PPHB
ENERGY INVESTMENT BANKING

MUSINGS FROM THE OIL PATCH

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

Understanding The Energy Revolution In Transportation

Eliminating ICE vehicles will mean putting out to pasture the workhorses that powered the industrialization of the globe

It seems like barely a day goes by without a new forecast about the revolution underway in the transportation sector that will seriously dent, or possibly even eliminate, the world's need for fossil fuels. The consensus view on how this might happen is by the combination of governments banning internal combustion engines (ICE), while at the same time, battery costs dropping so low as to undercut the prices of ICE vehicles. Eliminating ICE vehicles will mean putting out to pasture the workhorses that powered the industrialization of the globe. To hear the optimists promoting this revolution, the shift in vehicle fuel use has to happen. Moreover, it will happen faster than people anticipate because of the momentum of these two driving forces. Don't worry, though, because any economic shortcomings or dislocations will be offset by the good eliminating these vehicles means for our environment and air quality.

Countering the optimists are the various forecasts from energy companies and other energy market participants that see the pace of the global vehicle fleet transition as being slower than anticipated. We are still in the early stages of electric vehicles (EV) and have yet to move from the earlier adopters to mainstream embrace. EV's cost, the lack of an adequate charging infrastructure and range anxiety remain hurdles still to be overcome.

The exercise of preparing a forecast requires that all possible factors that might impact the outcome be considered

The art of energy forecasting has been improved, but success in predicting outcomes is less than stellar. The exercise of preparing a forecast requires that all possible factors that might impact the outcome be considered. Forecasts are built on assumptions. What they are is critical to the final results. What is missing in most forecasts is an understanding of what those assumptions are. Without understanding them, readers of forecasts cannot appreciate the sensitivity of results to changes in the assumptions.

Major auto companies are beginning to acknowledge how their business model may be at risk from the rise of EVs and the shift to ridesharing services

After seeing a recent forecast for the growth of the electric vehicle (EV) fleet and its impact on future oil consumption, we thought it would be interesting to examine, to the best of our ability, the assumptions underlying the forecast. A way to assess what assumptions might have been changed was to examine what the forecasters had projected in prior forecasts. In this case it was an eye-opening comparison. But then again, given the subject matter, it was not surprising. EVs, and their future, are receiving extensive analysis lately. Auto manufacturers have been announcing plans to begin electrifying their entire range of vehicle offerings starting in the next few years. Major auto companies are beginning to acknowledge how their business model may be at risk from the rise of EVs and the shift to ridesharing services. Fewer new car sales and sharply reduced repair revenues will forever change the auto industry.

This business disruption is coming largely due to government actions

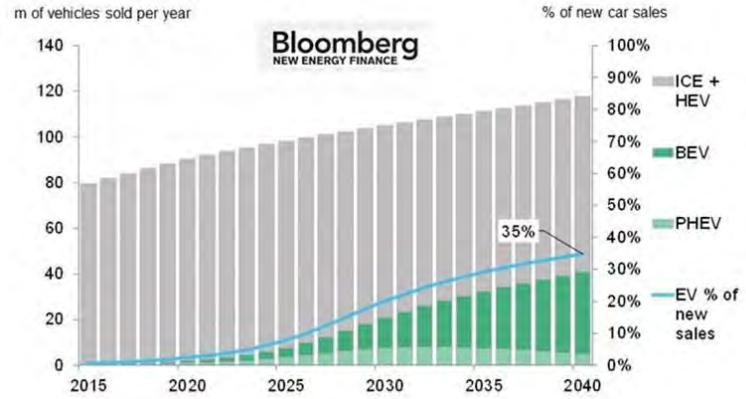
This business disruption is coming largely due to government actions. Governments at all levels are moving to outlaw ICE vehicles from their roads at various points in the future. Given these announcements, forecasters are becoming increasingly more optimistic about the future of EVs, but they are not explaining exactly how that optimism has been translated into their model's assumptions.

To appreciate how changes have occurred in forecasts, we examined the Bloomberg New Energy Finance (NEF) projections for the global auto fleet and EV penetration between their 2016 and 2017 projections. To contrast how the NEF forecasts compare with other forecasts, we examined the latest assessment by the organization with the greatest exposure to crude oil – the Organization of Petroleum Exporting Countries (OPEC). Unfortunately, OPEC isn't unveiling its 2017 oil market forecast for another month, leaving us only the 2016 forecast to compare against the NEF projections.

Based on this forecast, EVs as a percent of total annual vehicle sales were projected to climb from a virtually non-existent market share in 2015 to 35% in 2040

In the 2016 forecast, NEF projected an average of 100 million new car sales each year during the 25-years from 2015 to 2040. In reality, they have new car sales rising from 80 million to 120 million at the end of the forecast period. NEF also projected that EV sales would grow at a slow rate between 2015 and 2025, after which the growth rate would accelerate for five years before slowing during the final ten years to 2040. Based on this forecast, EVs as a percent of total annual vehicle sales were projected to climb from a virtually non-existent market share in 2015 to 35% in 2040. That is an impressive market share gain, with meaningful impacts on transportation use and oil demand as ICE vehicles decline as a share of new vehicle sales. The greater impact will come as more ICE vehicles are scrapped each year than new ones enter the fleet, sharply shrinking ICE's share of the global vehicle population.

Exhibit 1. A Now-Conservative EV Growth Forecast

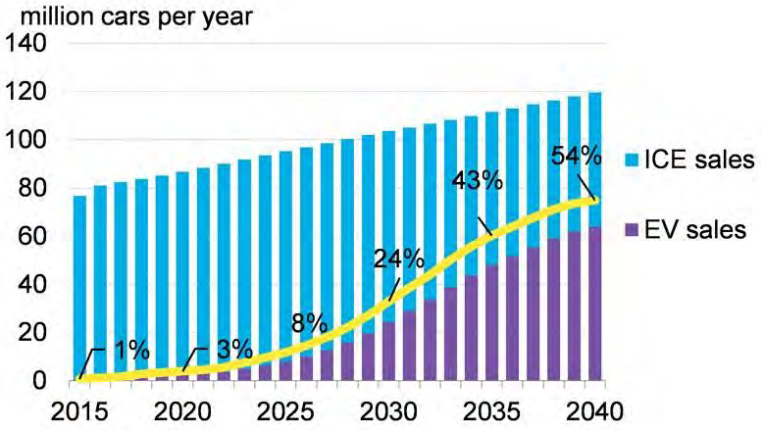


Source: NEF

We assume it is because of the statements by various governments about banning ICE vehicles by 2035 or 2040, plus the push by auto manufacturers to offer more EV models

The 2017 NEF forecast calls for a similar 100 million annual vehicle sales rate, but now EVs' share of total vehicle sales grows faster than in 2016, reaching 54% of annual sales in 2040. Why the greater acceleration in EV sales? We assume it is because of the statements by various governments about banning ICE vehicles by 2035 or 2040, plus the push by auto manufacturers to offer more EV models. It appears from the charts that annual vehicle sales are projected to reach the same level in 2040 in both forecasts. However, there is a 67% increase in the number of EVs projected to be in the global fleet between the 2017 and 2016 forecasts. Is that a reasonable difference from one year to the next?

