because it unfairly shifted the costs of operating the grid to lower-income customers without rooftop solar panels

The Wall Street Journal commented in an editorial about the recent decision by Nevada Governor Brian Sandoval (R) to sign legislation restoring net metering for electricity, which compensates power customers at the retail rate for electricity for excess power they generate and ship to the grid. This subsidy was eliminated by the Nevada Public Utilities Commission in December 2015 because it unfairly shifted the costs of operating the grid to lower-income customers without rooftop solar panels.

Solar customers will be compensated at 95% of the price of retail electricity, rather than the wholesale price

The retail electricity business involves the generation, transmission and distribution of electricity to customers. This means the price of retail electricity must cover the cost to build, operate and maintain the entire infrastructure that moves the power from the generating plant to the customer's home. For the utility, it buys the power at the wholesale price and then must cover the cost of transmitting and distributing it. Under the net metering plan recently enacted by Gov. Sandoval, solar customers will be compensated at 95% of the price of retail electricity, rather than the wholesale price. The current retail power price is about 11.8 cents per kilowatt-hour, while wholesale prices are in the 5 cent range.

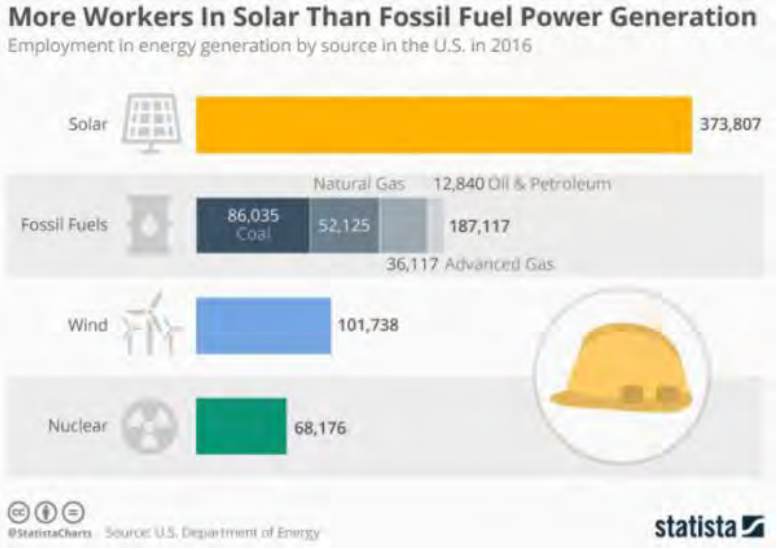
Solar power system installers who fled the state saying their business was unprofitable under the lower power-pricing plan

When the Nevada PUC issued its ruling in 2015, Gov. Sandoval supported it. Solar customers were then paid at the wholesale price for their excess power. Unfortunately, it was not attractive for the solar power system installers who fled the state saying their business was unprofitable under the lower power-pricing plan. The companies cited thousands of jobs being lost as a result of the decision. But as the *WSJ* pointed out, "many workers who installed panels were free-lancers and have been able to find other work in construction." This fact raises questions about the number of jobs generated by the rapid growth in the solar power business.

January DoE report that the solar industry employed 373,807 workers in 2016, more than employed in either wind or coal mining and coal-fired power generation

In April, *The New York Times* wrote an article based on figures from a January Department of Energy report that the solar industry employed 373,807 workers in 2016, more than employed in either wind or coal mining and coal-fired power generation. This article demonstrates the wisdom of Mark Twain's quote from his autobiography, which he attributed to former British Prime Minister Benjamin Disraeli, that: "There are three kinds of lies: lies, damned lies and statistics."

Exhibit 18. Does Solar Have That Many Full-time Workers?



Source: ***Statista***

The number of solar jobs reported by the Solar Foundation's survey for 2016 is more than 100,000 fewer workers than the Obama administration suggested having only identified 260,077 workers

The number of solar jobs reported by the Solar Foundation's survey for 2016 is more than 100,000 fewer workers than the Obama administration suggested having only identified 260,077 workers. What you have to dig to find out is that the nameplate number of solar jobs the DOE reported is for anyone who touches solar. When the government separated out the part-time solar workers, the total solar jobs dropped to the number reported by the Solar Foundation. When it reported the results of its 2016 jobs survey, the press release cited that 51,000 solar jobs were added in 2016, a 25% increase over 2015. Importantly, the Solar Foundation found that one out of every 50 new jobs added in the U.S. last year was created by the solar industry, representing 2% of all new jobs. For the uninitiated reader or apparently the media, the larger number has been cited as "proof" of the success of the solar industry.

