

MUSINGS FROM THE OIL PATCH

August 13, 2019

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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

Summary:

Trade War And Outlook For The Oil And OFS Markets

Tariffs are signaling lower global economic activity, and creating oil price volatility that hurts activity.

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Can We Address Climate Change Without Green New Deal?

Rather than dramatic programs, slow, incremental efforts may prove more successful, frustrating economists.

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Everyone But The Buyers Is Crying The Natural Gas Blues

Natural gas prices are at record lows, while power use and LNG exports drive demand. A change coming?

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IMO 2020 May Turn Out Differently Than Many Think

Indonesia is the first country to announce it will not comply with IMO 2020 requirements for ships operating in its territorial waters. With oil demand falling, IMO 2020 may be as disruptive as thought.

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Interesting Developments In Energy:

**Indonesia Suffers From Subsidence Not Rising Seas
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Correction:

Explaining an incorrect map from the last issue of the *Musings*.

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Trade War And Outlook For The Oil And OFS Markets

Our targeting of a major trade partner, and the second largest economy in the world, is creating fears of economic disruptions

By the close of business on that Thursday, August 1st, crude oil prices had fallen by nearly 8%

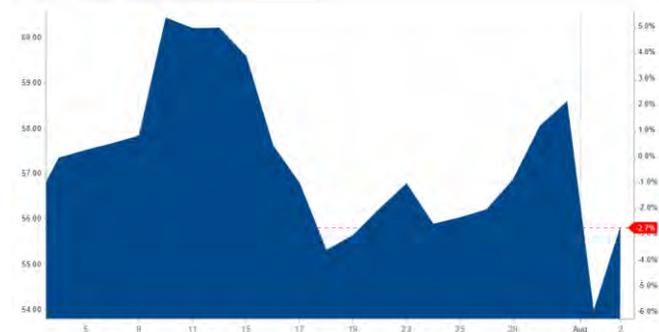
Those of us of a certain age probably remember movies from the 1930s and 1940s. Often, a dramatic scene included a bundle of newspapers hitting the sidewalk with the camera focused on the headline in big, bold type declaring a scary event. Murder! Conviction! War! The headline was used to dramatize the movie's story-line. Today, if we created such a scene (no movie would do it), the headline likely would be: Trade War!

Even without the headline drama, the stock and commodity markets are being roiled by the anticipated negative economic impact from the tariffs the Trump administration is levying against goods produced by many of our trading partners around the world, but most particularly, China. Our targeting of a major trade partner, and the second largest economy in the world, is creating fears of economic disruptions.

Two weeks ago, as negotiations over improving our trading relationship with China were underway, President Donald J. Trump tweeted that he was planning to levy a 10% tariff on \$300 billion of additional goods sold by China to the U.S. These trade tariffs are designed to pressure China into purchasing greater amounts of U.S. agricultural and industrial goods, while also slowing the pace of purchases of Chinese goods by U.S. residents. It is thought that an outcome of an improved trade relationship will be stopping China's theft of our intellectual property.

When the tweet appeared, the stock market began to dive and crude oil prices dropped like a rock. By the close of business on that Thursday, August 1st, crude oil prices had fallen by nearly 8%. West Texas Intermediate's (WTI) price closed trading on the prior Wednesday at \$58.58 a barrel. By the close of business on Thursday, after the tweet, WTI settled at \$53.95, down \$4.63 per barrel. That was the largest daily price plunge for WTI since February 3, 2015, when it fell by \$4.60 per barrel.

Exhibit 1. WTI Prices For July And Early August



Source: Oilprice.com

Exhibit 1 (prior page) shows how dramatic the oil price fall was on August 1st. WTI rebounded the following day, but the dramatic response of the oil market to the prospect of lower oil demand due to reduced economic activity from the imposition of the new tariffs took a toll on the outlook for oil prices. Welcome to volatility!

What is amazing when looking back at oil price history since the fall of 2014, when Saudi Arabia and its fellow OPEC members decided to alter policies for managing the global oil market, is how volatility has varied. The strategy shift from reducing output to support and/or lift oil prices and replacing it with a policy of boosting production in order to recapture previously lost market share, while accepting lower oil prices, has created a sharply different environment for energy companies than existed for the prior 30 years.

Increasingly, the energy world of today looks more and more like that of the mid-1980s, the last time Saudi Arabia concluded it could no longer justify being the balancing agent for global oil markets, and suffering lost income

Increasingly, the energy world of today looks more and more like that of the mid-1980s, the last time Saudi Arabia concluded it could no longer justify being the balancing agent for global oil markets, and suffering lost income. The aftermath of Saudi's shift in oil strategy in that earlier period was oil prices falling below \$10 per barrel, inflicting significant financial pain on all oil exporting countries and every operating energy company. That oil price collapse literally destroyed the global oil business, wiping billions of dollars of wealth from the industry. The price drop, and its resulting crippling of oilfield activity, bankrupted large segments of the oilfield industry sector. The outcome of the oil price collapse was an extended period of industry and country adjustment to lower prices, which cost tens of thousands of jobs in the energy sector. Are we doomed for a repeat?

The dramatic share price declines that day highlighted how much investors "hate" energy shares

The financial media on the day following the August 1st oil price fall focused on how devastating it was for the shares of energy companies. Moreover, the dramatic share price declines that day highlighted how much investors "hate" energy shares – not just because of oil price volatility. The pool of investors even willing to consider purchasing energy company shares is shrinking, as "environmental, social and governance" (ESG) policy considerations are increasingly governing portfolio investment decisions. With more institutions seeking to attract investment dollars from endowment, pension and sovereign funds that are adopting ESG mandates, portfolio managers have to execute them, meaning they will either sell all of their existing energy shares holdings or refuse to buy any new positions. In either case, the outcome means more supply of energy company shares and less demand, which puts downward pressure on their prices.

The stock market phenomenon is happening regardless of improving energy industry fundamentals. Those fundamentals argue convincingly that fossil fuels will continue to play a meaningful role in satisfying global energy needs for decades into the future. While the energy industry will continue to exist, the dynamic that drives the

Following the oil market's response to President Trump's tweet, investors wonder if we are in a new era of increased oil price volatility

business is being sapped by clean energy mandates of governments around the world – both at local and national levels. While the investment sentiment struggle is not truly over whether energy has a future, it is rather about how quickly the future may/will change. Permanently lower levels of global oil consumption, which is presumed to be the outcome of the trade tariff struggle, is the governing force for crude oil prices. Following the oil market's response to President Trump's tweet, investors wonder if we are in a new era of increased oil price volatility.

Oil fell from \$73.69 to \$66.15 per barrel, a \$7.54 drop, equal to 10.2%

The nearly 8% drop in oil prices on August 1st received much media attention. What we found when we went back and examined daily oil price changes since October 2014, it became clear that 2015 was a very volatile year. That volatility was only exceeded by what was experienced during the second half of 2018.