Exhibit 2. Optimistic Forecast For Electric Car Market



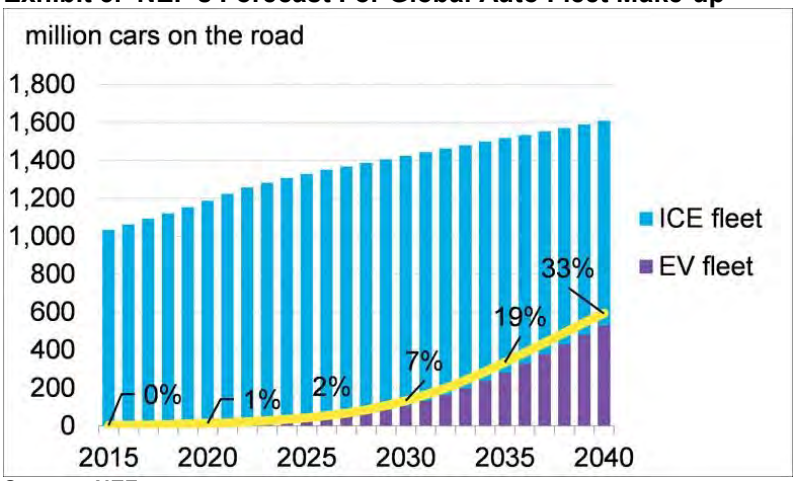
Source: NEF

While we haven't seen all the assumptions behind the two forecasts, there are some interesting points to consider. For the 2017 forecast, NEF provided a chart showing its view of how the composition of the global vehicle fleet will change between 2015 and 2040, based on its assumptions about the sharp rise in new EVs sold.

NEF expects the global vehicle fleet to grow from 1.1 billion to 1.6 billion vehicles, only a 500 million unit growth over 25 years

Between 2015 and 2040, with vehicle sales rising from roughly 78 million to 120 million a year, the total fleet population growth suggests only about an annual net increase of 20 million vehicles. NEF expects the global vehicle fleet to grow from 1.1 billion to 1.6 billion vehicles, only a 500 million unit growth over 25 years. Using the annual averages, the NEF forecast calls for an average of nearly 80 million cars to be scrapped each year. That suggests NEF has made certain assumptions about the likely impact of ridesharing services and possibly autonomous vehicles on total vehicle fleet growth. These vehicle categories are assumed by most forecasters to sustain higher vehicle use than a typical ICE vehicle. But maybe there are other factors at work in the model.

Exhibit 3. NEF's Forecast For Global Auto Fleet Make-up



Source: NEF

The dramatic growth of the EV fleet projected by NEF means that by 2040, there will be roughly 525 million EVs on the roads

From the point of view of the oil business, the dramatic growth of the EV fleet projected by NEF means that by 2040, there will be roughly 525 million EVs on the roads. But it also means there will be nearly 1.1 billion ICE vehicles on the roads. Yes, there may be less oil needed under the NEF fleet evolution scenario, but it is a far-cry from the death knell being sounded for the oil business.

Transportation markets consume about 64% of the total amount of oil used daily in the world

It is important to understand that transportation markets consume about 64% of the total amount of oil used daily in the world. If, what the International Energy Agency (IEA) says is correct, today the world is consuming 98 million barrels of oil per day, of which nearly 63 million barrels a day are for transportation. The remaining oil is being used in industrial and commercial applications, and in some cases for heating oil in places such as the Northeast and Midwest regions of the U.S. Will those other uses of oil grow or shrink?

Another question for the oil market is how much of the transportation sector's use is for cars and light duty trucks versus fuels for heavy duty trucks, ocean-going vessels and airplanes? We understand that electric vehicle sponsors are hailing efforts to electrify all modes

The fuel shares will be different in developing economies, and this may be why the oil industry should not be complaisant about EVs

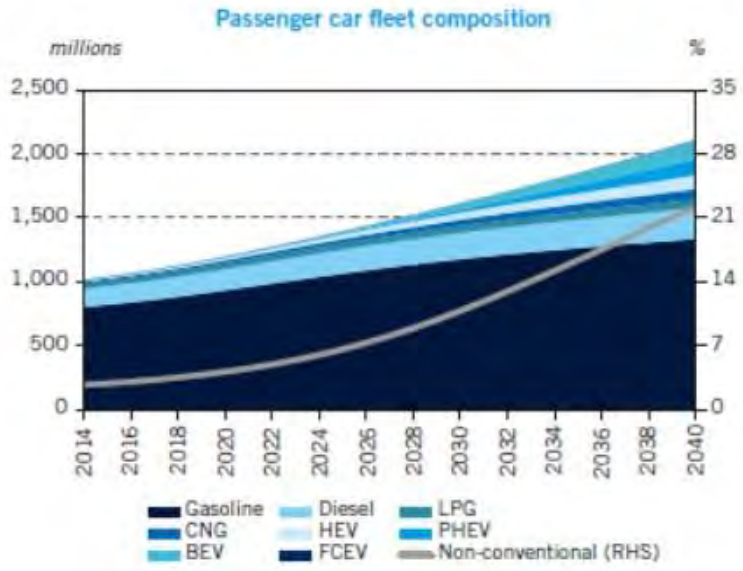
of transportation, but these other consumers of oil are much further behind in transitioning to electric power. If we use the 2016 breakdown of oil use by markets in the United States, 54% went to gasoline, 9% to aviation, 23% to diesel and home heating oil, and 14% to industrial applications. This provides a rough estimate of the exposure of the oil business to increased EV sales, at least in the developed world. The fuel shares will be different in developing economies, and this may be why the oil industry should not be complaisant about EVs.

OPEC sees the global vehicle fleet growing from 1.0 billion vehicles in 2015 to 2.1 billion in 2040

Shifting to OPEC's assessment of the transportation market and the impact of EVs based on its 2016 forecast, we find several critical ingredients that may produce a sharply different outcome from that projected by the NEF scenario. For example, OPEC sees the global vehicle fleet growing from 1.0 billion vehicles in 2015 to 2.1 billion in 2040. That would be approximately twice the fleet growth projected by NEF. When OPEC segregates the global vehicle fleet, it divides it into a number of categories based on the fuel powering the vehicle. In 2015, nearly the entire 1.0 billion vehicles are either gasoline- or diesel-powered. That share of the 2040 global fleet is projected to only reach about 1.5 billion of the 2.1 billion total vehicles, so its fossil fuel powered fleet projection is comparable to NEF's entire projected fleet size in 2040.

OPEC further projects that 21% of the world's fleet of 2.1 billion cars will be fueled with non-conventional fuels, which includes EVs, but also compressed natural gas (CNG) and liquefied petroleum gas (LPG) powered vehicles. While these are not crude oil based, they are fossil fuels, which suggests continued markets for the petroleum

Exhibit 4. How OPEC Sees Global Auto Fleet Evolving



Source: OPEC

The difference between the OPEC and NEF projections for EVs and non-conventional vehicles is about 70 million vehicles

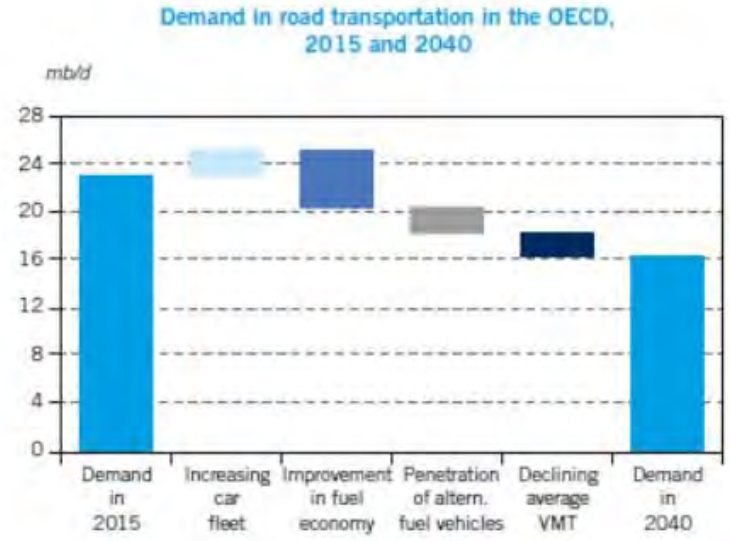
industry. The difference between the OPEC and NEF projections for EVs and non-conventional vehicles is about 70 million vehicles (460 million versus 530 million). That is a sizeable difference, but it represents only 13% more EVs and unconventional vehicles according to the NEF scenario.