"Overall, today's clean economy establishments added half a million jobs between 2003 and 2010, expanding at an annual rate of 3.4 percent. This performance lagged the growth in the national economy, which grew by 4.2 percent annually over the period (if job losses from establishment closings are omitted to make the data comparable)."

Counting jobs in the "green" economy is a messy effort. Early attempts were mostly conducted in Europe, which was leading the early move toward renewable power sources. Those early studies wrestled with assessing how many jobs were actually added by the growth of the wind industry, and whether the additional jobs were worthy of the subsidies being awarded to wind power companies. In the U.S., an early attempt to count green jobs was conducted by the Brookings Institute that estimated the number of green jobs in the economy as of 2010, as well as the increase in jobs during 2003-2010. The conclusion was surprising. "Overall, today's clean economy establishments added half a million jobs between 2003 and 2010, expanding at an annual rate of 3.4 percent. This performance lagged the growth in the national economy, which grew by 4.2 percent annually over the period (if job losses from establishment closings are omitted to make the data comparable)."

Those industries where the bulk of green jobs were added included: conservation with 121,147 new jobs, or 21.4% of total jobs added

According to the Brookings report, there were 565,337 green jobs added to the economy during 2003-2010. The authors suggest that the number would have been greater had the 2008-2009 financial crisis and recession not happened that resulted in job losses. One table in report showed 39 broad industry categories in which jobs were tracked, eight of which experienced job contractions. The total job losses for these eight industry groups were 52,296, of which 31% came from the hydropower sector. We would note that those industries where the bulk of green jobs were added included: conservation with 121,147 new jobs, or 21.4% of total jobs added. Public mass transit added 82,601, while waste management and treatment added 79,401 jobs. Surprisingly, nuclear energy added 7,813 jobs.

When he asked why they were using shovels, he was told this was a jobs creation program, to which he supposedly suggested that if they wanted jobs, then they should give the workers spoons

Examining the efficiency of the green energy economy is important when we consider its impact on costs. As pointed out by an American Enterprise Institute (AEI) study, it found a significant inefficiency in the renewable energy sector. The figures remind one of the anecdote attributed to economist Milton Friedman who observed Chinese men digging a canal with shovels rather than using heavy excavation equipment. When he asked why they were using shovels, he was told this was a jobs creation program, to which he supposedly suggested that if they wanted jobs, then they should give the workers spoons.

The AEI study found that:

- 398,000 natural gas workers = 33.8% of all electricity generated in the United States in 2016
- 160,000 coal employees = 30.4 % of total electricity
- 100,000 wind employees = 5.6% of total electricity
- 374,000 solar workers = 0.9% of total electricity

It takes 79 solar workers or 12 wind employees to produce the same amount of energy as one coal or two natural gas workers

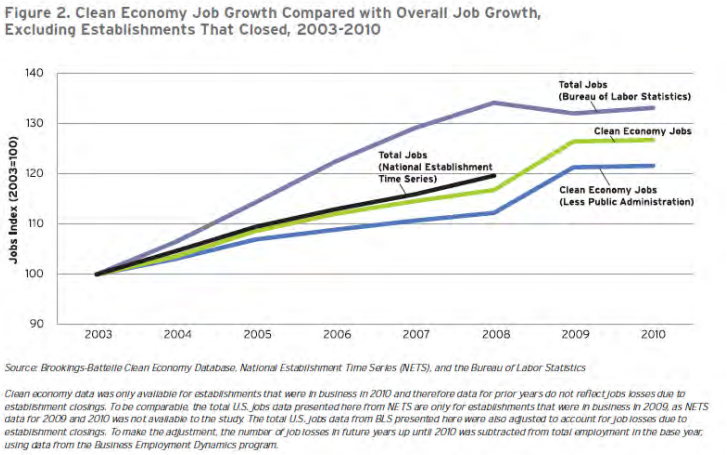
However, when the amount of electricity generated per worker is considered, coal generated 7,745 megawatt-hours (MWH) of electricity per worker; natural gas 3,812 MWH per worker; wind only 836 MWH for every employee; and solar barely 98 MWH per worker. Working the efficiency ratio in reverse, it takes 79 solar workers or 12 wind employees to produce the same amount of energy as one coal or two natural gas workers. These inefficiencies of renewable energy don't even begin to address other aspects such as land use.

