
MUSINGS FROM THE OIL PATCH

May 15, 2018

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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

Will Gas Injection Season Need A Tsunami Or Just A Wave?

April was a cruel month as snow and cold reigned for most of the time

According to T.S. Eliot, writing in his poem “The Waste Land,” April is the cruelest month of the year. The first seven lines of the first stanza of the poem often presents a challenge for readers, sufficient to discourage them from reading the entire work. For people living in the central and eastern regions of the country, April was a cruel month as snow and cold reigned for most of the time.

“APRIL is the cruellest month, breeding
Lilacs out of the dead land, mixing
Memory and desire, stirring
Dull roots with spring rain.
Winter kept us warm, covering
Earth in forgetful snow, feeding
A little life with dried tubers.”

The month’s colder temperatures put pressure on gas storage, as April witnessed withdrawals for three of the four weeks

This April was an unusual month for the natural gas business. The month’s colder temperatures put pressure on gas storage, as April witnessed withdrawals for three of the four weeks. This is unheard of in recent times, as the industry is always rebuilding storage in the early weeks of the shoulder demand period. This April failed to bring that storage help. Exhibit 1 (next page) shows April storage builds since 2010. This April was the only one to experience a withdrawal.

The question is whether the injection season needs a tsunami of weekly injections or just a wave, to return to a normal storage levels for next winter?

Last week, the Energy Information Administration (EIA) reported the first weekly build in gas storage volumes since the beginning of November 2017, exception for a freakish two billion cubic foot (Bcf) build the week of November 30, 2017. Now that we are into warmer weather nationwide and weaker gas demand for home heating, gas storage volumes should begin rebuilding. The question is whether the injection season needs a tsunami of weekly injections or just a wave to return to a normal storage level for next winter?

Exhibit 1. April Injections

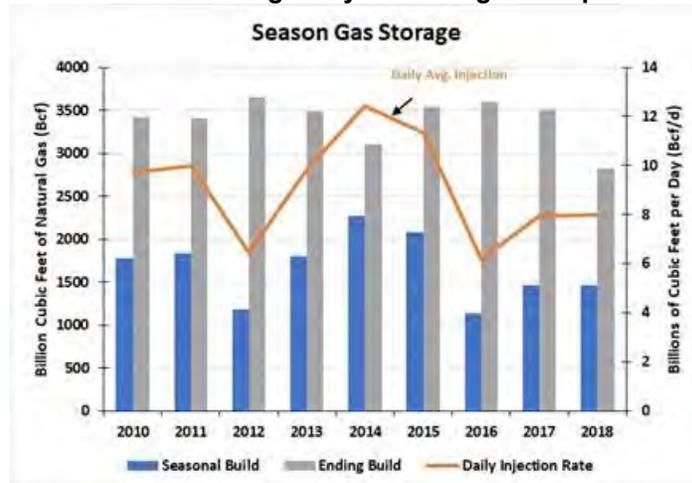
April Injections (Bcf)	
2010	274
2011	179
2012	104
2013	89
2014	157
2015	250
2016	89
2017	205
2018	-11

Source: EIA, PPHB

Versus last year, the industry has a huge mountain to climb

After April’s net withdrawal experience, the industry is now ready to truly begin the gas injection season, but it starts 913 Bcf below last year and 534 Bcf behind the five-year average. Versus last year, the industry has a huge mountain to climb. It will even be daunting to overcome the five-year shortfall. However, the fact that domestic natural gas production is growing rapidly, even with increased export volumes flowing, it may be possible for the injection season to end in a less precarious position than it appears now. That is probably why natural gas prices remain relatively depressed.

Exhibit 2. Gas Storage May Be Facing A Steep Hill



Source: EIA, PPHB

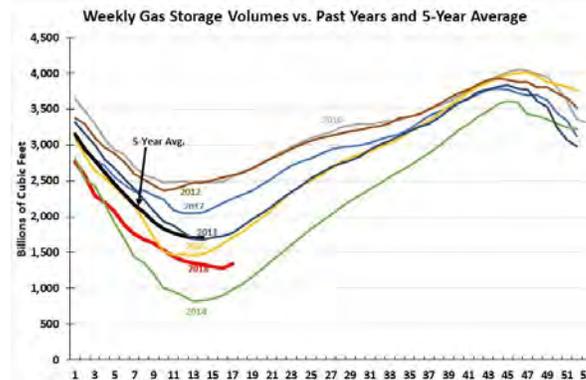
Average daily injections have been as high as 12.4 Bcf/d and as low as 6.2 Bcf/d

We examined the performance of the traditional 183-day injection season in years past for an assessment of the challenge the gas industry faces. Exhibit 2 shows the total volume of gas injected during the six-month-long season, the ending volume and the average daily injection amount. As we have seen, average daily injections have been as high as 12.4 Bcf/d and as low as 6.2 Bcf/d,

To achieve that 8-Bcf/d injection rate, given the negative results for April, means the industry must average 9.6-Bcf/d for the remaining 153 days of the injection season

and just during the three-year period 2014-2016. Last year, the industry injected gas at an 8-Bcf/d rate. Our 2018 columns reflect the industry achieving that same 8-Bcf/d injection rate over the 183-day season. While it would result in a similar volume of gas being injected into storage as last year, the industry would still begin the withdrawal season 700-800 Bcf below where it started in 2016 and 2017. To achieve that 8-Bcf/d injection rate, given the negative results for April, means the industry must average 9.6-Bcf/d for the remaining 153 days of the injection season. That is certainly not out of the question, as last week it was over 12 Bcf/d. It will depend, however, on how hot this summer is, whether cheap natural gas gains greater market share in the power generation market, how much gas is exported to Mexico and overseas, and continued growth in natural gas output.

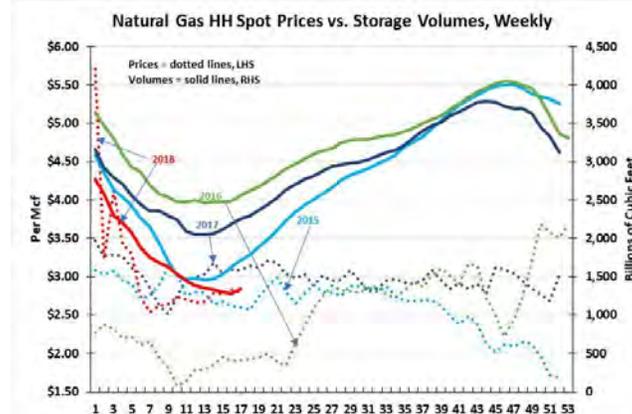
Exhibit 3. Gas Storage Turning Up – About Time!



Source: EIA, PPHB

We have also included our two favorite natural gas charts to put into perspective where the gas storage market is currently (a little better than last week), but also to present a view of the shape of the hill the industry will be climbing this summer.

Exhibit 4. Gas Prices Up In Response To Low Storage



Source: EIA, PPHB

There are many moving parts to the natural gas puzzle – any one of which could have an outsized impact

Our other favorite chart shows not only where current gas storage is relative to recent years, but also where current Henry Hub spot gas prices are compared to recent history. While natural gas prices are slightly better than where they were in 2015 at the comparable time, the expectation they will remain at this level may be tested if weekly injection volumes do not begin ramping up sharply in the coming weeks. As we have said in the past, there are many moving parts to the natural gas puzzle – any one of which could have an outsized impact. Many questions. Few answers. And, we are not into speculating on outcomes.

The Global EV Revolution: Are We At An Inflection Point?

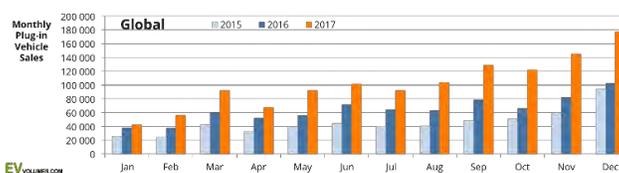
Even the proponents of an electrified global vehicle fleet believe it will take time for this transformation to occur

According to futurists, electric vehicles (EVs) are going to dominate new vehicle sales in the not-too-distant future. From that dominance will come a global light duty vehicle fleet predominantly powered by electric batteries rather than gasoline or diesel. Even the proponents of an electrified global vehicle fleet believe it will take time for this transformation to occur, but while they are convinced it will happen, they differ as to how quickly it will happen.