While that many additional EVs on the road will have an impact on oil consumption, a critical variable is what happens to vehicle miles traveled? OPEC provided guidance in its report on road-related oil use. The OPEC guidance leads to another issue that becomes very important when considering how a global oil forecast may be impacted by differing assumptions, a consideration we will explore later.

Oil consumption declines in the OECD market between 2015 and 2040 due to declining VMT, an increase in unconventional vehicles and greater fuel efficiency among the ICE cars in the fleet

OPEC provides charts showing how it sees road transportation oil consumption changing between 2015 and 2040, based on the projected growth of the car fleet, improvement in vehicle fuel economy, the growth in the number of alternative fuel vehicles in the fleet, and changes in average vehicle miles traveled (VMT). OPEC further segregates its estimates between developed economies, or those countries that are members of the Organization of Economic Co-operation and Development (OECD), and the developing economies of the world. As shown in Exhibit 5, oil consumption declines in the OECD market between 2015 and 2040 due to declining VMT, an increase in unconventional vehicles and greater fuel efficiency among the ICE cars in the fleet.

Exhibit 5. Why Oil Demand In Rich Economies Will Fall



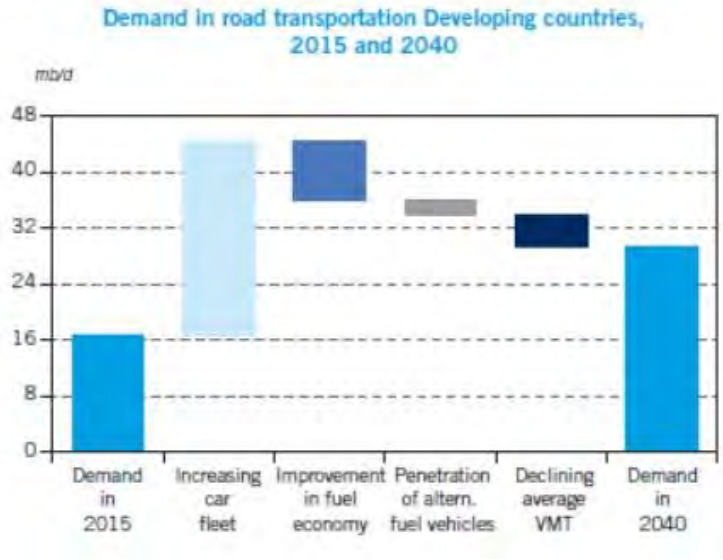
Source: OPEC

That is not the case for the developing economies of the world, as shown in Exhibit 6 (next page). There the impact on fuel demand comes from the growth of the vehicle fleet, which overwhelms the

Road transportation demand in developing economies increases by nearly 50%

negative impacts of improved fuel efficiency, more unconventional cars and declining VMT. The net result is that road transportation demand in developing economies increases by nearly 50%. We will be very interested is seeing what, if any, changes to these assumptions OPEC makes in its 2017 report due out in about a month.

Exhibit 6. Gasoline Demand In Developing Economies



Source: OPEC

This dichotomy in demand between developed and developing markets is highlighted in other parts of OPEC's forecast

This is another example of that old real estate mantra: location, location, location. If you are in the heart of the developing world – primarily Asia – you will be experiencing rising transportation-related oil demand despite EVs entering the fleet. This dichotomy in demand between developed and developing markets is highlighted in other parts of OPEC's forecast. The economic split points out the risk to the global petroleum industry of EVs gaining greater acceptance than currently assumed in developing economies.

OPEC's projection expects world oil use to increase by 17.6% between 2015 and 2040, but OECD's share of the global oil market falls from slightly under 50% to only 34%

As OPEC shows with its long-term demand forecast, the OECD outlook calls for falling oil demand, while developing economies will demonstrate robust growth. The Eurasia market will show growth, but much smaller growth compared to that experienced by the developing economies. OPEC's projection expects world oil use to increase by 17.6% between 2015 and 2040, but OECD's share of the global oil market falls from slightly under 50% to only 34%. NEF would likely say that under their scenario for EV fleet growth, OECD's oil market share will fall even more.

Exhibit 7. How OPEC Sees Oil Demand By Geographic Region

Long-term oil demand in the Reference Case — mb/d

	2015	2020	2025	2030	2035	2040
OECD	46.2	45.9	44.3	42.1	39.7	37.3
Developing countries	41.5	46.8	52.2	57.4	62.0	66.1
Eurasia	5.3	5.6	5.8	6.0	6.1	6.0
World	**93.0**	**98.3**	**102.3**	**105.5**	**107.8**	**109.4**

Source: OPEC

What happens to world oil demand if, instead of EV penetration being greater in OECD countries, EVs become the future vehicles in developing economies?

What happens to world oil demand if, instead of EV penetration being greater in OECD countries, EVs become the future vehicles in developing economies? Would there be a greater impact on oil demand than if EV growth was primarily centered in developed economies? We are sure it would have a greater impact. This is where comments from Robert Johnstone of Eurasia Group at the recent Baker Institute meeting on global energy transitions provide insights to the challenges the global oil business may be facing.

The rest of the world is dealing with peak demand and decarbonization because they lack domestic energy resources, have air quality and climate change concerns, and are accustomed to using industrial policy to implement government/social policies

Mr. Johnstone contrasted how the major driving forces for energy transitions, which include decarbonizing the world and shifting roles among energy producing countries, are different for the United States than the Rest of the World. He said that the U.S. has become an "outlier" due to shale, fracturing and energy dominance. On the other hand, the rest of the world is dealing with peak demand and decarbonization because they lack domestic energy resources, have air quality and climate change concerns, and are accustomed to using industrial policy to implement government/social policies. For all the media attention to these issues, it is important to understand that the U.S. is not as impacted by these issues as the rest of the world.

If Mr. Johnstone is correct, oil demand's future is at much greater risk than generally assumed within the industry. The oil business may find itself the equivalent of the frog in the sauce pan on the stove. It is slowly boiling to death, but since it is happening so gradually, no one realizes it is happening.

These are the economies that because of their wealth are now most interested in promoting cleaner energy, even if it turns out to be more expensive

What does this outlook portend for the oil market, and the prospects for Saudi Arabia? The OECD is comprised of the richest, most economically developed economies, but ones that are beginning to struggle to grow. These are the economies that because of their wealth are now most interested in promoting cleaner energy, even if it turns out to be more expensive. On the other hand, the developing economies are much more focused on improving the living standards of their citizens, which may translate into a willingness to concede improved environmental standards for lifting greater numbers of people out of poverty and providing them with a more comfortable lifestyle. The greater willingness to accept government control of industrial development means the rapidly

Energy transitions are always happening, it is more an issue of whether we are paying attention

growing energy consumption in these economies will likely slow, but should not stop or decline. This could make the oil market more competitive for suppliers, helping to keep oil prices lower than popular forecasts suggest. Lower demand growth will also ease the need for finding more reserves, further creating disruption within the energy industry. Energy transitions are always happening, it is more an issue of whether we are paying attention.