The largest one-day oil price drop since October 2014 occurred on the first trading day following the late-November OPEC meeting's outcome announcement. Oil fell from \$73.69 to \$66.15 per barrel, a \$7.54 drop, equal to 10.2%. Between February 3, 2015, and September 1, 2015, there were four days when oil prices fell by more than \$3.56 per barrel. There were a few days when oil prices rebounded, but the overall change during this period saw WTI falling from \$53.05 to \$45.41 per barrel.

Oil price volatility in 2016 and 2017 was benign, but volatility in 2018 was particularly brutal. On July 10, 2018, WTI fell by \$3.73 per barrel to \$70.38. While that should have alarmed people, it didn't. Oil prices continued to hold in the high \$60s and low \$70s a barrel, even rising in the latter days of September. WTI peaked on October 3rd at \$76.41 per barrel before beginning to slide. The downward pressure came from the belief that the initial wave of trade tariffs would materially slow global economic activity, leading to a growth in crude oil inventories. At the same time, Russia was threatening the tenuous agreement between it and OPEC to reduce the combined oil supply that was helping boost oil prices. By signaling that it was considering ending its participation, Russia was pushing for a better agreement with OPEC. Russia viewed high oil prices as a sign world consumption was rising and it could boost its oil output and reap the reward of greater income.

The combination of weaker oil demand and increased supply turned poisonous for oil prices

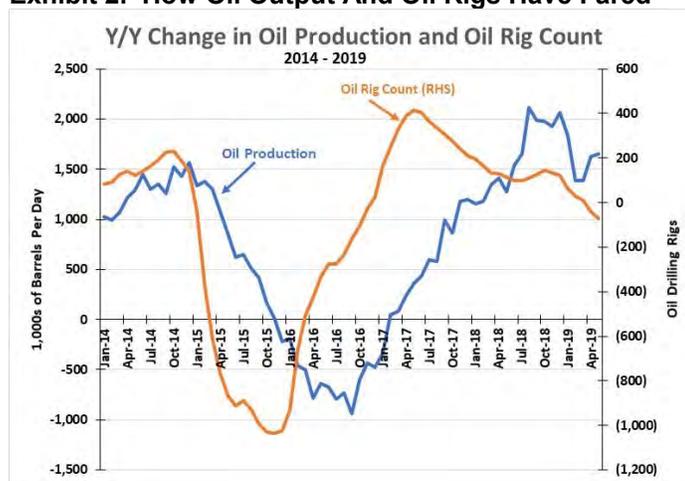
The combination of weaker oil demand and increased supply turned poisonous for oil prices. Between November 13 and December 24, 2018, there were five days when WTI fell by more than \$3 per barrel. Over that roughly six-week period, WTI fell from \$59.93 to \$42.53 per barrel, a loss of \$17.40 or 29%. Christmas Eve's trading marked the end of the oil bear market, partly helped by the absence of buyers heading into the holidays. The lack of liquidity (buyers) pushed minor downward pressure into an oil price rout. When the buyers returned after Christmas Day, sentiment about the future of crude oil shifted dramatically, causing it to begin rallying.

The August 1st trading may signal that oil prices are becoming more volatile

Prior to August 1st, there has been only one other day this year (May 31, 2019) when oil prices fell by more than \$3 per barrel. Given the economic and geopolitical events of 2019, oil price volatility has been relatively benign. The August 1st trading may signal that oil prices are becoming more volatile. Certainly, the geopolitical tension surrounding Iran’s actions in the Strait of Hormuz and its nuclear enrichment steps are at a high level, threatening the flow of Middle East oil to global buyers. Any act that limits shipments of oil from the Middle East would have a significant impact on oil markets, adding a “fear premium” to global oil prices. At the same time, the trade tariffs are having, and will have, an impact on global economic activity. The problem is that no one knows the magnitude of the economic damage that might be caused by the tariffs. Adding to the challenge in sorting out the impact of these forces on oil prices is the continued growth in U.S. oil production. Will growth continue unabated in light of potentially higher oil price volatility?

To answer the question of future oil production – the sustainability of the American oil shale revolution – we decided to examine how it has grown since 2014 compared to the oil rig count, which is the traditional metric for predicting future oil output growth. Exhibit 2 shows the year-over-year change in oil production along with the oil drilling rig count between January 2014 and May 2019. What the chart shows is not surprising: when oil drilling declines, oil production also falls. Likewise, with a short lag after the drilling rig count begins climbing, so too, does crude oil production.

Exhibit 2. How Oil Output And Oil Rigs Have Fared



Source: EIA, Baker Hughes, PPHB

Year-over-year growth of the oil drilling rig count peaked in early 2017, and the rig count began rising at a slower pace

Year-over-year growth of the oil drilling rig count peaked in early 2017, and the rig count began rising at a slower pace. Starting in early 2019, the oil drilling rig count growth ceased, before turning negative. In contrast, the oil drilling rig count dropped throughout all of 2015 after oil prices were crushed by OPEC’s. During the early months of 2015, investors, and many others within the oil

The rig count actually began rising again in May 2016, but not until over 80% of the working oil drilling rigs at the industry peak in 2014 had been idled

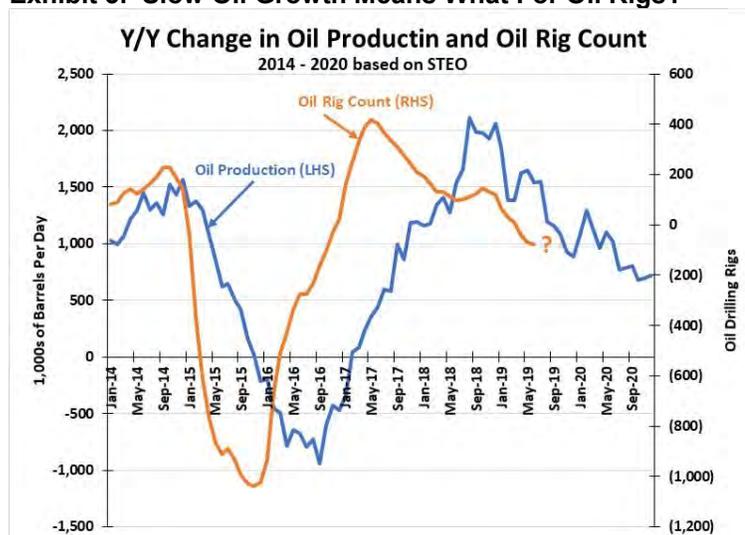
When the peak in the drilling rig count growth was achieved in early 2017, it was nearly 15 months before crude oil's production growth rate peaked

industry, anticipated a “V-shaped” drop and recovery in the rig count, as well as for oil prices, much as happened during the 2009 recession following the global financial crisis.

