PPHB
ENERGY INVESTMENT BANKING

MUSINGS FROM THE OIL PATCH

February 5, 2019

Allen Brooks
Managing Director

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

Disruption And Rethinking Energy Business Models

In the energy business, it seems as if disruptions are constant

The online version of the Merriam-Webster dictionary defines disruption as "the act or process of disrupting something; a break or interruption in the normal course or continuation of some activity, process, etc." In other words, whenever an industry trend or a business process is interrupted, there has been a disruption. In the energy business, it seems as if disruptions are constant. That was what surprised us when we looked at the dictionary website heading titled "Look-up Popularity." It said the word ranked in the bottom 10% of words searched. Either no one has a problem understanding what the word means, or few people care. That isn't the case in the energy business. In fact, we suspect it may be one of the more frequent words employed when energy executives discuss what is happening in their world.

It even fits with what E&P competitors thought about George Mitchell and his band of experimenting engineers after they finished drilling and completing shale gas wells in the Barnett Basin near Fort Worth

What we never knew about "disruption" was that there is also a medical definition. It means "the act or process of breaking apart or rupturing." To us, it seems to be the best description of what is occurring in the energy world. Medically, the implication is for a much more significant event, suggesting that things don't just return to the prior trend or process, but rather someone needs to figure out how to put things back together again. The example of the proper use of the word in the medical sense presented by Merriam-Webster was "bandaged her leg tightly to prevent *disruption* of the partly healed wound." It suggests that if there is disruption of the wound, a potentially serious, or possibly even fatal outcome might result. Our impression is that the definition matches oil company executives' thoughts after Saudi Arabia's decision at the Thanksgiving Day OPEC meeting in November 2014. It even fits with what E&P competitors thought about George Mitchell and his band of experimenting engineers after they finished drilling and completing horizontal gas wells in the Barnett Shale near Fort Worth. In the first

Companies were threatened with sudden extinction in a world of $20-something oil for the foreseeable future

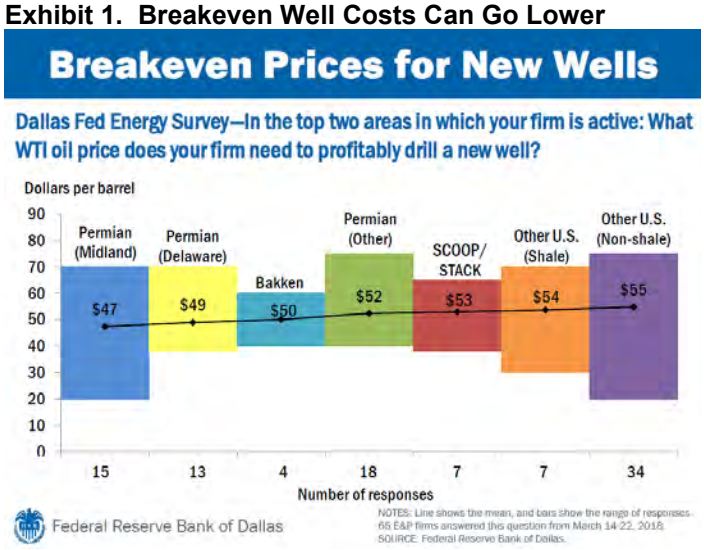
case, the luxury of operating in a world of $100 a barrel oil was shattered and companies were threatened with sudden extinction in a world of $20-something oil for the foreseeable future. In the other case, the danger zone for well drilling suddenly became the gas industry savior with its abundant reserves and high well flow rates. These were not mere interruptions in current industry trends, but rather forced a re-evaluation of every fundamental belief held about the operation and future of the energy business. In both cases, the parties associated with these actions had let a genie out of the bottle, and the industry would never be the same again!

Think about the challenge of managing a global oil company today. Not only must you watch the supply and demand trends for crude oil, but tracking geopolitical events in the major oil exporting countries, especially those in the Middle East, as well as Russia, is mandatory. All of this is happening as you need to stay attuned to shifts in energy policies in major oil consuming countries such as China, India and the developed economies in the West.

There are more optimistic outlooks calling for $70-$80 a barrel prices by year-end

Following the last three months of 2018, during which global crude oil prices fell by over 40% and caused energy stocks to be the worst performing market sector, oil prices have rebounded by 18.5%. The increase is actually greater if measured from the Christmas Eve low. The last day of January saw oil trade above $55 per barrel, up nearly $10 per barrel since January 1st. Forecasts call for oil prices to head higher with recent projections putting the 2019 average in the $55-$65 range. There are more optimistic outlooks calling for $70-$80 a barrel prices by year-end. For oil companies, the January improvement spells the difference between breaking even, or losing money on wells, to potentially making money, depending on where the production is located.