Shaking Up Saudi Arabia May Dislocate Global Oil Markets

Students of Saudi Arabian royal intrigue are speculating on why this decree was issued now and what it may connote for the future of the country

The latest event in Saudi Arabia drawing media attention is the royal decree from King Salman granting women in the kingdom the right to drive. Students of Saudi Arabian royal intrigue are speculating on why this decree was issued now and what it may connote for the future of the country. Speculation centers on the possible abdication of the throne soon by King Salman, allowing his son, Crown Prince Mohammed bin Salman, often referred to as MBS, to step up and lead the country. Remember, it was only about three months ago that MBS was elevated from Deputy Crown Prince to replace his cousin Crown Prince Muhammed bin Nayef.

That move continued the generational transition in the leadership of the House of Saud that rules Saudi Arabia, the leading oil supplier to the world. In January 2015, Saudi Arabia's King Abdullah died, resulting in his brother, Prince Salman bin Abdulaziz Al Saud, assuming the throne. King Salman's half-brother, Prince Muqrin bin Abdulaziz, moved up from deputy crown prince, a position that had been created by King Abdullah, to crown price, and next in line of succession.

That established the new crown prince as the first grandson of the kingdom's founder to eventually lead Saudi Arabia

Barely three months later, King Salman undertook the radical step of replacing his brother Crown Prince Muqrin with his nephew, and the country's powerful interior minister, Prince Mohammed bin Nayef. That established the new crown prince as the first grandson of the kingdom's founder to eventually lead Saudi Arabia. At the same time King Salman was preparing to pass the leadership torch to the next generation, the king appointed his son, MBS, as deputy crown prince. In the leadership shake-up, King Salman also relieved the long-serving foreign minister, Prince Saud al-Faisal, who had shaped the kingdom's foreign policy for nearly four decades, and replaced him with non-royal family member, Adel al-Jubeir, who had served as the Saudi ambassador to the United States.

Crown Prince Nayef was widely respected in the royal family for cracking down on Al Qaeda in the kingdom

While some government leaders and officials applauded the 2015 leadership moves, there were others upset and concerned about the long-term implications for Saudi Arabia's policies and its relationships with its allies. Crown Prince Nayef was widely respected in the royal family for cracking down on Al Qaeda in the kingdom, even suffering permanent injuries from a failed bombing assassination attempt, and for his active role in foreign policy. The

Crown Prince Nayef's role in counterterrorism within the kingdom and in the Middle East region had won him many friends in the U.S., especially at the CIA.

MBS, who had been a trusted advisor to Prince Salman's court before his elevation to the throne, was considered by many to be brash and power-hungry. On the other hand, he had demonstrated leadership vision about the needs of the kingdom to begin modernizing its government and economy. He differed from many of his contemporary family members because he was educated in the kingdom rather than at universities in either the United States or Europe. That educational difference, plus the Crown Prince's habit of wearing traditional garb, increased his popularity with younger Saudis who represent a huge segment of the kingdom's population. According to World Population Review, the median age of Saudi Arabia's population is 27.2 years old.

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The decree allowing Saudi Arabian women to obtain driver's licenses is seen as a radical step for the country, given its strong male guardianship system that requires females to secure approval from a male family member in order to do many things considered routine in western societies. The new policy goes into effect immediately, but a government committee will decide within 30 days on recommendations for implementing the policy. The government has until June 2018 to carry out the directives of the committee. This means that the decree may not have an immediate impact, until the rules are established. Issues to be resolved, among others include whether women can become professional drivers working for ride-sharing services. The question of whether women will need a male's approval to obtain a driver's license has already been resolved – they won't.

Issues to be resolved, among others include whether women can become professional drivers working for ride-sharing services

There remain many areas of everyday life that women still require male guardian approval, as women are often treated as second-class citizens under existing laws. For example, women need approval to marry or divorce, access healthcare when it involves elective surgery, go to work for certain employers and start certain businesses, and in how they dress. Women are required to wear the abayas, a full-length, loosely fitting robe. With respect to unequal legal treatment, women have a difficult time gaining custody of children after a divorce if the sons are older than seven and the daughters are older than nine. They also have their testimony in court treated as half the value of a male, and equal to the testimony of a minor child. Women cannot inherit wealth equally with a male, and they are routinely restricted from integrating with males in public venues such as restaurants.

There remain many areas of everyday life that women still require male guardian approval, as women are often treated as second-class citizens under existing laws

The real reason for the driving change is to enable women to more easily integrate into the work force. At the present time, women account for 16% of the Saudi workforce. But they depend on ride services, hired family drivers or male family members to get back

Another aspect of the decision is the potential for the elimination of upwards of 1.4 million family drivers, which at $500 a month in salary would add $8.8 billion to the economy

and forth to work. An estimate from an employment agency in Saudi Arabia said there are 400,000-600,000 positions open for females in the retail sector, but the cost of getting to and from work prevented them from taking these jobs. Another aspect of the decision is the potential for the elimination of upwards of 1.4 million family drivers, which at $500 a month in salary would add $8.8 billion in discretionary spending to families, helping to boost the country's economy according to the Saudi economic news service Maaal. That would be a great help for speeding up the Vision 2030 plan.

The real reason for the decree is economic

There were also claims that the decree was done to offset some of the blowback that came from the government's arrest of a handful of clerics, reportedly willing to challenge the leadership of the royal family. But the real reason for the decree is economic. As Saudi Arabian journalist Sabria Jawhar wrote in the *Huffington Post*, "It was not external pressure, but the domestic discussion … that allowed for an organic change in Saudi society and led to this landmark decision. And that time is now because it makes economic sense."

The country will need a more robust labor force, and women are critical to achieving that goal

The Vision 2030 plan, launched in 2016 by MBS, to diversify the Saudi Arabian economy away from its heavy dependence on oil – currently accounting for 75% of the country's income, is at the heart of the women's driving push. The country will need a more robust labor force, and women are critical to achieving that goal. The driving decree will mostly impact urban women, as those in rural areas have been driving without licenses and prosecution. But as Kristin Smith Diwan, a senior resident scholar at the Arab Gulf States Institute in Washington, D.C. put it, "As Saudi Arabia's reliance on oil becomes untenable, the kingdom will need a more productive workforce—and that includes women."

Saudi Arabia's oil actions within OPEC in 2014 were the first outward manifestation of its recognition that the country's future economic health is at risk by extending its dependence on oil

Saudi Arabia's oil actions within OPEC in 2014 were the first outward manifestation of its recognition that the country's future economic health is at risk by extending its dependence on oil. On one hand, there are questions about exactly how many reserves the kingdom has, and importantly, what happens to the country's output as its population growth and energy demands continue growing at the rapid rate of the past decade. Projections showed that eventually, virtually all the oil output would be consumed generating power for desalinization and air conditioning needs. An analysis of the recent driving decree said that if there was a 10% increase in driving due to women being able to drive could add 60,000 barrels per day to Saudi Arabia's gasoline consumption. Considering that Saudi Arabia is a net gasoline importer, the additional demand would add further budgetary pressures. These realities clash with the changes underway in the global oil market, which has been hurting Saudi Arabia's global oil market share that has been underway since oil reached $100+ per barrel. The high price was driving new oil supplies into the market, just as had occurred in the 1980s.

This is where Canada's oil sands supply battle with the European Union became an issue for Saudi Arabia

In particular, American shale oil's production growth since 2007 has had everyone's attention, as it was changing the role of the country from a major oil consumer to a new oil exporter. Having largely conceded oil market share in the U.S., Saudi Arabia was fearful of losing market share in Europe and Asia. This is where Canada's oil sands supply battle with the European Union (EU) became an issue for Saudi Arabia. In 2011, the EU determined that oil sands bitumen was too "dirty" because of its high carbon emissions to be allowed access to its market. This set up a long and hard lobbying effort by the Canadian government and its oil sands industry to convince the EU that the oil was not that dirty.