Global EV sales in December 2017 reached 2% market share for the first time ever

In 2017, the global automobile industry delivered 1,233,600 EVs, a 58% increase over 2016. The market growth was led by China, where sales increased 73%, while the U.S. and Europe grew by 27% and 39%, respectively. Global EV sales in December 2017 reached a 2% market share for the first time ever, helping boost the year's average to 1.3%. Two-thirds of the new EVs were battery electric vehicles (BEVs), while the remainder were plug-in hybrid EVs (PHEVs). The data for 2017 confirms a trend of BEVs gaining market share due to the policies of BEV-friendly China.

Exhibit 5. Global EV Sales Are On The Rise



Source: EVvolumes.com

Their forecast, like most EV forecasts, assume that battery costs continue to fall and that there are no significant changes in government subsidies

Market research firm Frost & Sullivan is forecasting global EV sales to grow from 1.2 million vehicles sold last year to 1.6 million this year, then further increase to two million units in 2019. Their forecast, like most EV forecasts, assume that battery costs continue to fall and that there are no significant changes in government subsidies. Based on monthly EV sales data in the U.S. for the first four months of the year, it looks like this forecast can be achieved. But, maybe sales growth will be greater. *EVvolumes.com* believes the industry will hit 1.9 million units sold this year, driven by expectations of strong sales for the Tesla Model 3 (TSLA-Nasdaq). Given the recent financial results for the first quarter of 2018, Tesla's

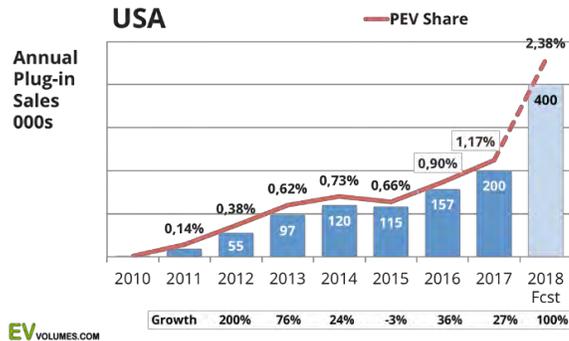
Talk of \$70, \$80 and even triple-digit oil prices may be pushing some fence-sitters off on the side of EVs

Model 3 output targets may prove unachievable, which could force *EVvolumes.com* to reduce its forecast.

In the U.S., April EV sales were 19,581 units, making it the fifth best monthly sales ever. March 2018 was the best month ever for the domestic industry. The high sales were possibly being helped by rising oil prices that are lifting gasoline pump prices, in many cases by 10% or more. Talk of \$70, \$80 and even triple-digit oil prices may be pushing some fence-sitters off on the side of EVs.

For the first four months of 2018, EV sales in the U.S. totaled 74,848 (according to *InsideEVs.com*), a 35.4% increase over the same period last year. *EVvolumes.com* is forecasting U.S. EV sales to double this year, with the EV share of the overall vehicle market reaching 2.4%, also doubling 2017 results.

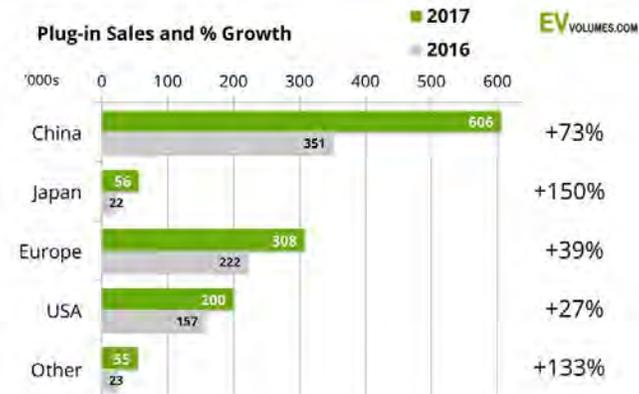
Exhibit 6. 2018 Forecast Calls For Doubling EV Sales



Source: *EVvolumes.com*

While China continues to lead the parade of countries in the sales of EVs, Europe’s growth seems to be accelerating. This comes despite a reduction in financial incentives in Denmark. Any weakness there may have been offset by sales growth in Germany.

Exhibit 7. China Continues To Lead EV Sales



Source: *EVvolumes.com*

Last year, Germany notched the largest increase in EV sales of any European country, nearly matching the market leader, Norway

Germany is known as the home of the diesel car. The diesel emissions scandal was started by cheating by engineers employed by Volkswagen AG (VLKAY-Nasdaq), and it has now engulfed all German car manufacturers and represents a cloud overhanging the country's entire conventional vehicle market. The combination of the scandal, the diesel car buybacks as part of the industry's scandal settlement plan, the institution of clean vehicle financial incentives by the German government and the move by major cities in Germany to ban diesel cars and possibly all internal combustion engine powered vehicles from city centers, is stimulating EV sales. Last year, Germany notched the largest increase in EV sales of any European country, nearly matching the market leader, Norway.

Exhibit 8. Germany Has EV Sales Momentum

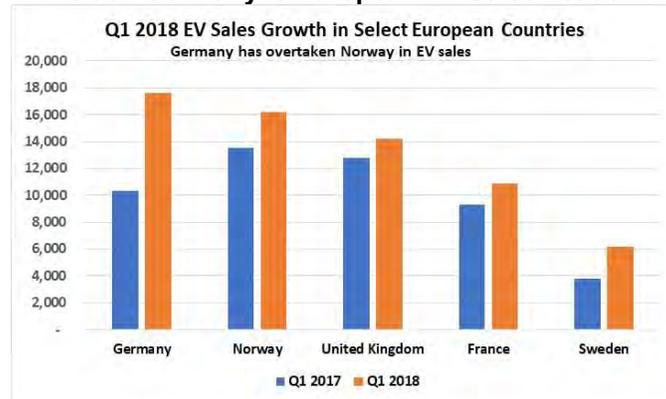


Source: *EVvolumes.com*

Current reports point to Germany having become the EV sales leader in Europe, surpassing Norway, which had been the leading EV sales market. Given the incentives and the sales momentum Germany demonstrated in 2017, the fact the country has become the leader in the first quarter of 2018 is not surprising.

The still unanswered question is how dependent is the EV market on financial incentives for its sales growth?

Given what is happening with respect to EV sales in Europe the United States and China, one must raise the prospect that this industry is reaching an inflection point with faster sales growth in the future. The still unanswered question is how dependent is the EV market on financial incentives for its sales growth? We saw that the winding down of tax incentives in Denmark brought the sales of EVs down sharply, and especially for the more expensive models. Norway is in the process of paring its incentives, and we will be watching closely to see what happens to sales in the next year. Until there are transformative shifts in battery costs, EV markets will continue to rely on governments for their success.

Exhibit 9. Germany Is European EV Sales Leader

Source: Bloomberg, PPHB

Using the success of EVs to predict the demise of the oil business, however, may be premature

While the EV market may appear to have reached an inflection point, we remind readers that EV sales represent a miniscule share of global automobile sales, but more importantly, these vehicles barely register among the global vehicle fleet. Much as our energy supply mix has expanded with the addition of renewable fuels, so too is our vehicle fleet composition broadening. Using the success of EVs to predict the demise of the oil business, however, may be premature.

Is Pace Of Change In Energy World Accelerating Or Not?

We recently attended an investment firm's presentation about markets and investment strategies. One presenter, who manages international mutual funds, focused her presentation on the opportunities coming from "Disruption," with a particular emphasis on major Chinese companies, huge and often unknown in the U.S., being attractive investment candidates because of their roles in disrupting economic sectors. To highlight the significance of disrupting technologies, she showed the following two pictures of traffic on New York City's Fifth Avenue on the respective Easter mornings in 1900 and 1913.