When it became evident that such a quick oil price reversal was not in the offing, producers became more serious about the need to scale back operations. Those actions contributed further to downward pressure on oil prices and drilling activity. As the industry approached a bottom in the oil rig count decline, it had shed over 1,000 rigs, or more than two-thirds of the active rig count at the peak. Unfortunately, that was not the bottom in drilling activity – it only marked the point at which the year-over-year pace of the rig count decline had peaked. The rig count actually began rising again in May 2016, but not until over 80% of the working oil drilling rigs at the industry peak in 2014 had been idled.

It was approximately nine months after the oil drilling rig count decline bottomed that the oil production decline rate peaked and started to fall at a slower rate. While the rig count recovered at a rapid pace, crude oil production grew less slowly. What we see is that when the peak in the drilling rig count growth was achieved in early 2017, it was nearly 15 months before crude oil's production growth rate peaked. In the prior downturn, the relationship between the drilling rig count growth and changes in oil output were almost simultaneous. This time there were significant lags between the two – likely a result of the extensive domination of shale drilling and production in today's oil market, as the need to fracture wells adds to the time between drilling and production.

Exhibit 3. Slow Oil Growth Means What For Oil Rigs?



Source: EIA, Baker Hughes, PPHB

Since oil drilling is key to future oil production growth, it is not surprising that when the rig count stopped growing rapidly and

Is it possible the EIA forecast is too optimistic in light of the new industry dynamic of producers being forced by their shareholders to live within their cash flow, while reducing debt loads and boosting cash returns to investors?

eventually turned negative, oil output followed. The consensus view for U.S. oil output is that it will continue to grow. In fact, the Energy Information Administration (EIA) has a forecast in its Short-Term Energy Outlook (STEO) showing domestic crude oil production reaching 13.64 million barrels per day (mmb/d) by December 2020, up from June 2019's output of 12.19, a gain of 1.45 mmb/d, or a 12% increase. What does this mean for oilfield activity? Is it possible the EIA forecast is too optimistic in light of the new industry dynamic of producers being forced by their shareholders to live within their cash flow, while reducing debt loads and boosting cash returns to investors? Adhering to this strategy means fewer wells are being drilled.

If the rig count continues to decline, will that put at risk the EIA's oil production forecast?

As we add the year-over-year growth in domestic crude oil production from the STEO forecast to our historical chart (Exhibit 3, prior page), we can see the quandary about what the future for rig count growth stands. If the rig count continues to decline, will that put at risk the EIA's oil production forecast? On the other hand, if the rig count ceases falling and merely remains static, will that pattern alter the oil volumes in the latter months of the EIA's forecast? Will oil prices in the low- to mid-\$50s a barrel be sufficiently high enough to push oil producers to step up their drilling, or will they continue to sit on their hands? Our best guess is for a slowing of the oil drilling rig decline, before going sideways while the global oil market sorts out the long-term level of oil prices.

Can We Address Climate Change Without Green New Deal?

The lone candidate whose platform is all about climate change – Washington Governor Jay Inslee – was unable to even convince his state's citizens to vote in favor of putting a price on carbon

The first Democratic Presidential Debate in Miami saw a combined total of 15 minutes of the roughly four hours of talking devoted to climate change. The topic received even more time – 20 minutes – during the second debate in Detroit. It is surprising that these candidates weren't more concerned about talking about efforts to curb climate change and prevent their initial debate host city from being underwater by the end of their second term in office. Then again, the lone candidate whose platform is all about climate change – Washington Governor Jay Inslee – was unable to even convince his state's citizens to vote in favor of putting a price on carbon as a step in the fight against climate change.

The Democratic Party's Green New Deal, which at least seven of its presidential candidates back, was unveiled earlier this year as a rallying cry for action by Congress. While it received extensive media attention, its estimated price tag of \$93 trillion has made the proposal a non-starter on Capitol Hill. In fact, when brought to the floor of the Senate, something Democrats called a mockery because there had been no hearings, the bill was voted down 0-57!

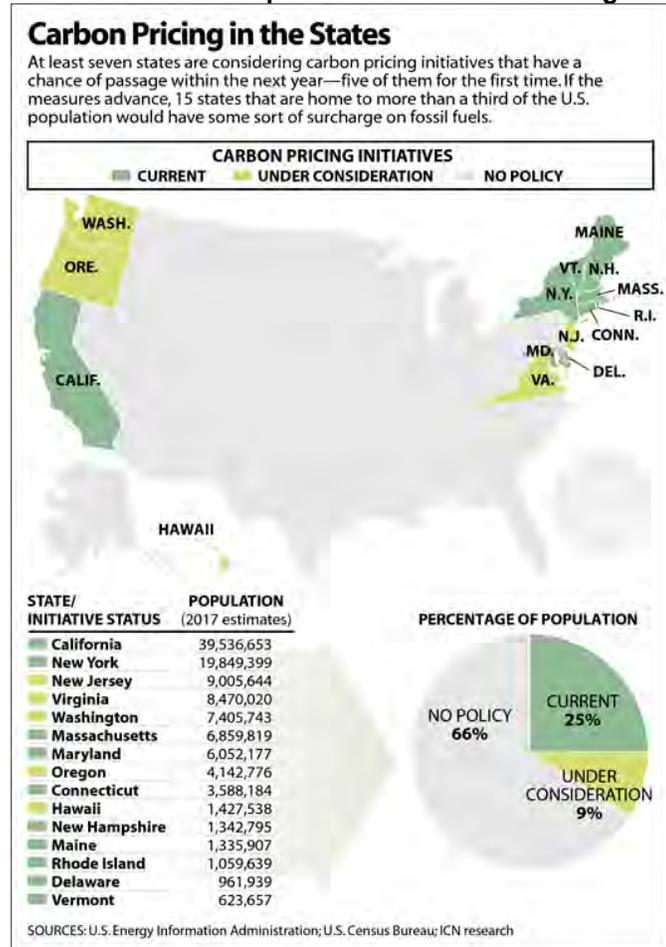
Wait, there were no supporters of this bill that has been endorsed by leading Democrats? It turns out that four Democratic Senators –

With 12 years left to stop climate change, the most popular strategy is to put a price on carbon via either a direct carbon tax such as exists in neighboring Canada, or through a cap-and-trade system

Sens. Joe Manchin III of West Virginia, Kyrsten Sinema of Arizona, Maine independent Angus King and Alabama’s Doug Jones – voted against the bill along with the 53 Republican Senators. The remaining Democratic Senators all voted “present,” employing a strategy popularized by then-Illinois Senator Barack Obama when he wanted to avoid taking a position on a controversial issue.