In 2011, the EU imported roughly 7.4 million barrels of Canadian oil, all light (>30° API), which accounted for 0.19% of the continent's total oil imports for the year. Interestingly, the Canadian oil was about $5 a barrel more expensive than the EU spent for all of its 2011 imports ($114.98 vs. $110.58).

While this was a major concession by the EU, it was still not acceptable to Canada

As Canada's lobbying efforts intensified, by the end of 2013 the EU was convinced to modify its stance against banning oil sands output, and instead allowed importers to only have to calculate the average carbon emissions of all its oil imports, rather than having to calculate them separately. While this was a major concession by the EU, it was still not acceptable to Canada. In 2013, EU oil imports from Canada were 17.9 million barrels, all light oil, and represented 0.47% of the continent's total oil imports.

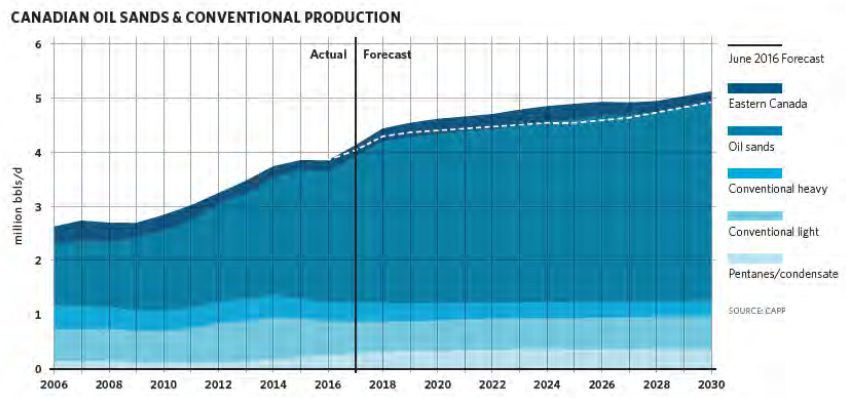
Between 2011 and 2013, Saudi Arabia's oil imports into the EU grew by 8.2%, from 299.3 million to 323.9 million barrels

In June 2014, the EU reversed that earlier oil sands position and agreed to allow oil sands bitumen in without restriction. This created a serious dilemma for Saudi Arabia. Between 2011 and 2013, Saudi Arabia's oil imports into the EU grew by 8.2%, from 299.3 million to 323.9 million barrels. The heavy oil volumes had grown from 0.14% of all EU oil imports to 1.26%, and the actual volume growth was over 800%. Given Canadian oil sands producer production growth and projections for future growth, Saudi Arabia felt its EU market share was threatened, at a time when the country was losing market share globally. If you look at Exhibit 8 (next page), the actual data is through 2017, so one needs to look back at 2014 and the rate of growth of production for the previous few years so see why Saudi Arabia was worried.

For Saudi Arabia, it saw its heavy oil imports into the EU cut nearly in half between 2013 and 2014, from 47.6 million to 24.4 million barrels

In 2014, with the loosening of carbon emissions restrictions, the first Canadian oil sands volumes reached the EU in February and then again in June, totaling 844,000 barrels, or 0.02% of total oil imports into the EU for the year. For Saudi Arabia, it saw its heavy oil imports into the EU cut nearly in half between 2013 and 2014, from 47.6 million to 24.4 million barrels. Its share of EU imports fell from 1.25% to 0.63%. Overall, Saudi Arabia's total oil volumes going into the EU were nearly unchanged between 2013 and 2014, as overall volumes fell by only 200,000 barrels. But in a global market where the refining sector is heavily skewed toward heavier crude oils,

Exhibit 8. Rising Oil Sands Output Concerned Saudi Arabia



Source: CAPP

seeing this much market share lost in one year had to be unnerving. How to stop Canada's oil sands producers? Cut the oil price to levels that would inflict significant financial pain on the oil sands producers.

Today, Saudi Arabia is fighting a fierce oil market share battle in Asia against Russia and Iran

As Saudi Arabia surveyed the energy market landscape in 2014, it faced a number of forces shaping its future – none of them positive. The loss of market share in the U.S., and now in Europe, forces the country to have to fight to gain market share in Asia, the only global market showing robust demand growth. Today, Saudi Arabia is fighting a fierce oil market share battle in Asia against Russia and Iran. One aspect of this battle has been the disappearance of the "Asian premium" for oil. Is that gone for good? Is that what is behind the move by Saudi Arabia to aggressively enter into refinery ownership deals in Asia as a way to lock in improved overall profit margins?

Now lurking in the background in Asia is the Clean Tech transportation revolution being pushed by China

Another aspect of this Asian market struggle is Iran's sponsorship of terrorism, with tacit support from Russia. That struggle, partially tied to the centuries-long struggle between the two Muslim sects that control Saudi Arabia and Iran is roiling the Middle East, and is forcing Saudi Arabia to become more involved in regional military actions. Now lurking in the background in Asia is the Clean Tech transportation revolution being pushed by China. If that revolution proves as successful as some forecasters predict and you are Saudi Arabia, you are facing a bleak outlook for your one-product economy. Saudi Arabia has now experienced negative economic growth for two quarters - -0.5% in Q1 and -1.0% in Q2 of 2017 – the first time this has happened since 2009.

The non-oil economy only grew by 0.6% in the second quarter

A troubling point of the recently released government economic statistics is that the non-oil economy only grew by 0.6% in the second quarter, reflecting weak consumer spending and government spending cuts. The recent decisions to restore Saudi official salary reductions and the move to allow women to drive, appear to be part

Exhibit 9. Saudi's Non-oil Economy Struggles To Grow

Source: Bloomberg

of the plan to stimulate the economy. More auto sales and eliminating the need for hired drivers may provide incremental disposable income gains and lead to higher consumer spending, and possibly increased capital spending.

We don't expect King Salman to step down anytime soon, given the recent high-profile meeting in Moscow, and the up-coming meeting scheduled for Washington next January

We will not be surprised to see more policy actions undertaken by King Salman at the urging of MBS, in order to boost economic activity. We don't expect King Salman to step down anytime soon, given the recent high-profile meeting in Moscow, and the up-coming meeting scheduled for Washington next January. We also expect the initial public offering of Saudi Aramco will go forward in 2018, and if oil prices continue to advance from current levels, we would not be surprised to see pressure to get the IPO done earlier in 2018 than many analysts are projecting.

To successfully diversify its economy, loosening up the restricting social structure governed by the strict religious leaders will have to be a part of that effort

With all these pressures on the royal family, we cannot rule out some geopolitical event striking Saudi Arabia – a consideration that is not currently priced in the oil market. The handwriting is on the wall, however, that Saudi Arabia needs to change. To successfully diversify its economy, loosening up the restricting social structure governed by the strict religious leaders will have to be a part of that effort, despite the difficulty it will present for those religious leaders. To gain a better perspective on the future of the oil business, we suggest watching the actions of MBS and the actions of Asian governments, in particular China, in promoting the Clean Tech revolution. Pay little heed to the litany of electric vehicle announcements in Europe and the U.S., as they will have less impact on global oil demand than similar changes in Asia.

It Was The Best Of Trips And It Was The Worst Of Trips

Three weekends ago, we made the return drive from our summer home in Rhode Island to our permanent home in Houston. To borrow a phrase from Charles Dickens, it was the best of trips and it was the worst of trips. Thankfully, the worst came first.

A strong gust of wind snapped off half of our neighbor's tree, taking the power lines down with it

The worst began the day before we left. Improvements to our house this summer reduced our workload in preparing the house for the upcoming winter. Early that morning, after finishing the draft of the last *Musings*, I was cleaning up my desk and packing clothes. At that moment, I heard an extremely loud crash and our power went out. A strong gust of wind snapped off half of our neighbor's tree, taking the power lines down with it. The tree blocked the road and trapped us in our house, as live power lines were laying in the street and across our driveway.