Exhibit 1. Breakeven Well Costs Can Go Lower



Source: Dallas Federal Reserve

At $45 a barrel, there are few profitable drilling locations

The response to a question posed by the Dallas Federal Reserve Bank in its first quarter of 2018 survey showed a wide range of breakeven prices by basin. The line on the chart in Exhibit 1 (prior page) connects the mean price of average wellhead prices for various basins that are depicted by the colorful bars. For the Midland basin of the Permian region, well breakeven costs run from a low of just over $20 a barrel to $70. At $45 a barrel, there are few profitable drilling locations. On the other hand, at $55 a barrel, there are considerably more production candidates. Importantly, these cost figures were estimated last year and are likely lower today.

With one eye, a CEO watches the current spot oil price, and with the other, the 12-month price strip

While contemplating well economics, which takes into consideration pricing leverage a company has over its oilfield service suppliers, potentially padding the profitability analysis, an executive will ponder the risk of bringing new supply to market just as oil prices take a dive, as they are often known to do. (No one ever worries about bringing on production prior to oil prices jumping.) So, with one eye, a CEO watches the current spot oil price, and with the other, the 12-month price strip. The CEO wants to be operating in a zone that capitalizes on forces guiding him between those two extremes. Three-to-five, or even ten-year oil price outlooks are relegated to planning sessions where the focus is on allocating capital between short-term, quick payback projects and long-term ones possessing large reserves and high well flow rates. Getting capital back quickly wins more kudos from Wall Street analysts and investors today than targeting potential elephant discoveries. For the sake of clamoring shareholders, and one's own pocketbook, executives are opting for short-term, quick payback projects.

Almost no one has been able to predict future oil prices, so planning falls back on economic expectations driven by population growth, increased labor force productivity and general increases in living standards

Looking further out becomes more speculative. Almost no one has been able to predict future oil prices, so planning falls back on economic expectations driven by population growth, increased labor force productivity and general increases in living standards. Those forces drive energy consumption. The pace of consumption growth can also be impacted by energy efficiency improvements as well as lifestyle shifts. Supply growth depends on oilfield technology developments. The state of global economic activity will have a bearing on consumption, and it is often influenced by geopolitical developments. When planning for the longer term, it is often easier to operate on the principle: What you see is what you get. In other words, accept trendline extrapolations in the factors that drive supply and demand, and only worry about how best to position your company to capitalize on those trends.

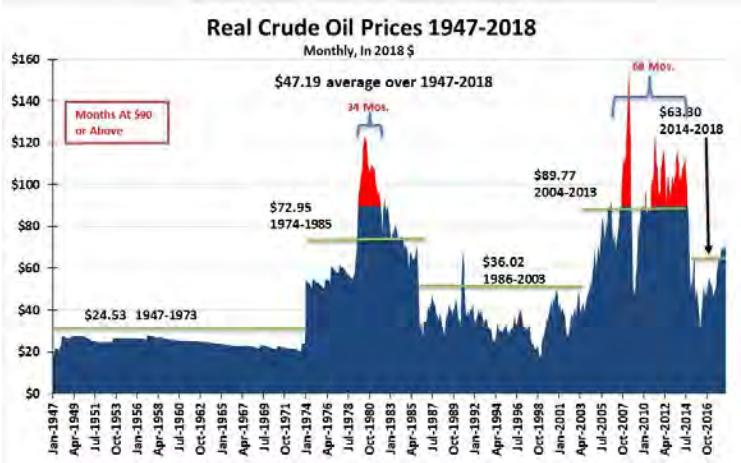
A more rigorous way to plan for the future is to examine where the industry is in its traditional 5-7-year cycle. That requires accepting that the industry has cycles, not an outrageous admission given the 150+ years of industry history. Much like a metronome, it is human nature for people to become aggressive when times are good because there exists the opportunity to capture "more than your

share." In the same vein, when times are bleak, people are reluctant to take risk, or they are spending all their time trying to rectify the problems they made when times were good.

Few people contemplated what those "good old days" were doing to the health of the industry, and how it would change the business in the future

People always think fondly of the "good old days," meaning the times when oil prices were high, discoveries were frequent and profits grew continually. Wall Street lionized the successful companies, and for those that were public, their share prices soared. Private company executives just lavished in the wash of cash coming over their transoms to be spread among the owners and employees. Few people contemplated what those "good old days" were doing to the health of the industry, and how it would change the business in the future.

Exhibit 2. Extended High Oil Prices Have A Cost



Source: EIA, BEA, PPHB

Their scale and scope provided the IOCs with the ability to emphasize whichever business sector of their enterprise that provided them the best return on investment

For perspective on shifting industry challenges, we revert back to a favorite chart (Exhibit 2) showing the history of real crude oil prices from 1947 to 2018. Visually, it divides into three sections: 1947-1985; 1986-2003; and 2004-2018. The stability of real oil prices in the first period was largely attributable to the concentration of the global oil industry and its control by the Seven Sisters, the name given the seven largest global oil companies. At that time, the United States was the world's swing producer. Demand growth was healthy as the western world was rebuilding following the destruction of World War II. By 1971, however, the U.S. exhausted its surplus oil production capacity, shifting global oil pricing power from the Seven Sisters to the Organization of Petroleum Exporting Countries (OPEC) that had been established in 1960 to push back on the pricing manipulations of the major oil companies. The global integrated oil companies (IOC) were interconnected petroleum operations (production, transportation and refining) spread across the world. Their scale and scope provided the IOCs with the ability to emphasize whichever business sector of their enterprise that provided them the best return on investment. Their global

operations provided them a unique view of economic and political shifts underway around the world, which they used to capitalize on profit-making moves.