With 12 years left to stop climate change, the most popular strategy is to put a price on carbon via either a direct carbon tax such as exists in neighboring Canada, or through a cap-and-trade system. Cap-and-trade systems have not been as successful, but they exist in California and the nine-state northeastern states’ Regional Greenhouse Gas Initiative (RGGI). Late last year, *Inside Climate News* published an article outlining the possibility for more states to enact carbon pricing legislation during 2019. Virginia is considering joining the RGGI, while New Jersey may rejoin.

Exhibit 4. Where Cap And Trade Carbon Pricing Exists



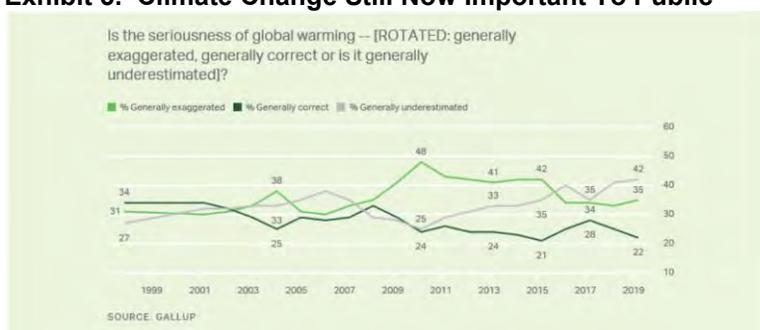
Source: *In Climate News*

The issue is that even if these additional states adopt carbon pricing, they are not significant emitters

The issue is that even if these additional states adopt carbon pricing, they are not significant emitters. As Marc Hafstead, director of the Carbon Pricing Initiative at *Resources for the Future*, a think-tank focused on environmental economics put it, "There's a fundamental issue, though, in that the states that are ready to move don't represent a lot of the emissions in the U.S. I think, at the end of the day, federal action is going to be required." However, it is unlikely that any federal action will be forthcoming before the 2020 presidential election, and maybe not until after the 2024 election if President Donald J. Trump is re-elected next year.

The issue of climate change still struggles to gain traction as a significant issue for Americans. While environmentalists point to high concern reflected in polls of Democrats, or in general surveys undertaken by climate activist organizations, whenever pollsters ask open-ended questions such as "list your top 10 concerns" seldom does climate change, or global warming, make more than a token appearance in the tallies.

Exhibit 5. Climate Change Still Now Important To Public



Source: Gallup

As the intensity of environmental activism grew during the past decade, both "underestimated" and "exaggerated" seriousness ratings rose, while "generally correct" declined

Gallup has been asking a question about characterizing the seriousness of global warming since 1998. The results showed essentially an even split among "exaggerated," "generally correct" or "generally underestimated" during the decade of 1998-2008. The end of that period was marked by very high tropical storm activity, which generated substantial media coverage of how climate change was the cause of the increased hurricanes. As the intensity of environmental activism grew during the past decade, both "underestimated" and "exaggerated" seriousness ratings rose, while "generally correct" declined. Over the past 10 years, after spiking to 48% for "exaggerated," that view subsequently declined by about a quarter in 2019. The "generally underestimated" view increased by over 50%, going from 25% to 42%. The "generally correct" view fell by about a quarter between 2008 and 2019. What is impossible to know is how much public perception has been shaped by the greater media attention to climate events. Our perception is that media coverage is largely the reason for the shifting views in recent years.

A recent opinion article in *Foreign Policy* magazine offered the most realistic view we have seen, but one that goes against the grain of the promoters of “climate emergency”

As the battle over climate change rages, and is likely to increase during the upcoming political campaign, the question of how best to deal with the issue remains unanswered. A recent opinion article in *Foreign Policy* magazine offered the most realistic view we have seen, but one that goes against the grain of the promoters of “climate emergency.” Surprisingly, the article was written by Ted Nordhaus, an author, environmental policy expert, and the founder of the Breakthrough Institute. He is also the nephew of William Nordhaus, the MIT economist and recent Nobel Prize for Economics winner for his work on climate change and carbon taxes.

Mr. Nordhaus’ article was titled: “Subtle Shifts.” The thrust of the article is that dramatic climate projects will not save the world, but rather slow, quiet incremental changes are the planet’s best hope for success in reducing the impacts from climate change. His article argues that while economists favor carbon pricing as the most efficient way to alter consumer behavior with regards to using fossil fuels, it may not be successful in curbing carbon emissions. What we have learned about consumer behavior with respect to curbing energy use is that it mostly comes from energy scarcity (spikes in energy prices), but the ability for “producing scarcity by political fiat is much harder in the real world than in an economist’s model.”

He points out that the Green New Deal will fail, like all other “ambitious measures that have claimed the mantle of markets.” While the plan would make the social cost of carbon visible in our daily consumption, subsidies have proven to be much more successful in achieving results. Of course, subsidies cause economists to pull their hair out, as they distort markets and allow policymakers with imperfect knowledge to make decisions about which technologies to champion.

Measured on a per ton basis, the shale fracturing investment translates into perhaps a few dollars per ton of carbon emissions avoided, a cost that continues to fall with every ton of coal pushed out of the market by shale gas

Governments have bet on many technology losers such as synthetic fuels, Solyndra solar cells, plutonium breeder reactors and biofuels. During the 1970s and 1980s, Washington wasted billions of dollars on synthetic fuels, yet it also invested minor sums in helping perfect the technologies for fracturing shale gas. As Mr. Nordhaus points out, the environmental benefits from that investment have likely offset all the unsuccessful energy investments by the federal government. Measured on a per ton basis, the shale fracturing investment translates into perhaps a few dollars per ton of carbon emissions avoided, a cost that continues to fall with every ton of coal pushed out of the market by shale gas.

Mr. Nordhaus also pointed out that U.S. investment in nuclear power has proven just as efficient in mitigating carbon emissions. He estimates that over the last half-century, nuclear plants have avoided between 15 and 20 gigatons of carbon emissions at a cost of less than \$5 per ton. On this basis, renewable energy subsidies, although costly today, may wind up being a low-cost climate mitigation tool over the long-term.

This approach will not sit well with politicians who see climate change as a rallying cry for its supporters as well as a fund-raising tool

While the economically preferred option, yet politically the most explosive, carbon pricing continues to be pushed by many factions on both sides of the political spectrum. Mr. Nordhaus argues that “quiet climate policy seeks to deescalate the political controversies associated with climate change and break up the costs of climate action.” He suggests policies such as establishing a federal clean energy standard that would require utilities to gradually transition entirely to zero-carbon technologies over the coming decades, or using U.S. Defense Department and national laboratories procurement policies to create initial markets for small nuclear reactor, geothermal power and energy storage technologies are the better way to go. Mr. Nordhaus’ effort to reach a decarbonized energy future will require going technology by technology and sector by sector in a non-partisan manner to negotiate changes with key stakeholders. This approach will not sit well with politicians who see climate change as a rallying cry for its supporters as well as a fund-raising tool. Besides, they like the attention they receive when requiring clean energy mandates.