That difference is represented by government employees - "your tax dollars at work."

Determining green jobs is difficult and open to criticism. As the chart in Exhibit 19 (next page) shows, we would point to the line showing Clean Economy Jobs Less Public Administration compared to the line of just Clean Economy Jobs. That difference is represented by government employees - "your tax dollars at work." Brookings cited that "over 90 percent of clean economy jobs lie in older segments that provide goods or services that solve long-appreciated environmental problems. Many of these jobs reside in government but others populate commercial segments like lighting, water

efficient products, green building materials, recycling and reuse, and pollution reduction." Doesn't sound like a lot of high-tech jobs.

Exhibit 19. Your Tax Dollars Yield Many Green Jobs



Source: Brookings Institute

There is little doubt that green businesses will use the potential for creating green jobs as a reason for seeking government support for policies, such as the push to reinstate net metering for solar power in Nevada, that support the growth of a green economy

So just how many solar jobs are there? We don't know, but we suspect the estimates tossed around are on the high side. Most likely they do what some previous studies did by counting all the employees of a company that offered a "green" product or service and not just the few actually engaged in the effort. For example, an architect designing an LEED building, would be classified as a green worker, but if his next project was a non-LEED building, would he have been reclassified? We're not so sure. There is little doubt that green businesses will use the potential for creating green jobs as a reason for seeking government support for policies, such as the push to reinstate net metering for solar power in Nevada, that support the growth of a green economy.

As the *WSJ* stated, Nevada's solar power generation has grown by 71% over the past year, but most of it has come from solar farms that are more economical than rooftop panels

The net metering issue ignores the fact that retail power prices in Nevada have declined by 12% over the past two years due to falling fuel costs. As the *WSJ* stated, Nevada's solar power generation has grown by 71% over the past year, but most of it has come from solar farms that are more economical than rooftop panels. The growth of solar, wind and other renewables has helped reduce the carbon emissions of the United States. However, the major driver for lower emissions has been the decline in coal in favor of using more natural gas in the electric power generation industry.

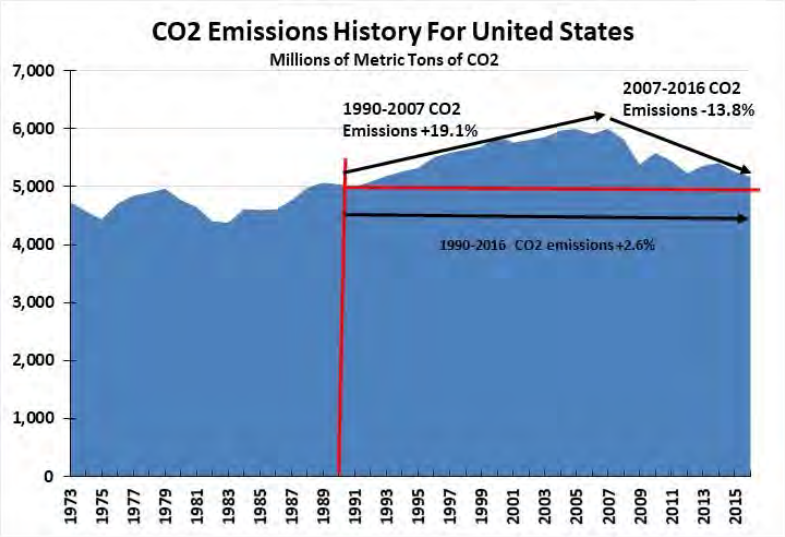
The EIA cautioned that carbon emissions is expected to grow by 2.2% in 2018 as coal's share of electricity generation should rise

The Energy Information Administration (EIA) in its most recent Short Term Energy Outlook (STEO) report predicts that the nation's carbon emissions will hit a 25-year low in 2017. But the EIA cautioned that carbon emissions is expected to grow by 2.2% in 2018 as coal's share of electricity generation should rise. At the same time, natural gas' share of power generation, which fell in 2017, will only marginally rise in 2018.