The point the presenter was making with these photos was how quickly a disruptive technology can revolutionize a market

Above each picture is a question – Spot the automobile (1900); and Spot the horse (1913). Answering the first question is easy because there is a red circle drawn around the car. Finding the lone horse in 1913 is harder. It is the second vehicle parked along the left-hand side of Fifth Avenue and is partially hidden by the second car on the left. The point the presenter was demonstrating with these photos was how quickly a disruptive technology can revolutionize a market. For automobiles, it was the Model T and the assembly line it was built on.

**Exhibit 10. How The Automobile Revolution Began
Easter morning 1900: 5th Ave, New York City. Spot
the automobile.**



Source: US National Archives.

Source: JPMorgan

**Exhibit 11. A Lonely Horse On Fifth Avenue In 1913
Easter morning 1913: 5th Ave, New York City.
Spot the horse.**



Source: George Grantham Bain Collection.

Source: JPMorgan

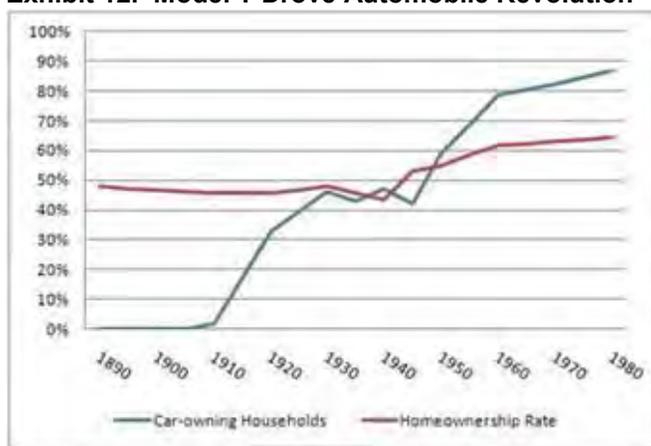
**Fifteen million Model T's were
manufactured**

Many people are familiar with Henry Ford's introduction on December 1, 1913, of an assembly line at his Detroit automobile plants allowing him to accelerate the manufacture of his famous Model T car. Fifteen million Model T's were manufactured between

The power of the assembly line allowed Ford to reduce the cost of a Model T from \$850 in 1908 to \$300 by 1925, opening the automobile market to the average family

1908 and 1927, when production ceased. The assembly line enabled Ford to cut the time to build a Model T from 12 hours to two hours and 30 minutes, initially. Within a year, further assembly line improvements reduced manufacturing time to 93 man-minutes. The power of the assembly line allowed Ford to reduce the cost of a Model T from \$850 in 1908 to \$300 by 1925, opening the automobile market to the average family. It resulted in the percentage of car-owning households climbing from negligible point to over 45% during the life of the Model T.

Exhibit 12. Model T Drove Automobile Revolution



Source: JPMorgan

Black paint was selected because it was the fastest drying color

It was interesting in researching the success of the Model T and the assembly line that Ford's 1922 policy manual stated: "Any customer can have a car painted any color that he wants, so long as it is black." It turns out that the black paint was selected because it was the fastest drying color, which meant that the assembly line would not be slowed.

You have essentially all energy coming from sources dug out of the ground

We found the disruption thesis reinforced when we read comments about energy business changes made by Geoffrey Heal, the Donald C. Waite III Professor of Social Enterprise and a Chazen Senior Scholar at Columbia Business School, to a reporter on *CNBC*. The professor highlighted that fossil fuels have been responsible for powering the world since the Industrial Revolution in the late 1700s until now. Adding nuclear power, which depends on uranium, to the coal, oil and gas fuels that have powered the economy, and you have essentially all energy coming from sources dug out of the ground. Now, with the recent and rapid declines in the prices of alternative energy sources such as wind and solar, coupled with the dramatic cost reductions for energy storage, Dr. Heal believes there is "a very different future on the horizon – one in which fossil fuels go the way of the dinosaurs, and where in the next 10 years we will see more changes to the energy industry than we have seen in the past 100." While a bold prediction, it rests on what appears to be an acceleration in changes in the energy business.

Energy executives are struggling to convince a skeptical public of the reality that energy transitions require time – extensive time

Predictions and perceptions are not necessarily reality, however. In a way, they are like the Cheshire Cat's comment to Alice in Alice's Adventures in Wonderland – "Imagination is the only weapon in the war against reality." Energy executives are struggling to convince a skeptical public of the reality that energy transitions require time – extensive time. The executives are being forced to operate in a world where the vision of a decarbonized future must be implemented now, regardless of the economic or social cost.

To appreciate the challenge of this reality, consider the scope and magnitude of changes currently underway within the energy sector. Furthermore, consider how these changes are impacting the businesses of industries dependent on energy, such as utilities, shippers and automakers, to name a few. The energy changes are reverberating throughout the business community, governments and even global political paradigms.

While fighting for business opportunities within existing regional markets, options to ship surplus oil and gas output to other regions did not exist as transportation infrastructure needed to be built

The most significant change in the energy business in recent memory kicked off this transition. The shale revolution, which commenced in the early years of this century, but whose roots extend back for decades, opened new oil and gas supplies, often from previously thought-to-be-exhausted basins. These new supplies have upended the energy transportation infrastructure in the United States, and now global energy trading, as surging output in newly productive regions could not be efficiently or profitably utilized. This forced producers and transporters to seek access to new or different markets. While fighting for business opportunities within existing regional markets, options to ship surplus oil and gas output to other regions did not exist as transportation infrastructure needed to be built. In other cases, existing pipelines in a region, such as the Marcellus/Utica formations of Ohio, Pennsylvania and West Virginia, were not export options because the flows only went one way. Pipelines in the region needed to be reversed or reconfigured to handle bi-lateral flows.

America's exports rose, while imports fell, and the nation's balance of trade was improved

The wealth of new shale oil and gas output not only revolutionized the balance of supply and demand in the domestic energy market but offered the potential to compete in world markets. After nearly 40 years, the ban against exporting crude oil was lifted by Congress and the industry became free to ship oil anywhere. America's exports rose, while imports fell, and the nation's balance of trade was improved.

The domestic natural gas market balance was upended by the shale revolution. A future expected to be highly dependent on imports, either via pipelines from Canada or in refrigerated ships in the form of liquefied natural gas (LNG) from foreign sellers, was turned upside down. Suddenly gas production overwhelmed domestic markets, driving down natural gas prices. Instead of building new LNG regassification receiving terminals, the U.S. natural gas industry shifted into building gas liquefaction plants and export

Now they must raise capital, meaning cutting distributions as well as selling new units

terminals in order to sell the suddenly cheap domestic gas to foreign buyers. The reversal of fortunes for the domestic oil and gas business has boosted the need for new pipelines, LNG plants, export terminals, and even more railroad track, tank and hopper cars, as well as new oil and sand loading/unloading terminals.

All the new infrastructure needed has stressed owners structured for only receiving imports that would be shipped through existing pipelines. These owners are now forced to raise substantial capital to finance the new infrastructure construction. Most of these owners were established as master limited partnerships (MLPs), which pay out most of their cash flow to their owners. Now they must raise capital, meaning cutting distributions as well as selling new units. This shift has hurt the financial performance of the MLPs, which have been forced to adjust their business models.

Growing volumes of cheap natural gas, natural gas liquids and other light oil products has stimulated a multi-billion-dollar construction boom of plants along the Gulf Coast

From being a 98-pound weakling in the global oil and gas trade, the U.S. has emerged as a supply force to be reckoned with. Not only is the U.S. changing global oil and gas trade and consumption patterns, it has sparked a boom for the petrochemical industry. Growing volumes of cheap natural gas, natural gas liquids and other light oil products has stimulated a multi-billion-dollar construction boom of plants along the Gulf Coast to process these raw materials into petrochemical building blocks. It has also stimulated construction of plants to produce plastics and other base materials. And, we cannot forget the expansion of the U.S. oil refining industry due to the growth in domestic oil output, as well as construction of a new refinery that has not happened in nearly 50 years.

While all those positive developments have been underway in the fossil fuel sector, concern over global warming that morphed into climate change has pushed governments to mandate the use of renewable fuels to replace fossil fuels. Periodic major weather events served to magnify the perceived climate damage being driven by burning fossil fuels that emit carbon dioxide, determined to be THE critical ingredient in the ultimate destruction of the planet, based on computer models. Rather than explore this issue, we accept that the energy mix has expanded, and institutional pressures have been brought to bear on the consumption of fossil fuels.