This contributed to the organization becoming more political and fractious

Things changed when global pricing power moved to OPEC. It was composed of a group of countries endowed with oil and gas resources but located away from major consuming markets. As a result, they had less intelligence about the geopolitical and economic forces impacting their operations. This contributed to the organization becoming more political and fractious. That enabled certain Middle East producers to use OPEC's power for revenge against western governments perceived as opposed to the oil exporters' nationalist goals. Oil became an economic weapon, used twice in the past 46 years, but each time with poor results.

Those days ended when the avalanche of new oil production from around the world, courtesy of high oil prices, displaced OPEC output and launched the global oil war of the mid-1980s

In nominal terms, oil prices entered the 1970s at low single-digit levels and exited the period some 10-times higher. During that span, as the chart shows, the world spent 34 months with real oil prices at or above $90 per barrel. Yes, high oil prices created substantial wealth for some. Who wasn't fascinated reading the Neiman-Marcus Christmas catalogues filled with exotic and extravagant adventures and gifts, as well as learning about the West Texas oil producer wives' afternoon private jet flights to Dallas to shop, or the Saudi royal families flying their private 747s to London and letting the wives and children loose in Harrods with Gold American Express cards and unlimited spending authorities? Those days ended when the avalanche of new oil production from around the world, courtesy of high oil prices, displaced OPEC output and launched the global oil war of the mid-1980s.

Following the 1970s, the industry spent 17 years in a world with an average real oil price half that of the 70s boom

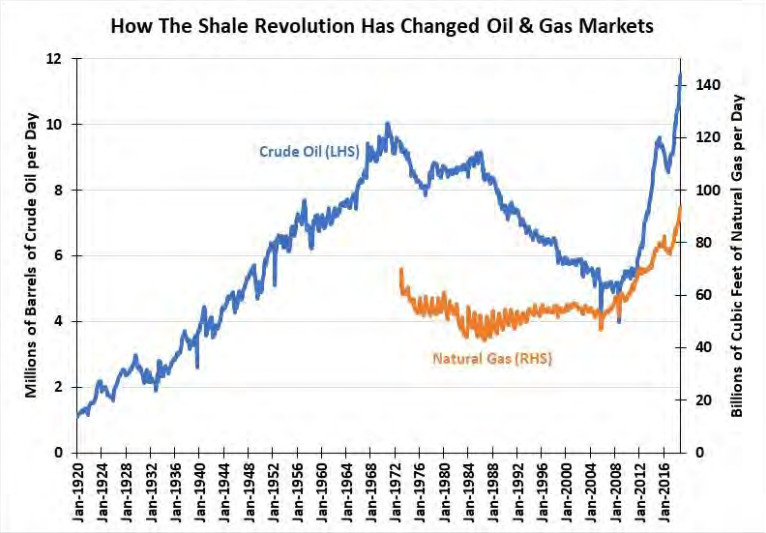
High oil prices not only brought on new production, for the most part controlled by the IOCs who could earn higher returns than merely being a conduit for getting OPEC oil to market, but it destroyed demand. The automobile industry went from making cars with mid-single digit mile-per-gallon efficiency to cars with twice that performance, dampening oil demand growth. Un-insulated homes were suddenly insulated. Appliances and lights became more efficient. Collectively, these forces changed the global oil business. As we see from Exhibit 2 (page 4), following the 1970s, the industry spent 17 years in a world with an average real oil price half that of the 70s boom, which was the result of more supply and reduced demand growth. The global oil industry that entered the 21st Century was far different than the one that exited the 1970s.

During that 20-year span, technology contributed to reducing the petroleum industry's cost structure. Whether it was bright spot seismic technology that identified new prospects in the Gulf of Mexico, or improvements in drilling and producing large well flows in very deep water, forces were reshaping the petroleum industry. In the Fort Worth basin, George Mitchell and his engineers were busy determining how to tap the source rock for natural gas. These

Mitchell's success spawned copycats who ultimately created a natural gas supply glut that undercut high prices and forced the industry to throttle back its activity

experiments in drilling horizontally and applying massive hydraulic fracturing treatments to completed wells were driven by Mitchell Energy's realization it could not meet its gas supply commitments. Solving the technological challenges of fracking these gas wells turned the company's fortunes around. Mitchell's success spawned copycats who ultimately created a natural gas supply glut that undercut high prices and forced the industry to throttle back its activity. That was when someone thought it might be fun to try using this technique on crude oil wells. The rest is history.