Too often, these claims ignore how often the cited weather events have occurred in our meteorological history, something the media is reluctant to investigate

As Mr. Nordhaus concludes, “...the choice we face is between some action and no action.” He views his quiet climate policy as “the art of the possible.” We found his argument persuasive. We have always rejected the “hair-on-fire” claims about climate change and its extreme remedies. Too often, these claims ignore how often the cited weather events have occurred in our meteorological history, something the media is reluctant to investigate. On the other hand, we have always tried to live our life in an energy-efficient manner, while paying attention to minimizing harm to the planet. Although we are in a warming phase for our climate, there is still so much that is unknown about how it works and adapts to assume simplistic climate models can accurately predict our future. At the same time, humans have proven highly adaptable to climate change throughout history. We should cheer that capability. Given our technological horizon, we should not regress or abandon our pursuit of a better environment at the cost of economic and social progress for those humans currently living in less-developed economies.

Everyone But The Buyers Is Crying The Natural Gas Blues

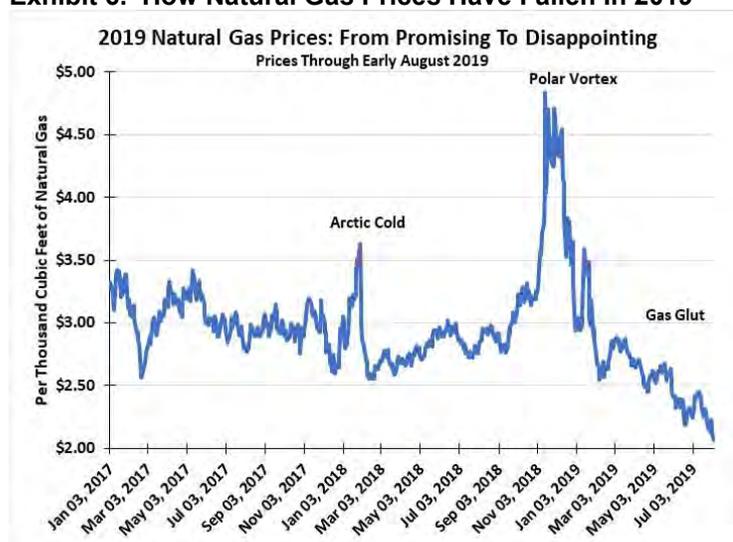
Instead of seeing strong demand lifting gas prices, global supply, and especially that in the United States, is overwhelming current demand pushing gas prices lower

The major integrated oil companies reported their second quarter results, which highlighted challenges many of them faced in the natural gas arena. Companies such as Royal Dutch Shell (RDSA-NYSE) and Exxon Mobil Corp. (XOM-NYSE) disclosed that their gas arms suffered from low gas prices. While both companies, as have others, seized on the shale revolution and the ability of natural gas to displace coal and help reduce carbon emissions, the gas market has not cooperated. Instead of seeing strong demand lifting gas prices, global supply, and especially that in the United States, is overwhelming current demand pushing gas prices lower.

The decline in gas prices has come despite strong demand from the power generation as well as liquefied natural gas (LNG) export markets

In the U.S., Henry Hub gas prices have been flirting with the \$2 per thousand cubic feet (Mcf) price level, which, if prices fall below it, would reach a low seen only a few times in the past decade. Looking at what has happened, up to a few days ago, to natural gas prices, we can see how dramatically they have fallen in recent months. As we show later, the decline in gas prices has come despite strong demand from the power generation as well as liquefied natural gas (LNG) export markets.

Exhibit 6. How Natural Gas Prices Have Fallen In 2019



Source: EIA, PPHB

What is most disturbing about the gas price chart is how stable prices were throughout 2017 and 2018, but since 2019 began, gas prices have been in a virtual freefall

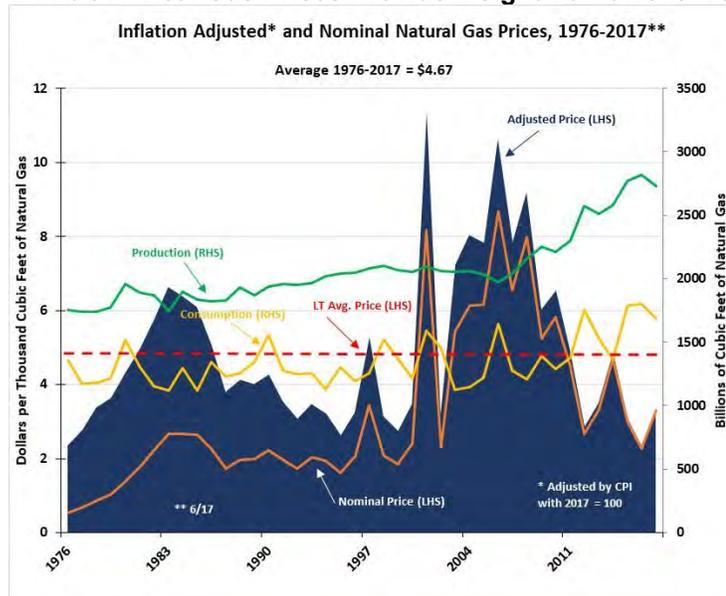
The chart above shows just how responsive natural gas prices have been to episodes of bitter cold temperatures. The magnitude of the responses reflects both the degree of the cold temperatures, as well as their duration. Another factor influencing the price spike is the magnitude of gas storage inventory, as prices are the way the market allocates supply and induces the addition of new gas storage volumes. What is most disturbing about the gas price chart is how stable prices were throughout 2017 and 2018, but since 2019 began, gas prices have been in a virtual freefall. While prices recently bounced off the \$2.06/Mcf level, it was in response to heat waves in portions of the nation. In fact, it seems that every time in the past two months when natural gas prices target falling below \$2, along comes a heat wave somewhere to stimulate electricity demand. Since low gas prices continue driving coal out of the power generation market, heat drives gas price rebounds.

We decided to look at the long-term history of natural gas prices for some additional perspective on the market. We had almost forgotten about this chart, but it provides an interesting contrast to the earlier chart showing natural gas prices since 2017. Note that the 40-year real natural gas average price is \$4.67/Mcf. That is more than twice the current gas price.

The periods of time when gas prices were above \$6/Mcf were relatively rare, and they were heavily concentrated in 2004-2010, an environment when crude oil prices traded over \$100 per barrel

The chart shows how the brief periods of double-digit gas prices were aberrations. Moreover, the periods of time when gas prices were above \$6/Mcf were relatively rare, and they were heavily concentrated in 2004-2010, an environment when crude oil prices traded over \$100 per barrel and the world was convinced energy demand was exploding and supply would prove inadequate without substantially higher prices to induce producers to increase output. Just as we learned with high crude oil prices, high natural gas prices also produced more supplies than ever imagined.