The two energy sectors most impacted by the green energy push have been transportation and power generation

The two energy sectors most impacted by the green energy push have been transportation and power generation. In the first case, the pressure has been applied to the automobile and oil businesses. In the latter, it has impacted natural gas and traditional utilities. In each case, however, the harm to one sector often contributes to better times for others. For example, consider how mandates for clean power have boosted wind and solar power, even though they require backup power sources and/or storage. These requirements are conveniently overlooked when calculating the economic costs of renewable power. Just how much does solar power cost at 2 am? We would venture to guess substantially more than it does at 2 pm,

These requirements, coupled with the intermittency of wind and solar power, increase the challenge of managing the local power grid, the most critical responsibility for utilities

assuming it isn't a rainy day. Moreover, the use of standby power has often contributed to increased carbon emissions, something environmentalists are struggling to rationalize.

A casualty of renewables has been the traditional utility business model. The governmental push for renewable power has often encouraged the development of a distributive power setup – homes and businesses that generate their own power and only access traditional suppliers when needed. This arrangement often means that suppliers are required to buy all surplus customer-generated electricity. These requirements, coupled with the intermittency of wind and solar power, increase the challenge of managing the local power grid, the most critical responsibility for utilities.

For utilities, a critical issue becomes the price to buy back surplus power. Many regulators require it to be at the retail price. However, included in the retail price is a component to fund the electricity delivery infrastructure. Utilities want to only pay the customer the wholesale power rate, which would leave the customer contributing toward the cost of installing and maintaining the wires and transformers necessary to deliver power when customers need it.

New rules by the California Energy Commission that will require solar panels be installed on the roofs of nearly all new homes, condos and apartment buildings starting in 2020

Additionally, the growth of the distributive electricity often results in fewer traditional utility customers, meaning the remaining customers must shoulder a larger share of the cost to sustain the system's infrastructure as others leave, thereby driving up rates and pushing more customers into the arms of alternative power suppliers. The latest news on this front is the anticipated implementation of new rules by the California Energy Commission that will require solar panels be installed on the roofs of nearly all new homes, condos and apartment buildings starting in 2020. Exemptions will be granted for homes that can't fit solar panels or the panels would be blocked by taller buildings or trees. Absent an exemption, new home housing developments will have to go green, i.e., meaning fewer future utility customers, well as \$8,000-\$20,000 higher house prices.

So far in developed economies, these "clean cars" have yet to become cost-competitive with comparable ICE models

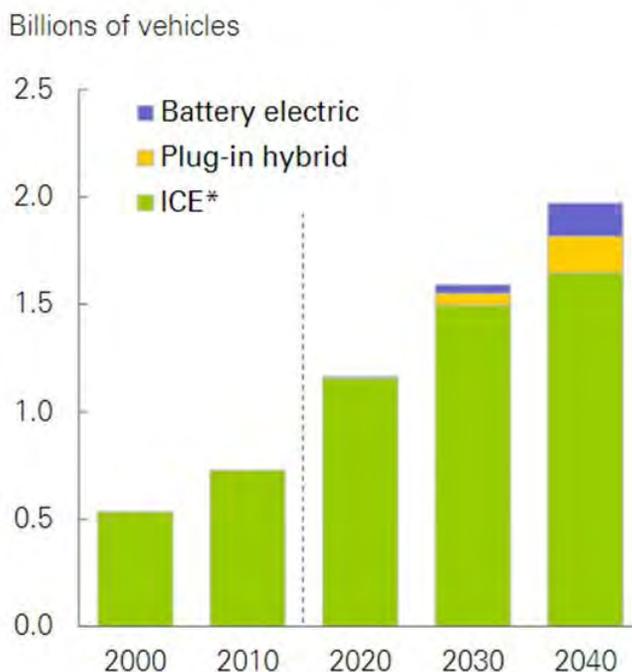
In the transportation sector, the push for cleaner vehicles historically has been addressed through tightening miles-per-gallon standards. Those improvements are achieved by reducing the mass-to-power ratio for propelling vehicles and increasing the fuel efficiency of the internal combustion engine (ICE). Now, these goals are further challenged by the mandates for electric (EV) or zero-emission vehicles (ZEV). So far in developed economies, these "clean cars" have yet to become cost-competitive with comparable ICE models. Nor have clean cars fully overcome buyer range-anxiety fears. The sales success of EVs is almost totally attributable to government subsidies. This has not stopped forecasters from predicting rapidly growing EV fleets. These expectations of rising EV sales are driven by the assumption of a continuing decline in battery costs, which enables the installation of larger batteries in cars, giving them greater range. Rapid increases in EV penetration of the global fleet

The debate currently underway is over how quickly the transportation transition will occur, and by how much these industries be hurt

are also projected based on a wider range of model choices for buyers, which are expected to be arriving after 2020, based on automaker announcements.

Some forecasters have taken the EV revolution a step further with these vehicles becoming the foundation of the Transportation as a Service (TaaS) industry, also known as ride-hailing services, which would radically alter consumer vehicle ownership and use trends. If this industry develops, expectations are it would reduce the number of vehicles built and sold each year, and significantly cut vehicle fuel consumption. This scenario paints a negative outlook for the auto and auto parts companies, as well as the oil businesses. The debate currently underway is over how quickly the transportation transition will occur, and by how much these industries be hurt. Educated guestimates range from the early 2020s to possibly not before 2040. The following series of charts from forecasters suggest the wide range of potential outcomes from the clean car shift.

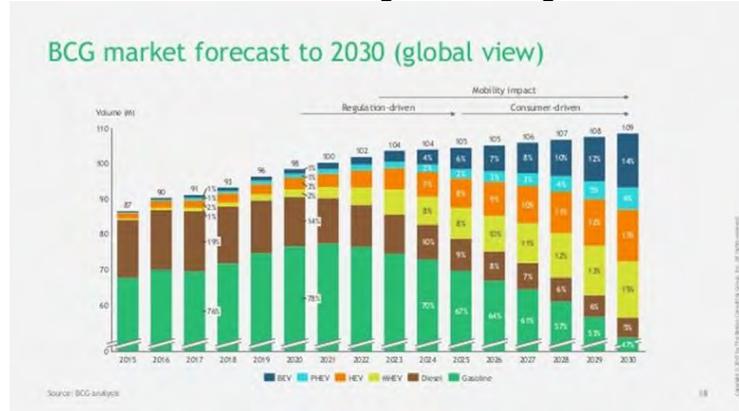
Exhibit 13. BP Sees Little EV Impact On Vehicle Fleet
 Passenger car parc by type



*ICE vehicles includes hybrid vehicles

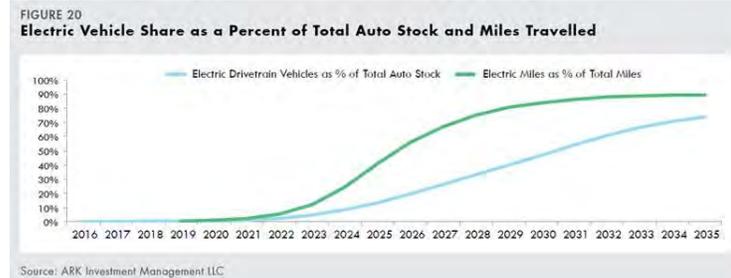
Source: BP plc

Exhibit 14. Boston Consulting Sees Strong EV Success



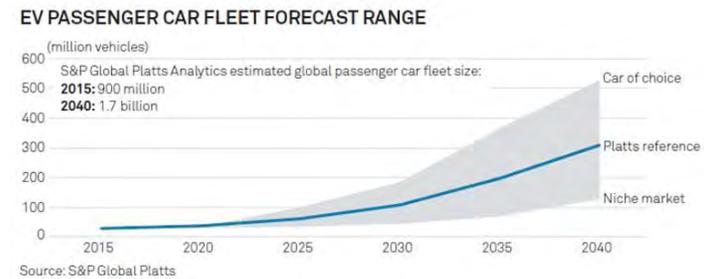
Source: BCG

Exhibit 15. One Of The Most Extreme EV Success Stories



Source: ARK Investment Management LLC

Exhibit 16. Platts Sees EVs Only Doubling By 2040



Source: Platts

That world outlook envisioned oil costing in the hundreds of dollars per barrel, translating into gasoline pump prices of \$10-\$20 a gallon

One of the most significant developments from the shale revolution is the changed role of America in the political world. Prior to shale, the U.S. energy future was based on a significant dependency on oil and gas imports to meet domestic consumption. That world outlook envisioned oil costing in the hundreds of dollars per barrel, translating into gasoline pump prices of \$10-\$20 a gallon. The future those prices dictated was a U.S. whose suburbs were decimated, adding to increased urbanization. Long-distance travel would be by highspeed rail as the cost of airplane travel would be prohibitive, returning it to its early days as a luxury expenditure reserved only for the wealthy. The global movement of goods would

This vision projected the U.S. being actively involved in every territorial dispute in the Middle East and having to expand its naval power to patrol and protect international shipping routes from potential disruptions, which would bring economies to their knees

be by huge ships (multiples of the size of the largest ones afloat today) powered by nuclear propulsion. Today's reality is virtually the exact opposite.