Since the peak in emissions of 6 billion metric tons of carbon in 2007, emissions have fallen by 13.8% by 2016

The progress the U.S. has shown in cutting its carbon emissions in recent years has been surprising. Based on EIA data, compared to the amount of emissions in 1990, the U.S. emitted only 2.6% more in 2016. What is important to note is that due to the shift in the fuel sources for power generation, since the peak in emissions of 6 billion metric tons of carbon in 2007, emissions have fallen by 13.8% by 2016. The 2007 peak marked a 19.1% increase from 1990's level.

Exhibit 20 U.S. Carbon Emissions Performance Over Time

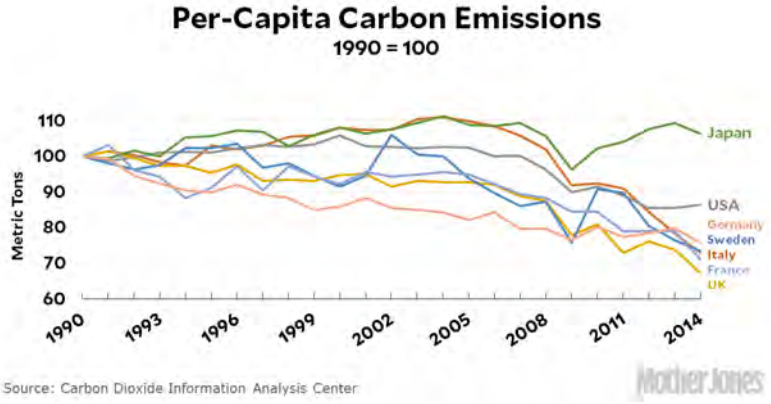


Source: EIA, PPHB

The articles all used the same chart from the Carbon Dioxide Information Analysis Center, showing that U.S. per capita carbon emissions were rising in 2014, while other countries – Germany, Sweden, Italy, France and the UK – were falling

The performance of the U.S. economy and its carbon emissions seems to be overlooked by the critics of President Donald J. Trump's decision to take the U.S. out of the Paris climate agreement. Several recent articles we have read try to make the point that the U.S. is lagging the performance of other countries, especially European ones, in cutting its carbon emissions. The articles all used the same chart (Exhibit 21, next page) from the Carbon Dioxide Information Analysis Center, showing that U.S. per capita carbon emissions were rising in 2014, while other countries – Germany, Sweden, Italy, France and the UK – were falling. Japan's per capita emissions are shown to be much higher than those of the United States, but theirs were falling in 2014. In 2015 and 2016, U.S. carbon emissions fell, and since the U.S. population has grown, the country's per capita emissions likely have fallen. In contrast, according to the BP plc (BP-NYSE) energy statistics database, France, Germany, Italy and Sweden all showed increases in their carbon emissions between 2014 and 2016. Germany's increase was the smallest, up only 1.5%, while the other three countries' increases ranged between 3.2% and 3.9%. Both Japan and the UK showed emissions declines of 4.0% and 10.6%, respectively.

Exhibit 21. How Per Capita Carbon Emissions Have Performed

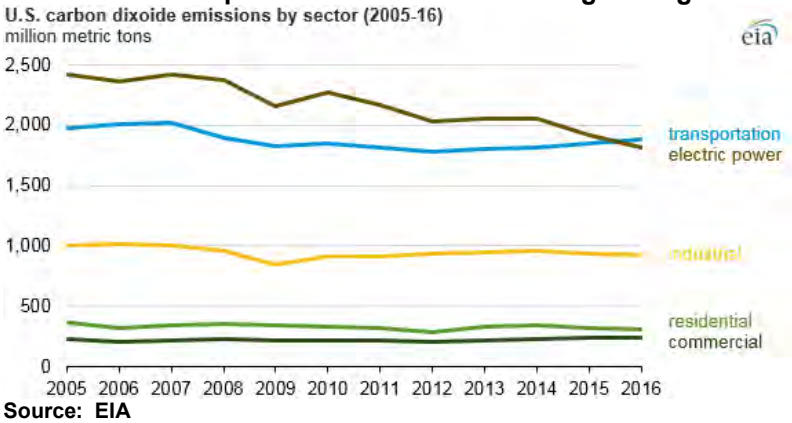


Source: ***Mother Jones***

The EIA's data shows that for the first time, carbon emissions from generating electricity are now below those emitted from the transportation sector

The greatest challenge for the United States and its carbon emissions future is what happens to the nation's fuel mix for generating electricity, as well as decarbonizing our transportation sector. The EIA's data shows that for the first time, carbon emissions from generating electricity are now below those emitted from the transportation sector. Reducing transportation emissions will mean the more efficient use of fossil fuels to power vehicles, and eventually increasing the number of non-polluting or lower polluting vehicles, such as fully-electric cars, hybrids and those vehicles powered by hydrogen fuel cells.