Exhibit 3. Oil And Gas Output Soaring



Source: EIA, PPHB

But the real story is the dramatic rise in both oil and gas production due to the success of horizontal drilling and hydraulic fracturing in the shale formations that underlie hydrocarbon producing basins

From a country whose future was projected to be highly dependent on oil and gas imports, horizontal drilling and hydraulic fracturing suddenly propelled the U.S. back into its historical role as a global oil and gas output leader. Exhibit 3 shows how domestic oil and gas output has climbed since the early 2000s. In the case of natural gas, the production improvement in the late 1980s and 1990s was largely due to the success of seismic techniques offshore and areawide leasing in the Gulf of Mexico that enabled producers to capitalize on that technology to the maximum. But the real story is the dramatic rise in both oil and gas production due to the success of horizontal drilling and hydraulic fracturing in the shale formations that underlie hydrocarbon producing basins.

The success of finding and development technologies has dispelled the Peak Oil narrative that dominated turn-of-the-century petroleum industry thinking. The experience demonstrates the power of industry technology to dramatically alter trends in hydrocarbon production. Merely extrapolating current trends in the oil and gas business could prove dangerous. In fact, it seems this may be a trap the Energy Information Administration (EIA) has fallen into with some of its very long-term forecasts for the U.S. oil and gas industry.

We will leave a discussion of the latest EIA Annual Energy Outlook to another time, but suffice that we shouldn't believe we have solved America's oil and gas supply issue forever.

That new force is climate change, or more correctly, the response of society to how to decarbonize our modern world

As we rethink energy business models, which is really an exercise in conceptualizing the long-term role of energy in the economy, we must still consider the fundamental forces that underlie energy supply and demand dynamics. Over the past 20 years, a new powerful force has emerged to reshape the energy world. That new force is climate change, or more correctly, the response of society to how to decarbonize our modern world. Decarbonization is believed to be the only feasible response to society's fear over ecological damage from increasing carbon dioxide emissions in the atmosphere due to burning fossil fuels. Just as concerns over a physical shortage of crude oil was captured in a phrase, so too has concern about the success of decarbonization. Today, we are worried about Peak Oil Demand!

Errors in climate models may lead to solutions that create either potentially worse problems or solutions that prove harmful to society with their application

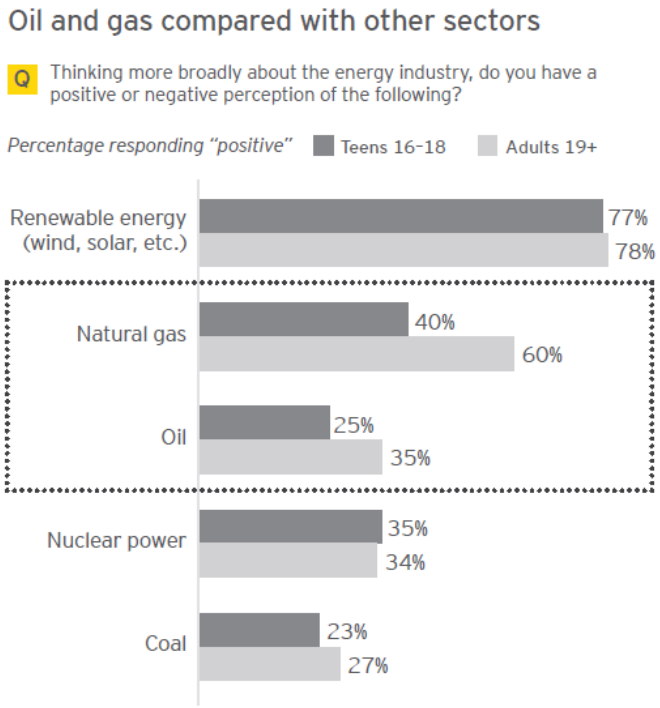
While we remain cautious about many of the claims by climate change proponents, we are more concerned that the simple climate models do not accurately capture the interacting dynamics of the planet's climate. Errors in climate models may lead to solutions that create either potentially worse problems or solutions that prove harmful to society with their application. This is not the place to argue the relative merits of climate change and its proposed solutions, but rather to acknowledge where we are in this struggle and what its potential outcome might mean for energy companies.

We are at a point where a generation of the world's population has come of age having been taught about the dangers of climate change, and that it is caused by humans using dirty fuels. As members of the Millennial generation are moving into positions of power and influence in politics and business, their views about climate change and energy will become increasingly more important. The chart in Exhibit 4 (next page) is from the 2017 *EY Oil and Gas US Perceptions Study*. The extensive study involved two surveys – one of the general public and another of energy executives.