Internationally, the old conventional view suggested that the U.S. would have to be actively involved in the Middle East, as well as most other well-developed oil and gas basins around the world. The U.S. would be competing against other countries – especially in Europe and Asia – for new supplies of oil and gas, which would lift prices higher. This vision projected the U.S. being actively involved in every territorial dispute in the Middle East and having to expand its naval power to patrol and protect international shipping routes from potential disruptions, which would bring economies to their knees. That vision was reminiscent of what had transpired during the 1970s, as OPEC gained control over global oil pricing and used its newly-found oil weapon for geopolitical gains.

Today, geopolitical scholars and analysts wonder whether the diminishing needs for Middle East oil are making the U.S. less willing to become involved in the region's battles. The concern over whether the U.S. will be actively working to prevent the outbreak of war in the Middle East has forced countries and their leaders to consider finding other political partners for support. Those leaders have also had to consider the impact reduced U.S. oil purchases may mean to the availability of petrodollars, an important ingredient in commercial trade and military expenditures.

The world of international politics is rapidly being upended by the growing volumes of U.S. oil and natural gas

The changing global role of the U.S. is also having an impact in Europe where the continent's dependence on Russian natural gas supplies may be challenged by the emergence of the U.S. LNG business. Cheap and dependable gas supplies from the U.S. may make European leaders more willing to agree to U.S. demands for increased military expenditures, as those leaders consider their experiences having been held hostage to Russian geopolitical desires via its manipulation of natural gas supplies in the past. The world of international politics is rapidly being upended by the growing volumes of U.S. oil and natural gas.

On the other hand, no one - and we repeat, no one - has a good timetable for when these impacts may be felt

The energy transition unleashed by the shale revolution is creating demonstrative and significant upheavals within the energy business, but more broadly throughout major sectors of the global economy and the geopolitical world. Some industries, companies and countries are being hurt, while others are benefiting, at least as long as financial support is available for any uneconomic projects being spawned by the push for green energy. No one involved in the energy business should underestimate the amount of change they may experience as a result. On the other hand, no one - and we repeat, no one - has a good timetable for when these impacts may be felt. That makes planning for the transition extremely difficult. Managers need to be considering multiple scenarios of the future and how each one may impact his or her industry and/or business.

We must never underestimate the ingenuity of mankind to create a future that is better than the present

Early and extensive preparation will be key to discerning the future and the opportunities and threats that may emerge.

While many people feel threatened by the current environment, this is actually an exciting time to be involved in energy since almost anything may be possible in the future, even a revival of coal. Just as the marriage of two old and disparate oilfield technologies fostered the shale revolution, we may witness similar developments throughout the energy space. We must never underestimate the ingenuity of mankind to create a future that is better than the present. But, as experienced in every past transition, someone suffers while others prosper. We expect the future to be no different.

Is It “California Dreaming” Or “Hotel California”?

Whether it was singing the Beach Boys’ surfing songs or dancing the Monkey, my fraternity set the pace on our campus

For those of a certain age, California led the way for the rest of America in social mores, as well as dress, automobile and music trends. When we were in college in Connecticut, we had several fraternity brothers who ventured to Los Angeles to hang out for the summer, setting up residence at our fraternity’s chapter house at UCLA. Their task on the start of the fall semester was to teach the rest of us the latest dance moves and the top music from the West Coast so we could set the standard at our university’s initial mixer of the fall. Whether it was singing the Beach Boys’ surfing songs or dancing the Monkey, my fraternity set the pace on our campus.

Should we be dreaming about the beautiful weather in California

Observing economic and energy developments in California raise the question of whether the state’s image today is better described by the 1966 song, “California Dreaming” by The Mamas & the Papas, or that of “Hotel California” by the Eagles, sung a decade later. California changed dramatically in that span of time as the flames of the Vietnam conflict, Watergate and movements of free speech and free love altered its social fabric, and that of the nation. So, should we be dreaming about the weather in California as suggested by the opening stanza and chorus of The Mamas’ & the Papas’ song?

All the leaves are brown (all the leaves are brown)
 And the sky is grey (and the sky is grey)
 I've been for a walk (I've been for a walk)
 On a winter's day (on a winter's day)
 I'd be safe and warm (I'd be safe and warm)
 If I was in L.A. (if I was in L.A.)
 California dreamin' (California dreamin')
 On such a winter's day

Or, maybe today’s California is more like the dark song sung by the Eagles in 1976, which finished with the following message, something that seems to resonate with the state’s residents.

Last thing I remember, I was
 Running for the door
 I had to find the passage back to the place I was before
 'Relax' said the night man,
 'We are programmed to receive.
 You can check out any time you like,
 But you can never leave!'

In assessing where the energy business is heading, we were struck by three news articles dealing with California, its current condition and the direction its politicians are taking the state. We will ignore the sanctuary city debate, other than to say that comments by present and former Californians about these articles referenced that issue as playing a role in reshaping the state's culture and economy and why they were personally upset.

Soaring home prices were driving residents to leave the state

The first article pointed out that soaring home prices are driving residents to leave the state. The median sale price for a home in California is more than double that in the rest of the nation. This is the result of low growth in new home construction. From 2008-2017, an average of 24.7 new housing permits were filed for every 100 new residents in California, which trails the national average of 43.1 permits per 100 people. If this trend continues, forecasters predict California will be three million homes short of market needs by 2025.

During 2006-2016, more than one million people moved out of California than moved in

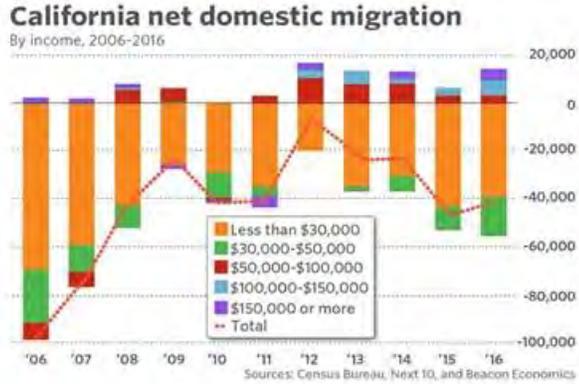
Lack of new home construction raises home prices, and for people with modest incomes, it drives them to find housing at greater commuting distances. Or, it drives them to leave the state. During 2006-2016, more than one million people moved out of California than moved in. Part of the explanation is housing costs. California homeowners spend an average of 21.9% of their income on housing costs, the 49th worst in the nation. For renters, it's worse. They spend, on average, 32.8% of their income on housing, the 48th worst state in the nation. A solution for renters is to double up. Nearly 14% of renter households had more than one person per bedroom, the highest figure for this statistic in the nation.

According to a report by Next 10 and Beacon Economics, more than 20% of the 1.1 million out-migration occurred in 2006, at the height of the housing bubble. When those "sky-high" prices came down, out-migration slowed, but now that housing prices are rising again, the pace of people leaving California is not only picking up, it is accelerating.