I called the electric company and reported the outage, describing to National Grid's emergency team where the wires were down, that our house lines were not impacted, and that the power poles were still standing. Almost immediately after hanging up, there was a knock at our door, and a Charlestown police officer was standing there. He wanted to make sure we wouldn't venture out given the presence of live power lines.

The tree fell across the street and not into our yard, which would have put it on top of our cars

Fortunately, the gusty winds associated with Tropical Storm Jose were blowing offshore so the tree fell across the street and not into our yard, which would have put it on top of our cars. I'm not sure what a tree on our cars would have meant for our trip home. With no power, preparations for leaving ground to a halt.

Besides the police, the local fire department showed up. Their vehicles isolated the street in front of our neighbor's and our homes. Before long, a National Grid truck arrived and its crew attempted to restore power to the remainder of the neighborhood, but the wiring set-up prevented it. The neighborhood was without power, but given the summer season was over, I'm guessing only about a dozen homes were still occupied.

Before long, there were four National Grid crews working to repair the damage

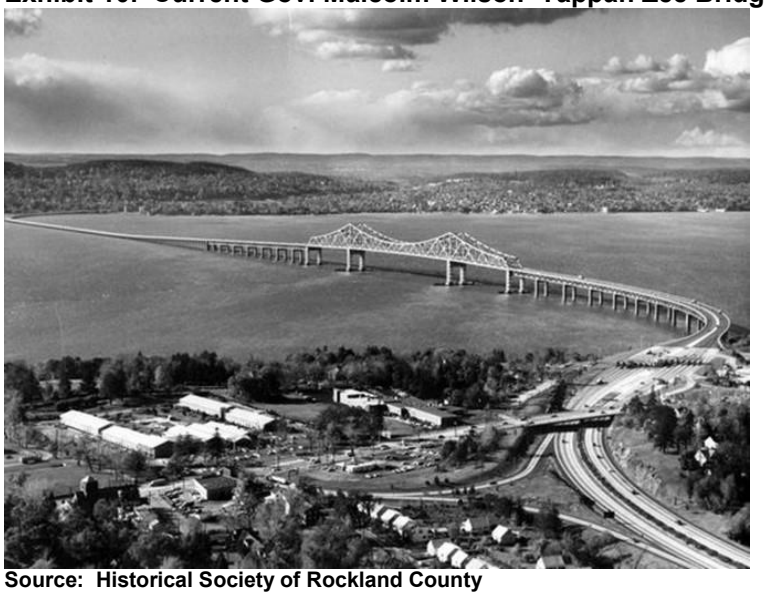
Soon a tree service truck arrived and the workers began cutting up the downed tree. Before long, there were four National Grid crews working to repair the damage and restore the power. Five and half hours after the tree fell, we had our electricity back.

With power restored, closing the house resumed. That's when we learned that the internet and security camera issues we had been experiencing were due to our four-month old router being bad. At 6:30 pm, we were standing in Staples talking with the store manager, who graciously credited us for the old router and sold us another. After a quick pasta dinner, we were home installing the new router, which solved our issues and finally allowed us to pack up the car.

Immediately, we noticed very heavy truck traffic for a Saturday morning

Saturday morning, after making sure all our winter preparations were set, we hit the road for Houston. Things couldn't get worse – or could they? Immediately, we noticed very heavy truck traffic for a Saturday morning. Equally heavy was the car traffic, especially in Connecticut. That was where we saw our one and only policeman.

Exhibit 10. Current Gov. Malcolm Wilson–Tappan Zee Bridge

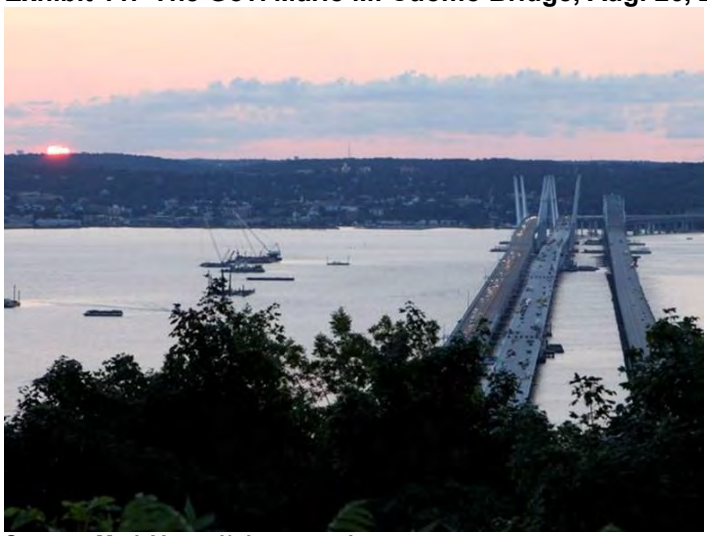


Source: Historical Society of Rockland County

In researching the official name of the Tappan Zee Bridge, we learned that "Tappan" was the name of an American Indian tribe from that area of New York, and "zee," came from the Dutch word for "sea," reflecting the influence of the original explorers of the Hudson River

What was fun was driving across the recently opened westbound side of the Gov. Mario M. Cuomo Bridge across the Hudson River, which will replace the Gov. Malcolm Wilson – Tappan Zee Bridge, built in 1955. In researching the official name of the Tappan Zee Bridge, we learned that "Tappan" was the name of an American Indian tribe from that area of New York, and "zee," came from the Dutch word for "sea," reflecting the influence of the original explorers of the Hudson River. We are guessing that part of New York history will die, as now everyone will focus on the new bridge named for the father of the state's current governor.

Exhibit 11. The Gov. Mario M. Cuomo Bridge, Aug. 26, 2017



Source: Mark Vergari/*The Journal News*

We needed nearly two hours to travel three miles!

Our first major delay came in New Jersey, where the highway was shut down. We needed nearly two hours to travel three miles! As we passed the accident site, a vehicle was upside down, showing signs of having rolled over for 20-30 feet. Unfortunately, that wasn't the only accident we encountered. In Virginia, we encountered a 45 minute delay waiting to get around an accident involving two trucks and an SUV that had shut down all the highway lanes. Besides those two accidents, we experienced two delays related to road construction that had us down to one lane.

Just as we parked at a McDonald's in Pennsylvania, we saw a tour bus disgorging passengers

Our day-one travels were also impacted by bad timing for lunch. Just as we parked at a McDonald's in Pennsylvania, we saw a tour bus disgorging passengers. We encountered an overflowing crowd at dinner at a Cracker Barrel in Staunton, Virginia. Not only was there a tour group, but we saw many families with college students in tow, representing neighboring James Madison University and VMI, among others.

We also saw numerous convoys of repair trucks from New England and Middle Atlantic utility companies returning from assisting in Florida's power grid repairs

We were fascinated by the truck traffic, which was heavy most of the way south. On day one, we noticed that there were few trucks at the rest stops, but after dinner, they were packed. We also saw numerous convoys of repair trucks from New England and Middle Atlantic utility companies returning from assisting in Florida's power grid repairs. It stirred up memories of the recovery vehicles we encountered in our trip home in September 2005 following Hurricane Katrina's devastation of New Orleans and the Gulf Coast.

As we passed rest areas and truck stops early that morning that were filled to overflowing, we knew we were in for another day of heavy truck traffic day

Sunday dawned bright and sunny. We started day two early, hoping to make it home that night. Once again, we encountered heavy truck traffic. On a Sunday? As we passed rest areas and truck stops early that morning that were filled to overflowing, we knew we were in for another day of heavy truck traffic day. Our hope was that the traffic would thin out by the time we got to Georgia. In other words, we hoped the trucks were heading east and west from Tennessee, and not further south. It is possible the truck traffic was associated with hurricane recovery efforts, but we are guessing it was tied to a stronger economy.