Exhibit 22. Transportation Emissions Are Largest Segment



Source: EIA

There remain hurdles to integrating intermittent renewables to the grid, but some of the regional power grids are making progress in managing that challenge

The power sector will continue to decarbonize as a result of the push by governments to add more renewable supplies to the system. Older coal-fired power plants will be retired, not just due to regulatory pressures but because it is too costly to make them more efficient and cleaner-burning. There remain hurdles to integrating intermittent renewables to the grid, but some of the regional power grids are making progress in managing that challenge. Decarbonizing the transportation sector will come from more efficient

The push for a greener world comes at a cost, and for many people, that cost is becoming more than they are willing to, or can, support

internal combustion engine cars as well as electric and hybrid vehicles, in addition to the growth of ride-sharing services. All of these transitions are underway. It is not an issue of whether there will be a transition, the questions are how fast it will happen and which technologies will win out in our new environment. The answers will be determined by either technology breakthroughs or improved economics. As we are seeing around the world, the push for a greener world comes at a cost, and for many people, that cost is becoming more than they are willing to, or can, support. How that dilemma is resolved is unclear.

Will 2017 Be The Year The Hurricane Drought Ends?

Now, CSU looks for 14 named storms, up three from the earlier forecast, as well as two additional hurricanes – six versus four – but still just two major hurricanes

Tropical Storm Cindy, which landed on the Texas/Louisiana border on June 22nd, reminds us that we are now well into the annual hurricane season. Virtually every forecast for this hurricane season updated at the start of the season, June 1st, called for more storms than they predicted earlier. The Atmospheric Science Department at Colorado State University (CSU) raised its tropical storm forecast for the season beyond adding Tropical Storm Arlene that formed before the official start of the season to the count. Now, CSU looks for 14 named storms, up three from the earlier forecast, as well as two additional hurricanes – six versus four – but still just two major hurricanes. The forecasters now see a slightly above-average storm season due to the absence of El Niño that produces wind shear that impedes the development and strengthening of tropical storms, compared to its slightly below-average forecast before.

The June forecast upped that probability to 55%, above the historical average

The greatest change to the CSU forecast deals with its experiment with projecting the probability of landfall on parts of the U.S. coastline. In CSU's April forecast, it projected a 42% probability of at least one major (Category 3-4-5) hurricane making landfall on the entire U.S. coastline, compared with a 52% average for the last century. The June forecast upped that probability to 55%, above the historical average. When the forecast focuses on the U.S. East Coast including the Florida peninsula versus the Gulf Coast from the Florida Panhandle westward to Brownsville, Texas, the increases were significant and are now above the historical averages. For the East Coast, CSU now sees a 33% probability, up from 24%, and the average of 31%. The Gulf Coast probability was raised from 24% to 32%, compared to the historical average of 30%.

The warmer water is where tropical storms spawn and strengthen as they move westward toward North America

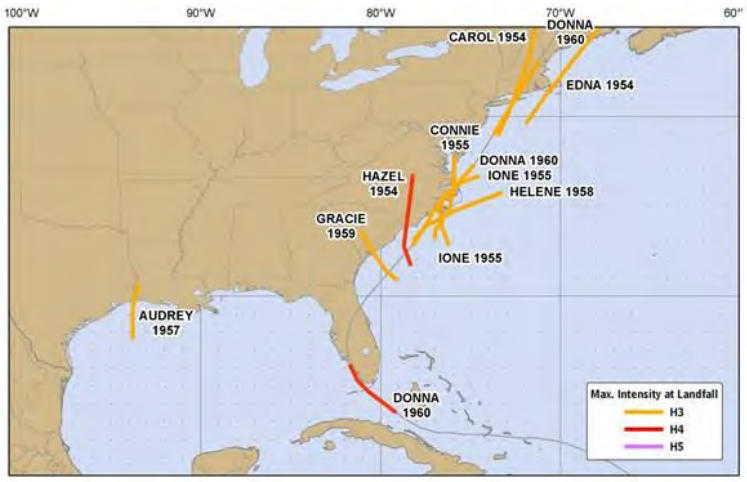
One of the leading meteorological forecasters, Joe Bastardi of WeatherBell Analytics LLC, has become concerned about the possibility that hurricane activity may be higher than average this year due to the warming waters in the Atlantic basin. The potentially offsetting factor may be that the waters in the North Atlantic Ocean are cooler, although the South Atlantic is warmer. The warmer water is where tropical storms spawn and strengthen as they move westward toward North America.