Electricity costs in California have soared by nearly 24% between 2011 and 2017

We must believe that some of the pressure to leave, especially for low-income people who dominate the out-migration statistics, is the cost of living. The "green movement" is contributing to that pressure. Electricity costs in California have soared by nearly 24% between 2011 and 2017. At the same time, the national average cost of electricity, excluding California, rose by barely over 4%. Prospects are that power costs will continue to rise as

Exhibit 17. California Out-migration Driven By Economics

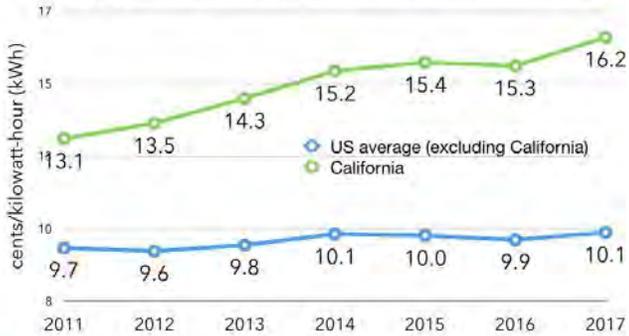


Source: Market Watch

the state pushes its utilities to increase their renewable fuels portfolios, while shutting down cheaper nuclear and fossil fuel power plants.

Exhibit 18. Renewable Push Drove Power Prices Up

Electricity prices in California rose 5x more than in rest of U.S.



Source: Environmental Progress

California also has the highest gasoline pump prices in the nation, even including Hawaii

California also has the highest gasoline pump prices in the nation, even including Hawaii, with regular gasoline selling for an average of \$3.63 per gallon according to the AAA website. High fuel prices have been a stimulus for people to purchase electric vehicles (EVs) along with the subsidies provided by the state. Besides the federal government's \$7,500 tax credit for an EV purchase, the state awards \$2,500 to buyers. Both credits are impacted by income and tax bills, as the credits have to be used in the year of vehicle purchase. California also provides benefits for EV owners, including allowing them to drive in high-occupancy toll lanes free of charge and without having to have a passenger. This can speed a commute materially.

An article in *The Los Angeles Times* last summer questioned whether the state should continue subsidizing EV purchases. It

Over the prior seven years, California had spent \$449 million on EV subsidies, yet in 2016 only 75,000 of the two million cars sold in the state were EVs

pointed out that over the prior seven years, California had spent \$449 million on EV subsidies, yet in 2016 only 75,000 of the two million cars sold in the state were EVs. Moreover, there were only 315,000 EVs out of 26 million registered cars and light duty trucks in California. The article was written at the time the state legislature was debating a plan to boost subsidies to \$3 billion to help push EV sales. Governor Jerry Brown (D) wants to see 1.5 million EVs and other zero-emission vehicles on the state's roads by 2025, while the California Air Resources Board's target is four million such vehicles by 2030.

The pain for California EV owners, at least for those living and driving in Los Angeles, will increase based on the Los Angeles County Metropolitan Transportation Authority's decision, by a 10-1 vote, to eliminate free access to the HOV/toll lanes by "sticker cars." EVs and plug-in hybrids get white or green stickers from the Department of Motor Vehicles when they are registered, which allows the cars access to toll and carpool lanes for free, with only a single occupant. The program has become so popular that these cars are starting to clog the toll lanes along the 110 freeway in Los Angeles.

Exhibit 19. Ticket To Free HOV/Toll Lanes Disappearing



Source: California DMV

Not only have more green cars slowed the traffic flow in the HOV and carpooling lanes, they have slowed the traffic in the rest of the highway lanes

Because prices on toll lanes are set according to the amount of traffic, all these free cars have boosted the cost for the other vehicles using the lanes. Not only have more green cars slowed the traffic flow in the HOV and carpooling lanes, they have slowed the traffic in the rest of the highway lanes. As a result, according to Metro, reported emissions from the highway have gone up.

These HOV and carpooling lanes have been dubbed "Lexus Lanes." The moniker comes from the fact that in 2017, 49% of the users of the lanes paid the toll in lieu of carpooling. The reputation of these lanes is furthered by the fact that Teslas outsell other electric cars. The image of the lanes became contentious. According to reports, during the Metro Commission meeting when Los Angeles City Councilman Paul Krekorian said, "I cannot subsidize someone who puts their tie on and drives their Tesla to work in these lanes." On

Look for more U-Haul vans exiting the state, assuming the residents can check out of Hotel California

the other hand, the lone dissenter, Los Angeles County Supervisor Sheila Kuehl, commented that the change will do little to decrease congestion since 49% of the cars already pay the tolls. She said, "We should simply admit we want to convert this to a toll lane, and we don't really care about clean air. It's because we need the money." Just what struggling Californians need to hear- but honesty is a refreshing quality! Look for more U-Haul vans exiting the state, assuming the residents can check out of Hotel California.

The Cauldron For Forecasting Natural Gas Market

Despite a winter in which natural gas storage volumes fell to the lowest level since 2014, gas prices remain stuck in the mid-\$2 per thousand cubic feet (Mcf) range

The one commodity market that has yet to gain any respect is natural gas. So far this year, and virtually all last year, the hopes/wishes/demands of producers and traders for higher gas prices have failed to lift them. Despite a winter in which natural gas storage volumes fell to the lowest level since 2014, gas prices remain stuck in the mid-\$2 per thousand cubic feet (Mcf) range. That fate appears dictated by the continued growing in natural gas output, something that doesn't appear likely to change soon, despite the signal to producers from low prices to stop drilling.

Last fall, as *The Old Farmer's Almanac* was offering its forecast for the 2017-2018 winter season, the prevailing view was that due to the warming conditions in the South Pacific, winter would be colder than the previous year, but warmer than normal.

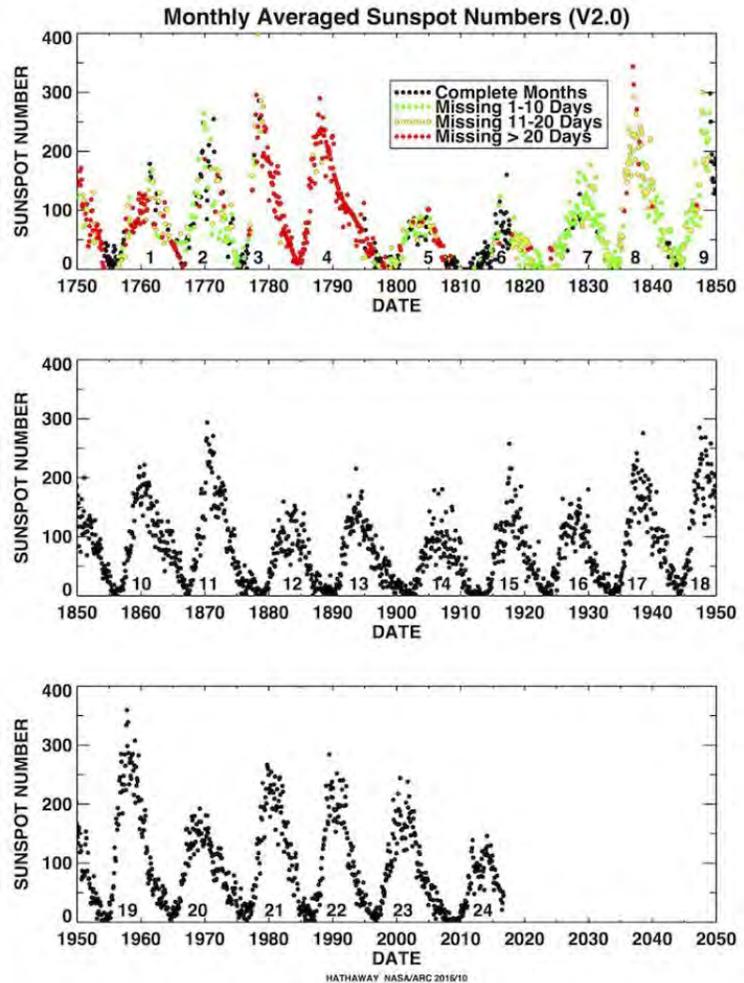
Despite a winter in which natural gas storage volumes fell to the lowest level since 2014, gas prices remain stuck in the mid-\$2 per thousand cubic feet (Mcf) range

The *Almanac's* forecast relies on solar activity trends to drive its long-term predictions. The lack of sun spot activity is a signal that the Earth is entering a period of cooling. The editors of *The Old Farmer's Almanac* published a chart showing the solar cycles by decade since 1750. The cycles clearly show those times when sun spot activity was high, as well as when it has been low. As shown in the third panel, after a peak in the late 1950s, sun spot cycle tops since then have been in a downward trend. We have now arrived at a point where sun spot activity is virtually non-existent.