Again, we saw utility truck convoys heading north. We kept on rolling south as the traffic thinned out. In Alabama, we witnessed a handful of police – always with stopped drivers. We never passed a hiding police car – or one that we noticed.

The reality was that we saw more highway construction this time than at any time in the past few years

The miles ticked off as we listened to our Tom Clancy audiobook. Thankfully, there was no tour bus at lunch time. As we appeared to be making record time, we held our breath hoping not to run into more accident tie-ups or more road construction. The reality was that we saw more highway construction this time than at any time in the past few years. It was especially shocking given our spring driving when we saw virtually no construction. Did Donald Trump's infrastructure plan begin working without the media noticing it?

Turning from I-59 onto I-12 produced a sky full of ominous black clouds

As we raced down I-59 in Mississippi that afternoon, we began to sense the possibility of actually making it home in the early morning hours of Monday. Knowing we had a car in our garage with a dead battery, we knew Monday would be a recovery and resettlement day. Turning from I-59 onto I-12 produced a sky full of ominous black clouds. As we stopped for gas in Hammond, thunder claps roared and light rain began falling.

Why is tailgating de rigor in Louisiana?

Driver styles seem to change when we reach the Gulf Coast. Why is tailgating de rigor in Louisiana? We grew nervous as the rains came, and then the white-outs! One panic stop saw the car in front and the one behind us going left, as we pulled right. Everyone avoided a crash, but it didn't stop the tailgating daredevils. We began to reflect on how many times we have encountered heavy rains on I-12 – more times than we could count on one hand, and how many times we have experienced near misses from tailgating cars. We must have somehow angered the Louisiana rain gods. But once they were over their hissy-fit, the sun came out and we steered toward Texas on I-10. On that leg of the trip we saw Texas highway patrol enforcement effort, but it was all on the eastbound side, with police cars repeatedly looping around to set up to catch the next unsuspecting driver.

Darkness presented a challenge in construction zones, but the traffic moved well and the drivers behaved

Darkness presented a challenge in construction zones, but the traffic moved well and the drivers behaved. Knowing that the stretch of I-10 in Houston from I-59 to I-45 was shut down, we prepared to skirt that area. The question was which option to take - Beltway 8 or 610? We chose the latter, getting to see parts of Houston we haven't seen in a while. For those familiar with Houston, we went south on 610 south to I-45, then north to downtown, and west on 288 to I-59 to the Westpark Tollway and home. From 6:30 am to 10:15 pm, we covered 1,150 miles – one of our fastest drives. From the worst of trips, it turned into one of the best of trips.

Natural Gas Injection Season Will Leave Storage Nearly Full

The end of the natural gas injection season on November 1st will find the U.S. with storage facilities nearly completely full

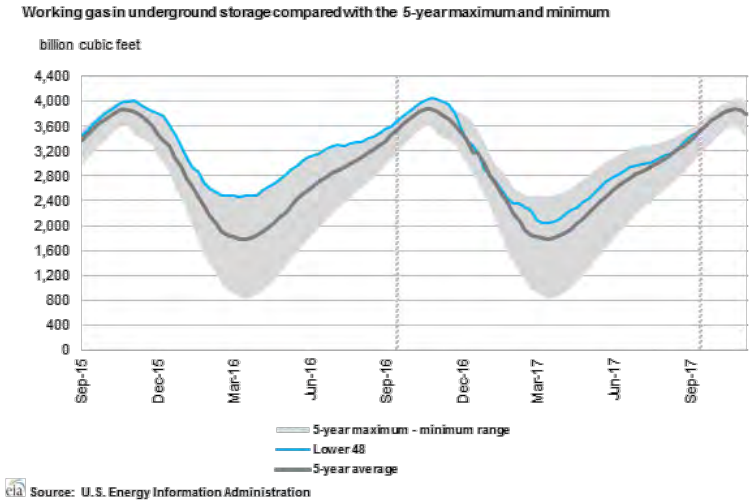
A recent report by Richard Zeits concluded, as have we, that the end of the natural gas injection season on November 1st will find the U.S. with storage facilities nearly completely full. Full is defined as 3.9-4.0 trillion cubic feet (Tcf) of gas, equivalent to the amount of gas in storage at the end of the past two years' injection seasons. As of the week ending September 29, the U.S. Energy Information Administration (EIA) estimated the nation has 3.508 Tcf of gas in storage, which is 172 billion cubic feet (Bcf) below the same week last year, according to our data. The EIA estimates the volume to be 161 Bcf lower than last year, or 11 Bcf less than our data shows. The difference is relatively meaningless with regards to the implications of a full storage scenario.

When the EIA reports its weekly estimate of gas storage volumes, it produces a chart showing how the weekly storage volumes are

Winding up at this high point was not what some of the more bullish gas analysts had anticipated when they discussed the upcoming 2017 injection season earlier this year

tracking against the average of the past five years' weekly volumes, as well as the maximum and minimum values for the same five year period. As shown in Exhibit 12, the blue line marks the track of the weekly gas storage volumes for 2015 through the current week. As seen, the most recent data shows current storage volumes essentially at the 5-year average (down 8 Bcf), but which still remains in the upper portion of the 5-year maximum-minimum range. Winding up at this high point was not what some of the more bullish gas analysts had anticipated when they discussed the upcoming 2017 injection season earlier this year.

Exhibit 12. 2017 Gas Storage Now Below 5-Year Average



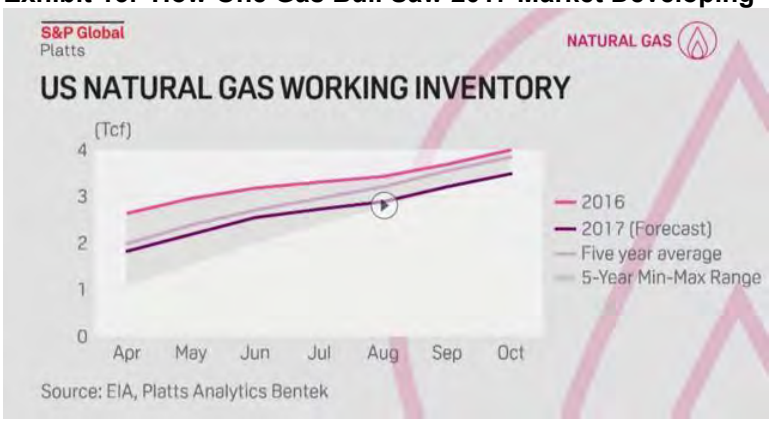
Source: EIA

Bentek anticipated that production growth limitations during the injection season would only allow a 1% increase over the volume injected into storage in 2016

Mr. Zeits produced a chart from a February report on the 2017 gas market outlook prepared by Platts Analytics, using production estimates from its sister research firm, Bentek Energy. At that time, Bentek anticipated that production growth limitations during the injection season would only allow a 1% increase over the volume injected into storage in 2016. According to the Platts report, gas storage would only reach 3.4 Tcf, 12% below the corresponding level of last year and 5% below the 5-year average. It would have been the lowest end of injection season level since 2008. The line representing the Platts projection is the cherry-red line on the graph in Exhibit 13 (next page), which tracks significantly below the 2016 storage line. The implication of the Platts report was that natural gas prices would be much higher than they currently are, as higher prices would be needed to get more storage.