Among Adults, oil's positive perception represents only about half that of renewables

The chart shows the percentage of positive perception about various fuels, divided between Teens (age 16-18), now referred to as Generation Z, and Adults (age 19+). This chart was used by Dr. Sami Al-Nuaim, the 2019 head of the Society of Petroleum Engineers (SPE), in speeches and in his effort to engage and develop working relationships with agencies and organizations globally that will enhance the SPE's role. Note that among Teens, oil's positive view is barely above the group's view of coal. Moreover, oil's favorability rating is only a third of that of renewable energy. Among Adults, oil's positive perception represents only about half that of renewables. This is a serious problem for the oil industry, and these perceptions will shape its business environment for the foreseeable future. How that environment is reshaped should

Exhibit 4. Gen Z Has Low Opinion Of Fossil Fuels



Source: EY

Of great concern to executives given the oil industry's negative perception

be of great concern to executives given the oil industry's negative perception. The introduction to the EY study's first survey results explains the dilemma facing energy industry executives as they consider their corporate strategies. The study states:

> "For decades, US oil and gas executives have lamented the industry's public perception and the lingering lack of trust between consumers and energy companies.
>
> "Despite periodic calls for more industry openness — as well as a number of high-profile campaigns to inform the public — many oil and gas executives believe Americans have never been less mindful of the importance of energy in their day-to-day lives, nor more skeptical toward the companies that find, produce and deliver the oil and gas that make modern living possible.
>
> "But is that really the case? Is there a chasm that can't be mended between the public and the industry? Or is there common ground oil and gas companies could build upon to increase consumer acceptance and appreciation for the value they provide?
>
> "These are important questions because, in this era of technological disruption, when many industries are fighting

to stay relevant, oil and gas may be facing its "last cycle" — a time when energy abundance, driven by technology, creates a permanent oversupply that not only keeps prices low but also allows consumers to make new choices about their energy usage. In this environment, public perception of the industry will become ever more critical. And as younger consumers grow in both number and political influence, their viewpoints will become especially vital to the continued relevance of the industry."

Recognize that the industry's future relevance over the long term will diminish and be replaced by renewables, at least based on the currently available fuel slate

The final paragraph summarizes the challenge facing the oil and gas industry. We are not willing to endorse the "last cycle" concept for the fossil fuel industry, but recognize that the industry's future relevance over the long term will diminish and be replaced by renewables, at least based on the currently available fuel slate. That will mark the "last cycle," but when? Maybe a new clean fuel is in development that will supplant oil and gas as the preferred energy to power the global economy. We have recently read some technical and policy articles presenting strong arguments for nuclear power to be favored, but we will save that analysis for another time.

The underlying pressure to decarbonize today's economy is a powerful force, even though the goal is questionable

At the heart of the movement to reshape the oil and gas industry is the issue of climate change. While manifesting itself in issues such as tropical storm frequency and intensity, the melting of glaciers, drought and warming temperatures, to name a few, these are not the subject of this article. However, the underlying pressure to decarbonize today's economy is a powerful force, even though the goal is questionable, given carbon's key role in the planet's atmosphere, plant-life, and human existence and comfort. Decarbonization is often a catchall phrase for describing all efforts at removing polluting agents from our daily lives – sulfur, ethane, particulates, etc.

Two weeks ago, the University of Houston announced the establishment of the Center for Carbon Management in Energy, as well as creating the Consortium for Energy Corporate Social Responsibility. The Center and Consortium will independently, but in concert, strive to advance the practice of Corporate Social Responsibility in the various sectors of the energy industry, while helping identify and develop possible carbon management strategies during the production, management and distribution of energy resources and products.

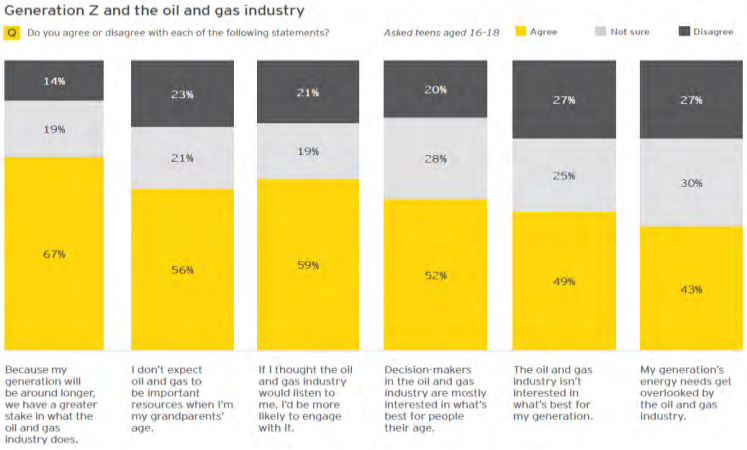
The oil and gas industry is the only one with the experience, scale and technical expertise to decarbonize the world's energy industry

The presentations associated with this kickoff event focused on carbon and energy. One point all the speakers at the event agreed on was that the oil and gas industry is the only one with the experience, scale and technical expertise to decarbonize the world's energy industry. This may be a critical insight. As John Hofmeister, CEO of Citizens for Affordable Energy Inc. and a member of the University of Houston's Energy Advisory Board, put it, energy companies need to approach the carbon issue just as meatpackers

For the oil and gas industry to embrace decarbonization of their product, they need to turn carbon from a cost and into a product that generates profits

approach sausage making, which was described by *Wikipedia* as "an outcome of efficient butchery." Mr. Hofmeister, and other speakers, highlighted that for the oil and gas industry to embrace decarbonization of their product, they need to turn carbon from a cost and into a product that generates profits. That shift would get executives' attention, but also stimulate corporate research and development efforts. The approach to carbon must be similar to the oil and gas industry's approach to safety, where manhours worked have risen steadily but accidents have declined, equally as steadily. Achieving such a shift for carbon would be a game-changer for the oil and gas industry.