Exhibit 7. Real Gas Prices Provide Insight To Current Woes



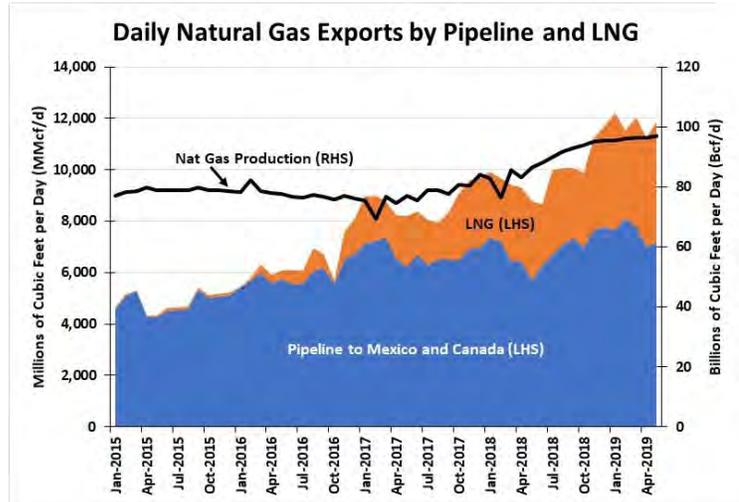
Source: EIA, BEA, St. Louis Fed, PPHB

Gas supply growth, despite increased consumption for power generation, LNG and pipeline exports, continues overwhelming demand

The other issues we would point to are the gas production and consumption lines, in particular the former. From the mid-1970s through 2005, U.S. natural gas production was relatively flat. It was when the shale revolution opened up gas resources never before thought producible that domestic gas output began climbing, something it continued to do beyond 2017. Gas supply growth, despite increased consumption for power generation, LNG and pipeline exports, continues overwhelming demand. To a certain degree it is because residential and commercial consumption is not growing, and industrial gas use fluctuates with economic activity at the same time industrial users continue improving their efficiency.

Power consumption of gas and LNG are the two growth sectors currently impacting the gas market. Since 2015, when the first LNG export facilities began pumping, volumes shipped abroad have exploded, as shown in the accompanying chart. Additionally, the U.S. is planning to construct more LNG export facilities, so greater gas volumes will be flowing to buyers around the world in the future, capitalizing on extremely low domestic gas prices.

Exhibit 8. LNG Is New Growth Market For Gas



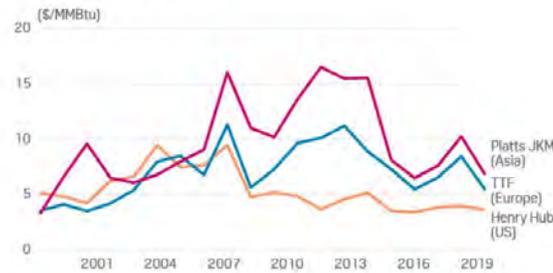
Source: EIA, PPHB

The problem for U.S. LNG is that global gas prices are falling

The problem for U.S. LNG is that global gas prices are falling. This is especially true for the Asian market, which is the predominant LNG consumption market of the world. In Japan, the second largest LNG buyer, the restarting of some of its nuclear power plants, which had been shut in the aftermath of the tsunami following the 2012 earthquake, is cutting into the nation’s LNG appetite. China, another gas consumer, is also slowing its use of LNG as its economy slows and it continues to add coal-fired power generation plants to its electricity system.

Exhibit 9. High International Gas Prices Are No More

GLOBAL GAS PRICES



Source: S&P Global Platts Analytics

Source: *Platts*

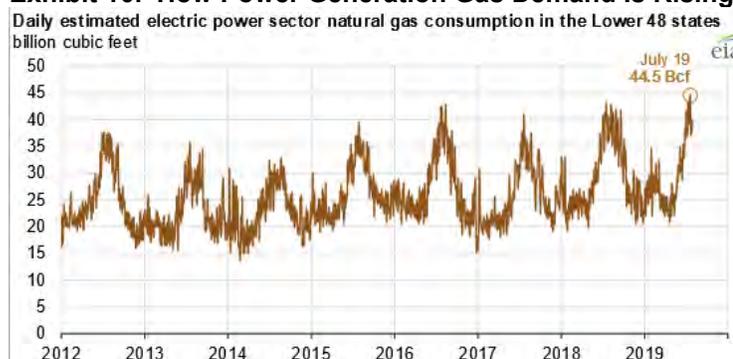
The European price slide has come despite the increased use of LNG by various countries

While we puzzle over the Henry Hub gas price shown in *Platts’* global gas price chart (Exhibit 9), it is instructive that both Asian and European gas prices have fallen fairly steadily over the past eight years. The European price slide has come despite the increased use of LNG by various countries, as domestic supplies decline and many countries remain leery of committing to additional gas purchases from Russia.

Continued low gas prices likely signal that coal's future in power generation will continue to shrink

Turning to the U.S. power market, the Energy Information Administration (EIA) recently published a chart showing daily gas consumption by the electric power sector in the Lower 48 states since 2012. The chart shows the seasonal variation in gas use, which coincides with the increased air conditioning load during summer months. Therefore, this peak is often influenced by temperature variations due to climate. However, if one examines the bottom of the annual gas consumption curve, it is evident that there has been an increase in the past five years compared to the prior three. This increase is probably a better indicator of the impact that natural gas has had on the electricity generating sector, as gas pushes coal out of the market. Continued low gas prices likely signal that coal's future in power generation will continue to shrink. Although this is positive for gas demand, we should be mindful of government climate policies that are working aggressively to replace natural gas with renewables, even though the price argument for the latter is tenuous when all aspects of intermittency are considered.

Exhibit 10. How Power Generation Gas Demand Is Rising



This disruption has altered the way in which global oil and gas markets are functioning, presenting new challenges for industry executives who have spent their entire lives with one view of how markets worked

Stepping back from the current dynamics impacting the U.S. natural gas market, we cannot avoid reckoning with the fact that the gas market is being shaped by the shale revolution and its ability to tap resources never before considered available for use. The global natural gas market, as well as the global crude oil market, is being reshaped by shale production. These markets are vivid examples of how a “revolutionary” technology can become a significant disruptor of a market. Moreover, this disruption has altered the way in which global oil and gas markets are functioning, presenting new challenges for industry executives who have spent their entire lives with one view of how markets worked. Those views have been turned on their heads, forcing all oil and gas players to rethink how they will operate in this “new” world.