We prepared a chart showing weekly gas storage volumes for all of 2016 and year to date for 2017. As 2017 progressed, the gap with the 2016 storage volumes has closed. We marked with letters the four points this year when the gas injection rate accelerated compared to the injection pace of 2016. Those inflection points

Exhibit 13. How One Gas Bull Saw 2017 Market Developing

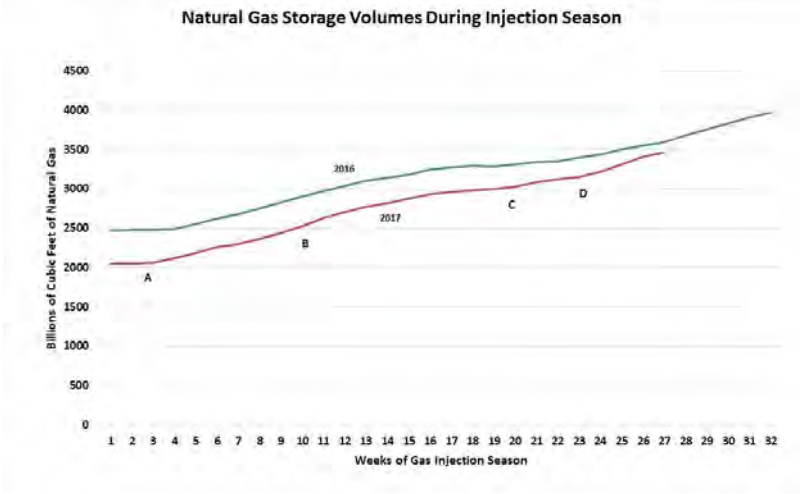


Source: Zeits Energy Analytics

The trajectory of the faster increase in 2017 gas storage volumes puts the industry on track for storage to be full

were when there was more production relative to demand, which may be due to cooler weather and/or reduced industrial and power generation use of gas. The trajectory of the faster increase in 2017 gas storage volumes puts the industry on track for storage to be full by the end of the current injection season on November 1.

Exhibit 14. How 2017 Storage Is Tracking Last Year's Volumes

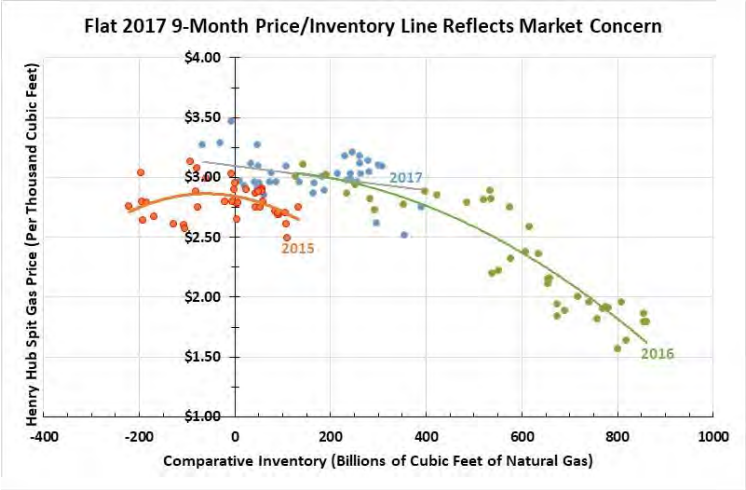


Source: EIA, PPHB

Another interesting analysis of the gas market is to look at the weekly storage volume changes compared to the weekly spot gas price. We have plotted that data for 2015, 2016 and year to date for 2017. In Exhibit 15 (next page), we show this relationship for the first nine months in each of the three years.

Additionally, we have plotted the supply/price relationship for the nine months of 2017 against those of the full years of 2015 and 2016. Note that the significant volume changes in 2016 occurred early in the year, which was a reflection of the very cold early winter

Exhibit 15. 2017 Supply/Price Line Signals Flat Gas Prices



Source: EIA, PPHB

months in 2015, which had depleted gas storage volumes. That relationship was reversed in 2016, again due to the relative comparison with the prior year, and is shown in Exhibit 16.

Exhibit 16. Large Gas Volume Swings Due To Prior Demand

Source: EIA, PPHB

The message we take away from these two charts is that the gas market does not believe it needs materially higher prices to secure sufficient storage volumes for the winter heating season

In both the full-year and nine-month charts, we are drawn to the essentially flat trend line the supply/price relationship has demonstrated in 2017. The message we take away from these two charts is that the gas market does not believe it needs materially higher prices to secure sufficient storage volumes for the winter heating season. On the other hand, in only a few cases have large comparable inventory changes been occasioned with appreciably lower gas prices, suggesting that the growth of the gas export markets is providing some support for gas prices. The relationship between natural gas prices and coal prices in the power generation market has demonstrated much greater sensitivity than many expected. However, the primary force beginning to alter the

domestic natural gas market is greater gas exports to Mexico and Canada, as well as the growth of access to the global liquefied natural gas market (LNG).

Most likely, natural gas prices are probably stuck around the $3 per thousand cubic feet (Mcf) level until we are well into the winter of 2017-2018

It will be interesting to see what happens to the supply/price relationship as we move into the early winter months of 2017-2018. All indications suggest that there may be downward pressure on prices, but that will largely depend on whether there is an early cold snap. Most likely, natural gas prices are probably stuck around the $3 per thousand cubic feet (Mcf) level until we are well into the winter of 2017-2018, or more LNG export capacity comes on line, something that is happening slowly.

We are due for a colder winter than last year, but not a colder than normal winter

With regards to the upcoming winter, based on the forecasts of the *Old Farmer's Almanac* and the *Farmers' Almanac*, we are due for a colder winter than last year, but not a colder than normal winter. The only possible saving grace from these forecasts is that they foresee colder temperatures in the Southeast as far down as the Gulf Coast. Since this region of the country relies on natural gas for heating, it is possible more gas will be consumed than if the cold temperatures were centered in the Midwest and Northeast regions. The lack of clarity for higher natural gas prices in the foreseeable future doesn't seem to have discouraged producers from increasing their output. Maybe all this additional production will wind up being burned in Asia.

TransCanada Kills Energy East And Alters World Oil Market

The former pipeline was planned to move crude oil from Western Canada to the Eastern Provinces, with export and refinery offtake points in Ontario Province, and ultimately a marine terminal in New Brunswick

Canada's TransCanada Corp. (TRP-NYSE) announced last week that it would not proceed with seeking approval of its Energy East and Eastern Mainline pipeline projects. The former pipeline was planned to move crude oil from Western Canada to the Eastern Provinces, with export and refinery offtake points in Ontario Province, and ultimately a marine terminal in New Brunswick. That project would have provided greater access to world markets for Canada's crude oil, which currently sells at upwards of a $10 per barrel discount to U.S. oil prices due to the more costly logistics of accessing world markets. The Eastern Mainline project was to add new gas pipeline and compression facilities to an existing system in Southern Ontario, where most of the country's gas consumers are located.

Both pipeline projects were killed following reversal of the approvals by the Energy Board, Canada's pipeline regulator, which forced TransCanada to have to restart its approval processes, adding additional costs to the projects.

Exhibit 17. Killing Pipelines Will Hurt Canada Citizens

Source: ***Financial Post***

For U.S. gas producers shipping gas to Ontario, there may be less completion from Canadian volumes reaching that market, providing more room for U.S. gas exports

The implications for global oil markets is that Canada's oil will be limited in reaching world markets, extending the time when the country's oil producers will be earning less money, and the government less in tax revenue, than if Energy East had been built. For U.S. gas producers shipping gas to Ontario, there may be less completion from Canadian volumes reaching that market, providing more room for U.S. gas exports. This will hurt Canadian natural gas producers. Once again, government policies will roil world oil and gas markets, and Canada's citizens and its oil and gas industry will suffer.

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