Exhibit 5. More Negative Views Of O & G Industry



Source: EY

Windfall profits tax, price controls, new oil, new-new oil, and gasoline allocations became part of the vernacular as the government's efforts to control the oil business grew

Considering the attitudes of Generation Z and even Millennials toward oil and gas, the long-term future for the industry will be very different from the past. Many people forget that beginning during the second half of the 1970s and extending through the 1980s and 1990s, energy was viewed as the beneficiary of that earlier explosion in global oil prices, therefore governments needed to exert increased control over the industry to prevent further exploitation. With the international oil and gas industry viewed complicit in the oil price explosion that created high inflation and harmed citizens, it could not be trusted to solve this economic shock. Instead, it needed to be punished and regulated in order to prevent further damage. Windfall profits tax, price controls, new oil, new-new oil, and gasoline allocations became part of the vernacular as the government's efforts to control the oil business grew. While drivers sat in lines at their local gasoline stations, speculation was rampant that the oil industry was withholding oil, tankers were being held offshore to drive up prices, and companies were deliberately hoarding oil and creating shortages to drive up prices. The oil industry became public enemy number one.

Clifton Garvin, the chairman of Exxon Corp. commented on the public mood at the time. "The American is a funny person," he said.

"He worships the result of things that are big, economies of scale, mass production, but he hates anything that is big and powerful, and the oil industry is seen as the biggest and most powerful industry." As cited by the attitudinal surveys about the oil and gas industry, this assessment from the late 1970s seems equally applicable today.

Certainly, a portion of their cash flow needs to be reinvested to sustain oil and gas output, but are there other prospective non-fossil fuel investments that will generate positive returns at some point in the future?

As oil and gas company executives contemplate the long-term future of their business, they must balance operating their companies to generate profits near-term, while wrestling with where to invest for the future. Certainly, a portion of their cash flow needs to be reinvested to sustain oil and gas output, but are there other prospective non-fossil fuel investments that will generate positive returns at some point in the future? As they ponder this issue, they must deal with the perception of investors about the business and its future. Peter Tertzakian, Executive Director of ARC Energy Research Institute, describes the challenge:

> "For a growing number of money managers, proliferation of renewable energy and electric cars are seen as challenges to long-term volume growth. Meaningful reduction in oil demand is years away, however the psychology of envisioning obsolescence—compounded by the pressures of environmental issues like climate change— will continue to subdue investor interest in all jurisdictions.

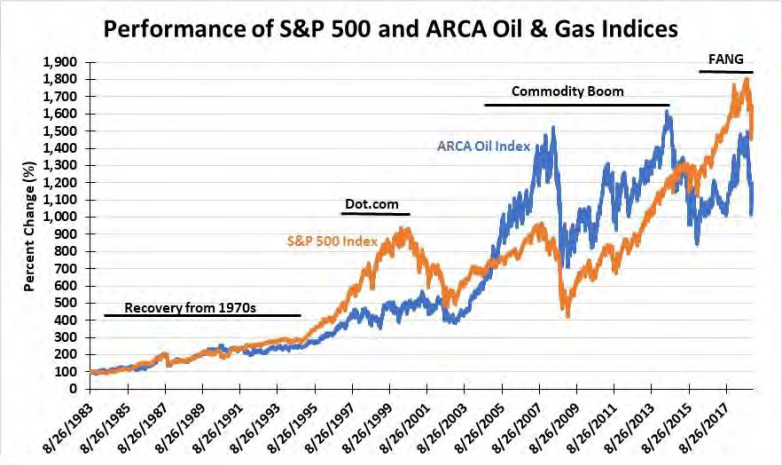
That result will make attracting the next generation of workers and leaders to the energy industry that much more difficult

The energy industry has been one of the worst performing investment sectors for the past decade. After recovering from the financial crisis and recession of 2008-2009, energy stocks hit a peak in 2013, but have since underperformed the overall market, and declined in absolute terms. This performance record is alarming. It signals industry and company changes will be necessary to attract investors, especially those willing to provide fresh capital to support long-term projects. What changes should be made needs to be the focus of industry strategic planning. There is no magic solution. Even companies with outstanding executive leadership may not be recognized or compensated for years, if ever. That result will make attracting the next generation of workers and leaders to the energy industry that much more difficult.

For an industry with a record of not maximizing its return on oil and gas invested capital, renewables have become a double-edge sword

Is shifting capital spending toward "green energy" the answer? BP plc (BP-NYSE), under then CEO John Brown, attempted to rebrand the company as 'Beyond Petroleum' in 2000. By 2013 it had abandoned that effort, sold its solar and wind power businesses, and re-emphasized building up its oil and gas assets. Today, virtually every major IOC has a renewables business, with some, especially companies based in Europe, undertaking substantial efforts to build them. The problem is that renewables are not as profitable as traditional oil and gas investments. For an industry with a record of not maximizing its return on oil and gas invested capital, renewables have become a double-edge sword.