This new energy world has forced significant changes in the global crude oil market. Primarily, it has been the new working relationship no one foresaw prior to 2014, i.e., the marriage of Russia with Saudi Arabia and OPEC to manage global oil supplies. The two countries were fierce rivals in the world's oil market as they were the two

While U.S. LNG shipments have gone to almost every market, the widened Panama Canal has opened the Asian market to U.S. sales

largest suppliers. With the United States' oil production revival propelling it into the number one producer slot in the world, the prior rivals have had to reach an accommodation to prevent global oil supplies from swamping demand. This new relationship is still a work-in-progress, so it is impossible to know if the current relationship will survive, and/or what modifications may be necessary for it to continue.

We see similar changes underway in the global natural gas market, which was previously controlled by Qatar, with help from aging gas suppliers such as Algeria and Indonesia. The emergence of huge LNG supplies from Australia has challenged Qatar's power, and now the U.S. is emerging as another market threat. While U.S. LNG shipments have gone to almost every market, the widened Panama Canal has opened the Asian market to U.S. sales. With significantly lower gas prices in the U.S., coupled with LNG exporters willingness to price their volumes independent of consideration of global oil prices, traditional global gas market dynamics are being challenged. As long-term LNG contracts in Asia are being renewed without oil price linkages, the global gas market is being reshaped. What remains unknown is how quickly the global LNG market will evolve into a gas-on-gas pricing battle, and its impact on global natural gas supply and demand development. For those who labored in the 1970s and 1980s to understand how global and national gas markets were being reshaped, are we now engaged in a redo?

As history has shown, once change is underway, there is no chance of dynamics returning to their prior state

We admit we don't know how the global oil and gas market dynamics will evolve. As history has shown, once change is underway, there is no chance of dynamics returning to their prior state. That said, we also are confident in saying that the changes underway will take years to settle out, with many twists and turns along the road to the oil and gas industry system of the future. The journey will prove frustrating at times, disappointing at other times, but rewarding at still other times. It will always be challenging.

IMO 2020 May Turn Out Differently Than Many Think

Citibank's chief energy economist Ed Morse who said that the trade war was cutting global oil demand growth to only 600,000 barrels per day

Two items caught our attention last week. First was commentary from Citibank's chief energy economist Ed Morse who said that the trade war was cutting global oil demand growth to only 600,000 barrels per day. That is a significant reduction from the estimate that global demand would rise by its normal 1.5 million barrels per day. Obviously, it is such a drastic reduction in the outlook for global oil demand, in the face of unrelenting oil supply growth, that has oil prices under significant downward pressure.

While we accept that global trade is slowing – one only has to watch the news coming from the global shipping industry to see it happening – it was the other item that seemed much more significant. Indonesia announced it will not comply with IMO 2020's mandate that ships switch their fuel away from high-sulfur fuel oil to

The rationale for Indonesia's action is the lack of low-sulfur fuel oil and the significantly large high-sulfur fuel oil inventories from its local refineries

one containing only 0.5% sulfur content by weight. This global change is mandated to become effective on January 1, 2020, hence the name. What Indonesia said was that it would not enforce the IMO standard for ships involved in local trade. Low-sulfur fuel oil will still be required for Indonesian ships trading in international markets.

The rationale for Indonesia's action is the lack of low-sulfur fuel oil and the significantly large high-sulfur fuel oil inventories from its local refineries. Indonesia is made up of thousands of islands, necessitating substantial local marine traffic. Many of these local ships are not capable of paying the higher price for low-sulfur fuel oil, and its availability in all locations is highly questionable, especially within the next six months. Moreover, the inventory of high-sulfur fuel oil is huge and would present a financial problem for the national oil company if the oil cannot be burned. The government's move will also provide more time for its national oil company, Pertamina, to reconfigure its refineries to produce more low-sulfur oil and less high-sulfur fuel oil, projects that are way behind schedule.

As one would expect, the shipping industry members of the Trident Alliance are upset and telling the government it has no option but to comply, and threatening legal action. However, as we have pointed out in the past, the International Maritime Organization is an arm of the United Nations and has no policing powers. It must rely on governments to enforce the policy. We suggested that non-compliance would be a partial solution to dealing with the market disruption caused by IMO 2020, and Indonesia is the first to adopt that strategy. The shippers are worried about other governments following Indonesia, something we will not be surprised to see happen, especially if the global economy is weakening. It is likely other small countries, or those where few sophisticated refineries to produce prodigious volumes of low-sulfur fuel oil exist, will follow.

Oil price forecasters have argued that IMO 2020 would cause the loss of one million barrels a day of oil supply, which would contribute to higher oil prices

Oil price forecasters have argued that IMO 2020 would cause the loss of one million barrels a day of oil supply, which would contribute to higher oil prices. If Mr. Morse's prediction is correct, we are losing almost a million barrels a day of demand, which conveniently is equal to the volume of oil being disrupted that lies behind the fears of forecasters for oil demand in 2020 to overwhelm supply and create a crude oil price spike.

Indonesia's decision to allow high-sulfur fuel oil to be used by local shippers only amounts to about 30,000 barrels per day, which equates to about 3% of the demand shift forecasters have been worried about. As a result, we may be seeing the road to a low-sulfur shipping world achieved with less price and market disruption than earlier anticipated. This is something to watch as we progress toward 2020.

Interesting Developments In Energy:

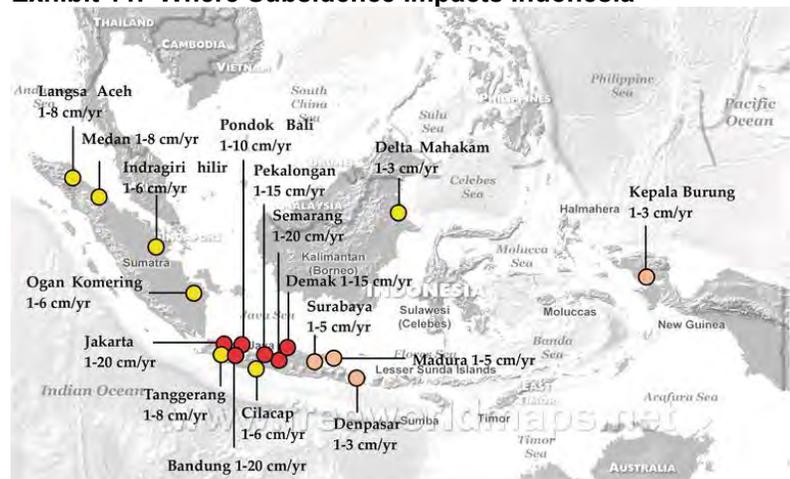
“Jakarta keeps sinking. If subsidence continues at the same rate, 95 percent of northern Jakarta will be underwater by 2050.”