Admittedly, not all meteorological forecasters consider sun spot activity when determining what will impact the following winter's weather. The National Oceanic and Atmospheric Administration (NOAA) issued a similar 2017-2018 winter forecast to that of *The Old Farmer's Almanac*. NOAA's forecasts are based on extensive data collection and measurement analyses. They expend significant effort and resources in assessing the outlook for both temperatures and precipitation. While the latter aspect of winter is important for people, the amount of rain and snow is less impactful in the natural gas market. Yes, rain and snow mean cloudy skies, reducing the impact of the sun's warmth in areas, its overall impact on temperatures is minimal.

What was the verdict about the past winter, assuming we agree it ended March 31st and not when the cold weather finally abandoned

Exhibit 20. Sun Spot Activity Now At Historical Low Level



Source: *The Old Farmers' Almanac*

Compared to a normal winter with 4,218 heating degree days, last winter was 6.2% warmer

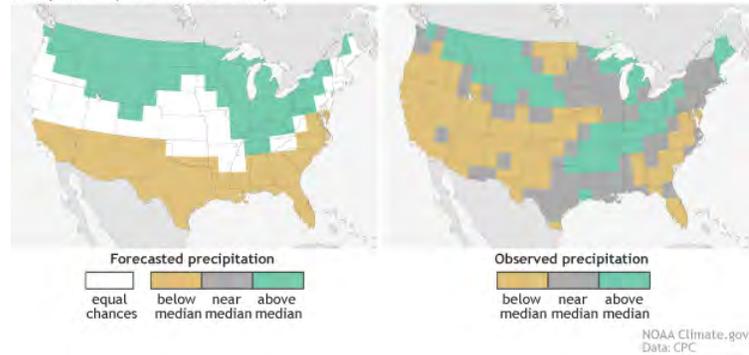
North America in April? The American Gas Association publishes a weekly update on heating degree days. The association's members track this data as it helps them assess the health of natural gas consumption. In the association's April 2nd report, which covered the weeks starting with October 7, 2017, and extending through March 31, 2018, there was a total of 3,956 degree days. That compares with the 3,520 heating degree days in the winter of 2016-2017, making this winter 12.4% colder. Compared to a normal winter with 4,218 heating degree days, however, last winter was 6.2% warmer. Thus, heating degree day data supported the conventional forecast for the recently ended winter.

NOAA meteorologists publish a blog where comments are offered about the weather and the agency's forecasts. A late March blog, in reviewing the NOAA winter forecasts, presented charts showing what the forecast predicted for average temperatures and

precipitation and the actual outcomes. It was the easiest way to assess the “hits and misses” of the forecast.

Exhibit 21. Measuring Forecast vs. Actual Precipitation

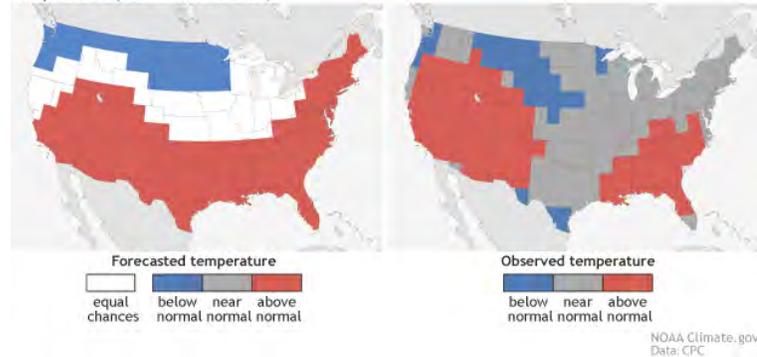
Precipitation (Dec 2017–Feb 2018)



Source: NOAA

Exhibit 22. NOAA Got 2017-2018 Temperature Forecast Correct

Temperature (Dec 2017–Feb 2018)

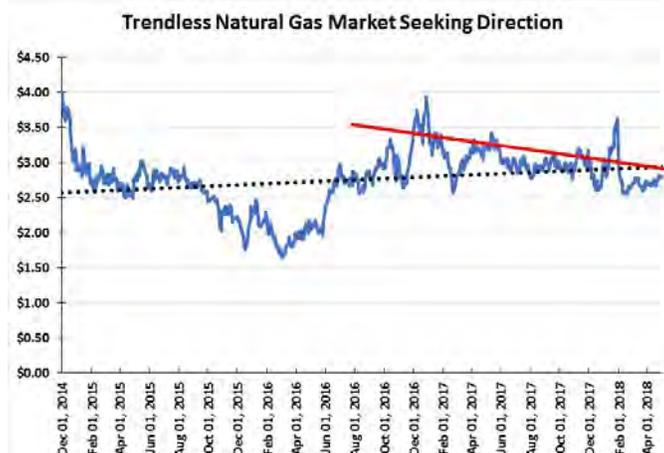


Source: NOAA

This April, gas storage volumes declined by 11 billion cubic feet (Bcf) compared to last year when volumes grew by 205 Bcf

April’s weather extended the winter season, at least in the Northeast, Midwest and Upper Plains states. Traditionally, gas storage withdrawals cease at the beginning of April, with the rare exception of a withdrawal during the first week of the month. This year has been different as we experienced gas storage withdrawals for the first three weeks of the month. This April, gas storage volumes declined by 11 billion cubic feet (Bcf) compared to last year when volumes grew by 205 Bcf. Despite this change in gas supply, the futures market just yawned.

To appreciate what has happened to gas prices, we note that from the time Saudi Arabia disrupted the global crude oil market in late November 2014, they have traded between the high of \$4.01/Mcf on December 1, 2014, and the low of \$1.64 on March 3, 2016. During the 2016-2017 winter, gas prices rallied back toward the old high, reaching \$3.93/Mcf on December 28, 2016. Since then, prices have traded lower.

Exhibit 23. Natural Gas Prices Are Now In Downtrend

Source: EIA, PPHB

The last high price point coincided with the surge in shale oil output from the Permian Basin with its extensive associated natural gas content

In Exhibit 23, the dotted line is an upward sloping linear trendline for the period. The trendline extends from slightly over \$2.50/Mcf at December 2014 to just under \$3.00/Mcf in early May 2018.

However, when we consider the trend in gas prices since they crossed the trendline in June 2016 on their way toward \$4.00/Mcf, the trend (red line) has been downward. The last high price point coincided with the surge in shale oil output from the Permian Basin with its extensive associated natural gas content. In other words, the gas market was spooked by the rapid growth in associated gas output, after assuming little growth would be coming following the sharp decline in dry gas drilling. High and rising oil prices are a stimulus for more shale oil production, and unfortunately, more associated natural gas.

The issue natural gas forecasters and traders are wrestling with is what happens to natural gas demand in the face of continued supply growth. While there may be some uncertainty about future gas output growth, the key to the natural gas price puzzle will be U.S. gas consumption.

In recent years, natural gas consumption has been driven by the fuel's conquest of coal in the power generation market. The environmental push to shutdown coal-fired power generating facilities has been facilitated by low gas prices that undercut coal prices, especially given the implied cost from the stigma of operating "dirty" power plants.