Exhibit 6. Oil Has Bettered Market But And Now Trails



Source: ***Yahoo Finance*****, PPHB**

Major oil and gas firms, collectively, are spending around 1% of their 2018 budgets on clean energy, despite all the talk and focus on renewables

This investment return issue was highlighted in a *Reuters* interview from the sidelines of the recent World Economic Forum in Davos, Switzerland with Iberdrola SA's CEO Ignacio Galan. "It's good that they [oil and gas companies] have moved in this direction but they make more noise than the reality," he said. According to CDP, a not-for-profit charity that runs the global disclosure system for investors, companies, cities, states and regions, major oil and gas firms, collectively, are spending around 1% of their 2018 budgets on clean energy, despite all the talk and focus on renewables. Mr. Galan, head of the Spanish utility, the world's largest wind power company, said that with returns on oil investments far exceeding those typical of wind and solar projects (15-20% versus 8-9%), he doubted major oil companies would make a meaningful shift until that changed.

Environmentalists believe the risk to the health of the planet is so high that only the most radical of actions will solve the problem

With prominent investment publications such as *Barron's* cover story of their January 28th issue titled "Calculating The Cost Of Climate Change," and leading investment managers such as Jeremy Grantham of GMO devoting $1 billion of his net worth to fighting climate change and over-population of the planet, the challenges for energy will not diminish anytime soon. Extreme weather and failed climate change mitigation topped the 2019 list of long-term risks facing the world according to the World Economic Forum. Carbon taxes, mandates for clean energy and banning internal combustion engine cars are driving the economic and societal world into the future. In some cases, environmentalists believe the risk to the health of the planet is so high that only the most radical of actions will solve the problem. Therefore, they advocate the extreme position of keeping all fossil fuels in the ground, essentially ending of the oil and gas era, and the companies that provide those fuels. The reality is that energy will still be needed long into the future since it is impossible physically or financially to reorder our world's economy. As a result, IOCs will continue to play a significant role in that future

In history, we have never reverted to lower energy-density fuels in our march to an improved society

world. But if oil and gas represent declining shares of energy, it is hard to imagine those fuels producing outstanding investment returns. Unless the investment returns of renewables improve, attracting sufficient capital without government subsidies or mandates will not be the answer. In history, we have never reverted to lower energy-density fuels in our march to an improved society. A move to powering the world with renewables would be the first such experiment. Given all the skills and tools of the global oil industry, IOCs are best positioned to determine how to turn carbon into a profitable product, which might be the ticket to reviving the long-term health and attractiveness of the oil and gas business.

Another View Of Oil's Investment Performance Record

Last year's worst performance is attributed to the dramatic fall in oil prices, taking energy share prices down along with them, in the fourth quarter

Energy has been among the worst investment sectors in the stock market for the past decade as demonstrated by Standard & Poor's data. As we also showed in our last issue, energy went from the worst to best performing sector and then back to the second worst in the three years of 2015-2017. Last year's worst performance is attributed to the dramatic fall in oil prices, taking energy share prices down along with them, in the fourth quarter. This performance record haunts energy executives and leaves energy investors questioning why, despite the volatile oil price track record, the old historical relationship between oil prices and energy stocks has broken down.

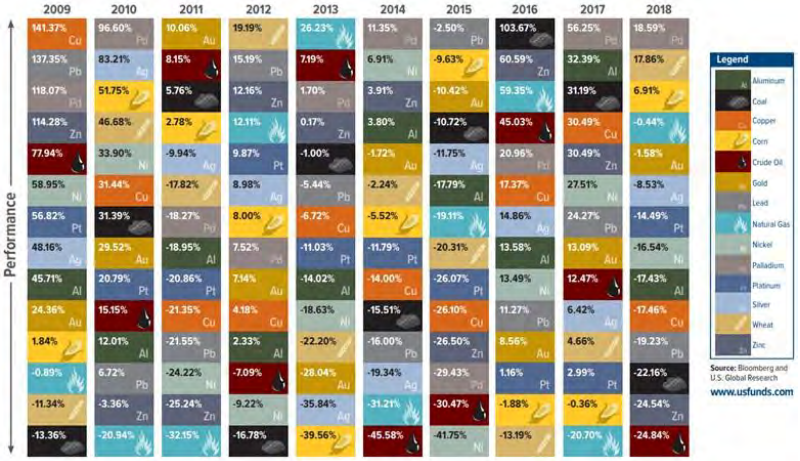
Better energy stock performance early in 2019 has accompanied an improvement in global oil prices. Moreover, there is a significantly improved crude oil price outlook given a better global oil supply/demand balance, albeit managed by production cuts by various large oil exporters. The apparent break in the oil/energy stock relationship cannot be dismissed as an over-reaction to the temporary fear of a developing global oil glut, which would restrain oilfield spending and activity in 2019, and therefore company earnings.