Indonesia Suffers From Subsidence Not Rising Seas

The New York Times last week contained a brief item in its Science section that stated: “Jakarta keeps sinking. If subsidence continues at the same rate, 95 percent of northern Jakarta will be underwater by 2050.” The quote was attributed to Henri Andreas of the Bandung Institute of Technology in Indonesia. He reportedly has predicted that one-third of the nation’s capital, Jakarta, will be underwater by the middle of the century.

Indonesia suffers from flooding during its raining season, and especially when tropical cyclones hit the region. The region is also often cited as being at risk of flooding from rising sea levels. According to a book authored by Mr. Andreas and others, subsidence is the major problem for the islands that make up Indonesia. A chart shows the subsidence range across the region. Annual subsidence ranges from 1-20 centimeters per year (cm/yr).

Exhibit 11. Where Subsidence Impacts Indonesia



Source: intechopen.com

Jakarta suffers from groundwater extraction as well as the load from buildings, or compaction of the soil

The chart was followed with a table showing the region, the rate of subsidence and its possible cause. What one sees when examining the possible causes of subsidence, most are due to groundwater extraction. But there are a handful of citations for oil and gas extraction. We were amused, but not surprised, that Jakarta suffers from groundwater extraction as well as the load from buildings, or compaction of the soil. We suspect this is an issue with many major cities around the world.

Exhibit 12. Indonesia's Sources Of Subsidence

Regions	Rate subsidence (cm/year)	Notes
1. Langsa Aceh	1-8	Possible main cause oil and gas extraction
2. Medan	1-8	Possible main cause groundwater extraction
3. Indragiri Hilir	1-6	Possible main cause peatland draining
4. Ogan Komering	1-6	Possible main cause peatland draining
5. Tangerang	1-8	Possible main cause groundwater extraction
6. Jakarta	1-20	Possible main causes groundwater extraction and load of building
7. Bandung	1-20	Possible main cause groundwater extraction
8. Pondok Bali	1-10	Possible main cause oil and gas extraction
9. Cilacap	1-6	Possible main cause oil extraction
10. Pekalongan	1-15	Possible main cause groundwater extraction
11. Semarang	1-20	Possible main causes groundwater extraction and land reclaimed
12. Demak	1-15	Possible main cause groundwater extraction
13. Surabaya	1-5	Possible main cause groundwater extraction
14. Madura	1-6	Possible main cause oil and gas extraction
15. Denpasar	1-3	Possible main cause groundwater extraction
16. Delta Mahakam	1-3	Possible main cause oil and gas extraction
17. Kepala Burung	1-3	Possible main cause gas extraction

Source: *intechopen.com*

It is useful to keep this information in mind when articles begin citing rising sea levels as a contributing factor to the coastal flooding being experienced by cities and regions.

Get Ready For Flying Cars That Aren't Cars

It hovered about 10 feet above the ground for a minute

According to a recent item from MIT Technology Review, a Japanese flying car made its first test flight. Japanese electronics company NEC tested a drone-like prototype inside a cage at one of its facilities (pictured). It hovered about 10 feet above the ground for a minute. It did not carry any passengers and it was powered by a battery. NEC engineers spent about a year developing the model, which weighs about 330 pounds and measures nearly 13 feet long. A problem is that the car cannot drive and then take flight.

Exhibit 13. The Drone That Imitates A Flying Car



Source: *MIT Technology Review*

The Japanese government's "road map" document says it plans to ship goods this way by 2023 and let people ride in the vehicles in its cities by the 2030s

Japan is hoping to position itself as the leader in the 'flying car not-quite-as-large-as-a-helicopter drone space.' The model that flew was basically a large drone, with four propellers, which can carry people. The Japanese government's "road map" document says it plans to ship goods this way by 2023 and let people ride in the vehicles in its cities by the 2030s. Critical to this plan will be the perfection of autonomous technology, as well as an autonomous drone flight-control system. Will this become an economic proposition, or merely a toy for the super-wealthy? Package delivery services will seldom require such a large vehicle, and its size will reduce maneuverability in tight city spaces.

At the moment, Europe's Airbus Group (EADSY-OTC) and America's Boeing Company (BA-NYSE) have projects under way. More likely, it will be one of or several of the raft of smaller companies pushing aggressive development timelines for flying cars. Germany's Volocopter plans to start trials in Singapore this year. Uber Technologies Inc. (UBER-NYSE) has claimed it will start test runs in 2020 for a taxi service between Frisco, Texas and the DFW airport, and that it plans to start commercial flights in 2023. Uber has five flying-car makers as partners.

Exhibit 14. New Way To Cross English Channel



Source: Steve Parsons/AP

He was strapped to the board and had to lean into the wind gusts, which presented his greatest challenge

While we wait for this technology to be developed, we note that Franky Zapata, a French inventor, recently crossed the English Channel on his hoverboard, or personal travel device. From his description of the challenge (he only got half way across on his first attempt), he was strapped to the board and had to lean into the wind gusts, which presented his greatest challenge. As he put it, he would lean into the gusts, but then had to recover rapidly when they stopped to prevent falling over. He commented that his leg muscles were "burning" from the balancing effort during his 22-mile, 20-

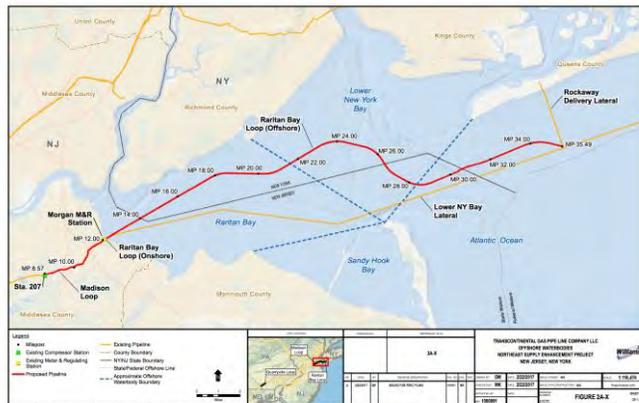
minute crossing. We don't think we are ready for this travel technology. Therefore, we will opt for the 'Chunnel train' the next time we have to go between London and Paris.

Correction:

We used an illustration of the second project and not the Northeast Supply Enhancement project

Last issue of the *Musings* contained an article about energy infrastructure projects being fought by protestors or rejected by regulators and politicians. One proposal was the Williams' Northeast Supply Enhancement project, which involved a pipeline extending from New Jersey, across the lower portion of New York Harbor, to Long Island and designed to bring greater natural gas volumes to the market. Williams also had proposed a project to install two liquefied natural gas (LNG) receiving buoys and a pipeline connection to Long Island (Liberty project), again to increase LNG supplies to this market. Both projects have been rejected by the governors of New York and New Jersey. We used an illustration of the second project and not the Northeast Supply Enhancement project. A reader brought this to our attention. The correct illustration is adjacent. We apologize for the mistake.

Exhibit 15. Northeast Supply Enhancement Project



Source: Williams

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