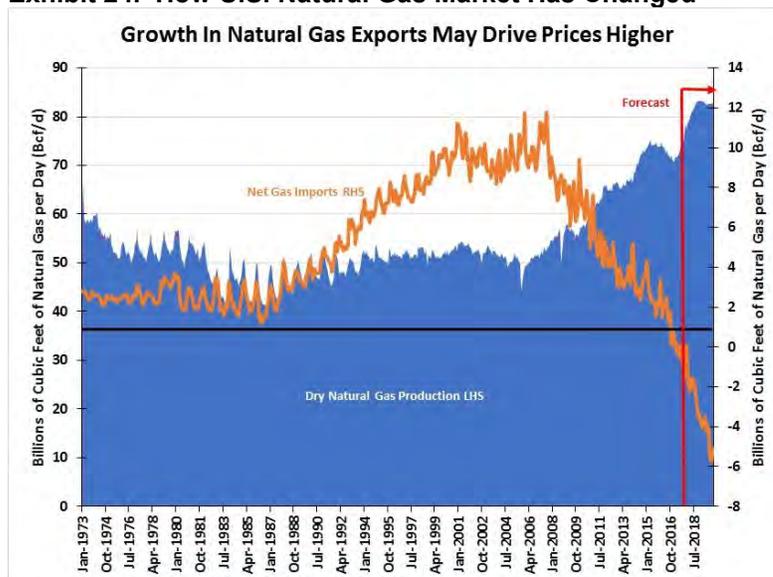
The new dynamic surrounding the market has been gas exports

In the recent past, the new dynamic surrounding the market has been gas exports, either via pipelines to Mexico and Canada, or in liquefied form (LNG) to markets outside of North America. To appreciate how this new dynamic is reshaping the domestic gas market, Exhibit 24 (next page) shows the history of gas production, net imports, along with the Energy Information Administration's (EIA)

In recent years, with domestic natural gas output growing, the U.S. began exporting increased gas volumes to Mexico to offset its falling gas production

April Short Term Energy Outlook. The increase in gas net imports was the result of the long history of Canadian gas supplies helping meet U.S. consumption needs. Canadian imports were offset by a small volume of domestic gas shipped into Canada’s Eastern provinces. As the chart shows, from 1990 to 2007, the U.S. relied heavily on net gas imports from Canada, but, as the gas shale revolution began to unleash significant new supplies into the market, Canadian volumes began slowing. In recent years, with domestic natural gas output growing, the U.S. began exporting increased gas volumes to Mexico to offset its falling gas production. Now, besides shipping gas south of the border, the U.S. is exporting LNG through terminals at Sabine Pass, Texas, and Cove Point, Maryland. New LNG export terminals are being built along the Texas and Louisiana Gulf Coast. These new terminals have helped the United States become a net gas exporter, a condition forecast to grow.

Exhibit 24. How U.S. Natural Gas Market Has Changed

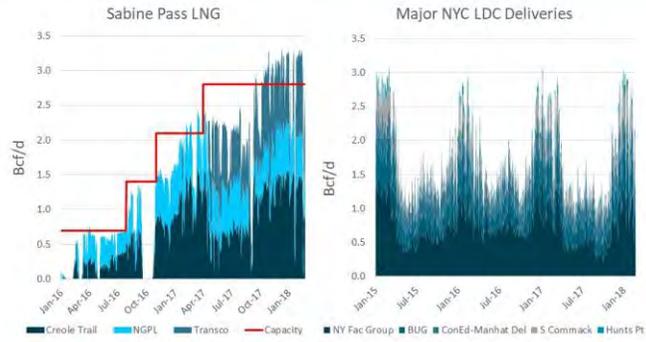


Source: EIA, PPHB

A recent article by *BTU Analytics* on natural gas demand highlighted two interesting points. First, the daily volume of natural gas flowing into the Sabine Pass LNG liquefaction terminal equals the volume of gas used by New York City gas utilities during peak winter demand periods.

Exhibit 25. Sabine Gas Input Rivals Peak NYC Demand

BTU Analytics Deliveries to Sabine Pass LNG terminal in Cameron Parish LA represents more demand than NYC



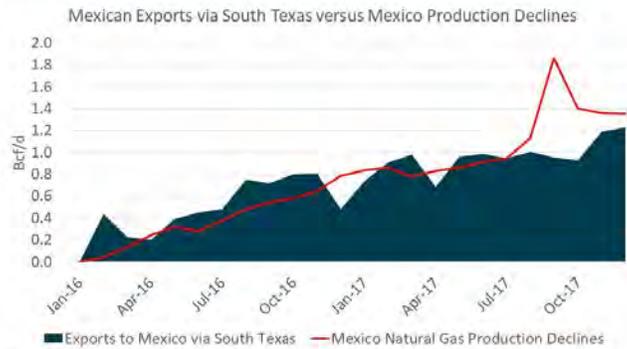
Source: BTU Analytics - Genecapdata as of Feb 2018

The apparent 1:1 relationship between U.S. gas exports to Mexico and the decline in that country's domestic gas production

The second point was the apparent 1:1 relationship between U.S. gas exports to Mexico and the decline in that country's domestic gas production. An important question is whether the opening of the Mexican oil industry to western oil companies will continue after the upcoming presidential election and allow bringing new gas supplies to that market.

Exhibit 26. U.S. Gas Offsets Mexico Production Fall

BTU Analytics Incremental natural gas exports to Mexico have largely been driven by the replacement of declining Mexico production, not new demand



Source: BTU Analytics - February 2018. SENE

LNG export terminals approved and under construction will need approximately 8.13 Bcf/d of natural gas supplies to operate at full capacity

According to data from the Federal Energy Regulatory Commission, LNG export terminals approved and under construction will need approximately 8.13 Bcf/d of natural gas supplies to operate at full capacity. That has been the situation at Sabine Pass. The current maximum output of the four liquefaction trains operating at Sabine Pass, coupled with maximum shipments from Cove Point, equates

The timing of the arrival of this new capacity may play havoc with gas markets and gas prices

With continuing gas production growth lurking in the background, increased energy efficiency has negated colder temperatures and highlights the sensitivity of U.S. gas prices to the dynamics of export markets

to U.S. natural gas exports of 2.6 Bcf/d. The terminals under construction will add more than the twice the existing maximum LNG shipping capacity. However, the timing of the arrival of this new capacity may play havoc with gas markets and gas prices. Freeport LNG recently announced construction delays that will cut 450 million cubic feet per day (MMcf/d) in 2018 and 630 MMcf/d in 2019 from LNG export volumes. Given this announcement, one needs to be mindful of other terminals experiencing similar delays and how that could disrupt the gas market and gas pricing.

So far, the shift in the U.S. status from a natural gas importer to a gas exporter is proving significant. It is the first time since 1957 that the U.S. is not a net gas importer. However, this changed status, and the prospect it will continue and grow, has had little impact on natural gas prices. That reality is apparent in Exhibit 27. We suspect the lack of a price reaction reflects concern about consumption growth weakness in the power generation market as cheap coal delays the shutting down of coal-fired power plants. At the same time, residential, commercial and industrial gas demand is barely growing. With continuing gas production growth lurking in the background, increased energy efficiency has negated colder temperatures and highlights the sensitivity of U.S. gas prices to the dynamics of export markets.

Exhibit 27. U.S. Gas Exports May Boost Prices



Source: EIA, PPHB

The growth in natural gas production has come largely from increased oil shale drilling with its large volumes of associated natural gas

The growth in natural gas production has come largely from increased oil shale drilling with its large volumes of associated natural gas. A recent report by Wall Street research firm, Bernstein, highlights the impact of rising gas-oil ratios (GORs) in oil shale basins on future associated natural gas supply growth, and ultimately on future natural gas prices. According to their research, Permian Basin oil output will increase from 1.6 million barrels a day

To put that additional output into perspective, it represents about 32% of current gas production

(mmb/d) in 2017 to 7.6 mmb/d by 2025. This will bring a serious increase in gas supply.

GORs rise as shale oil wells age because the lighter gas molecules can escape from the well as the volume of heavier oil molecules shrinks and will no longer block the gas molecules. Based on their oil output forecast, Bernstein expects associated (wet) natural gas output to climb from 5.5 Bcf/d to 32 Bcf/d by 2025, for a net 25 Bcf/d increase in supply. To put that additional output into perspective, it represents about 32% of current gas production. Even though that incremental volume will be coming onstream over the next seven years, it represents a market overhang, which will hold gas prices in check, barring some near-term event suggesting that we are much closer to a supply/demand balance for gas. Will all this natural gas market bearishness eventually be pointed to as having marked a bottom for the commodity?

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