About a decade ago, following the 2005 hurricane season when we experienced the most active storm season on record, Mr. Bastardi made comments about changes underway in the weather cycle. People were shocked when the 2005 storm season generated 28 tropical storms, of which 15 became hurricanes and seven were major hurricanes. In that major hurricane group was Dennis, Emily, Katrina, Rita, and Wilma – two of which inflicted serious damage to the Upper Gulf Coast including Houston and New Orleans.

What that meant was that there would be more storms and especially ones heading up the East Coast such as experienced in the 1950s

Mr. Bastardi said, "In 2006, I loudly proclaimed on national outlets that we were going back to the 1950s as far as the climate pattern went and that the patterns of the 50s which opened the east coast up for hurricanes, as well as hot, droughty look, for the southern US would take over. The reason was simple, we were in a cycle roughly like the period when the PDO [Pacific Decadal Oscillation] and AMO [Atlantic Multi-decadal Oscillation] warmed and a flip to the cold PDO was on the way." What that meant was that there would be more storms and especially ones heading up the East Coast such as experienced in the 1950s. Having lived through those storms, we knew what Mr. Bastardi was talking about.

Exhibit 23. Major Hurricanes By Landing Strength In 1950s



Source: WeatherBell

If the tropical storm forecasts prove correct this year, then we could experience a much more active season than in recent years. Which way the storms go – up the East Coast, or into the Gulf Coast – will have an impact on energy supplies, besides energy consumption.

Latest Quality Survey Harbors Issues For Autonomous Cars

The recent *J.D. Power's* annual Initial Quality Study, which highlights the best cars and technology each year, found dissatisfaction with

Although this year's complaint uptick was minor, it was the only survey category that failed to show improvement this year

many of the semiautonomous features showing up in new vehicles. Issues raised involve advanced safety tools such as adaptive cruise control, autonomous braking and lane-departure assist. There was an average of nearly 13 complaints about semiautonomous features per 100 vehicles surveyed in 2017, up from about 12 problems cited in 2016. Although this year's complaint uptick was minor, it was the only survey category that failed to show improvement this year.

It has been suggested that the solution to these problems is better communications

Of all the quality problems reported by consumers in 2017, 34% were related to adaptive cruise control, up from 17% in 2016. According to the survey firm, in another study it released earlier this year that examined problems confronted by owners of 2014 model-year vehicles, customers were frustrated with their infotainment systems including wireless Bluetooth connections for smartphones and voice-recognition features. It has been suggested that the solution to these problems is better communications.

That may have been true with Bluetooth connections, but that is not the same as safety related issues cited in the current survey

According to Jim Sayer, director of the University of Michigan Transportation Research Institute, "The question for auto makers is, 'How do they communicate and explain these features to the general public?' That's something all manufacturers will struggle with because there's not always consistency in how these systems operate, or even what they're called." That may have been true with Bluetooth connections, but that is not the same as safety related issues cited in the current survey. These concerns should be of greater concern to auto manufacturers, who are pushing forward aggressively with autonomous vehicles, because it may signal objections to these new technologies.

Based on all the activity in the self-driving business, it appears auto companies may not have either heard the message or have not processed it yet

Dave Sargent, a vice president with *J.D. Power* commented on the issue of semiautonomous features. They "are coming quickly and some customers are registering some concerns. This is not a major problem yet but could become one if industry moves too fast." Based on all the activity in the self-driving business, it appears auto companies may not have either heard the message or have not processed it yet. We aren't sure this issue will be resolved with merely a better communications effort.

Contact PPHB:
1900 St. James Place, Suite 125
Houston, Texas 77056
Main Tel: (713) 621-8100
Main Fax: (713) 621-8166
www.pphb.com

PPHB is an independent investment banking firm providing financial advisory services, including merger and acquisition and capital raising assistance, exclusively to clients in the energy service industry.