What has been happening over the past few years, at least since 2013, is a reflection of more fundamental problems confronting energy firms

Now that oil prices have rebounded by about 20% from their December 2018 low, executives and investors are feeling better. In fact, for the month of January 2019, the ARCA Oil & Gas index gained 10.0% compared to the S&P 500 index increasing only 8.8%. After the last half of 2018, any increase in energy stocks is welcomed, but one cannot dismiss the possibility that what has been happening over the past few years, at least since 2013, is a reflection of more fundamental problems confronting energy firms.

We now have the performance record for the primary commodities traded by investors for the past few years. In 2018, crude oil was the worst performing commodity, falling 24.84%, barely beating out zinc for last place. Natural gas performed better, falling only 0.44%, and finishing in fourth place among the 14 commodities tallied.

Exhibit 7. How Commodities Have Done Since 2009



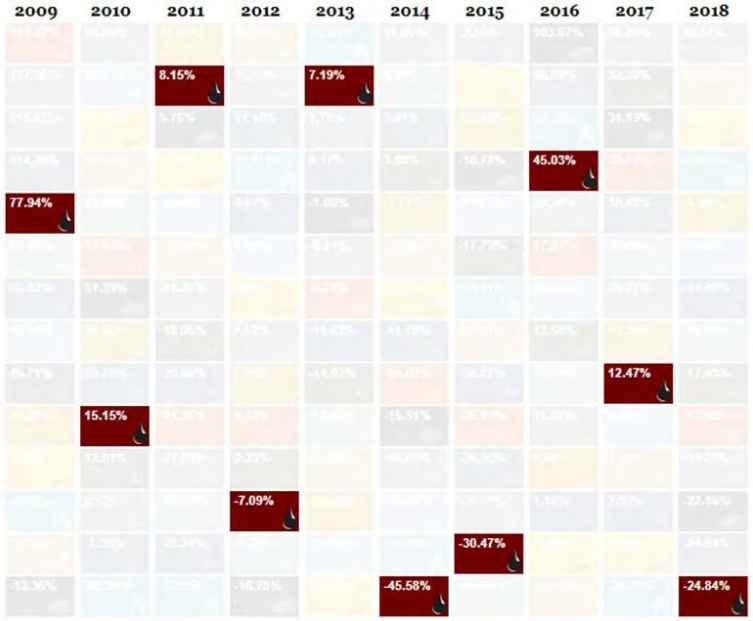
Source: USFunds

The best performing commodity during 2009-2018 was palladium, a major ingredient in catalytic converters for automobiles and other engine-equipped machines

The best performing commodity during 2009-2018 was palladium, a major ingredient in catalytic converters for automobiles and other engine-equipped machines. It is also used in cell phones and other consumer electronics applications. Both of these markets have shown significant growth globally since the 2008-2009 recession, which has helped pricing and the earnings of the mineral producers.

The annual performance of the various commodities is shown in Exhibit 7. It is important to remember that a commodity or investment sector can rank poorly in a particular year, but still produce a meaningful positive return, although it was not as high as others. USFunds, who published the commodity performance chart, also published two charts that singled out the top ranking of palladium and the poor ranking for energy. These charts support our comment about years generating positive returns, but the commodity significantly lagged other top performing commodities.

Exhibit 8. The Poor Investment Returns Of Oil

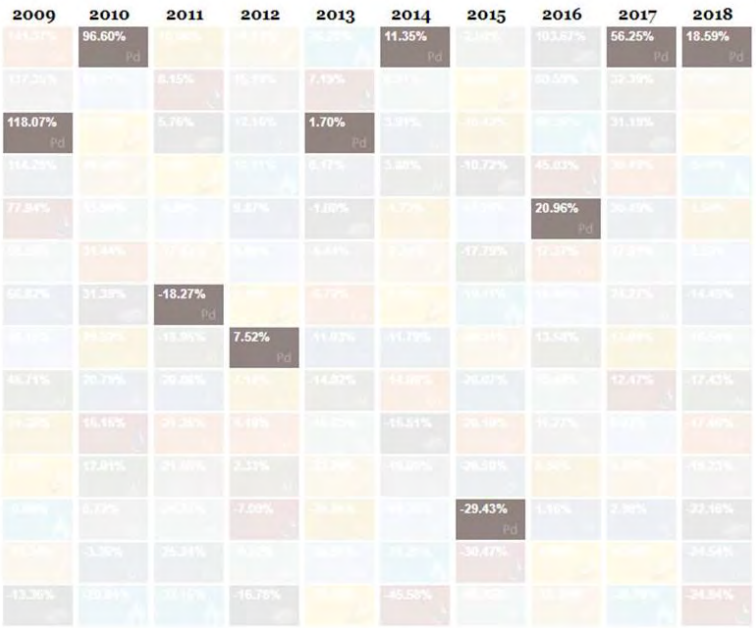


Source: USFunds

Oil was hurt by four years with negative returns

Oil was hurt by four years with negative returns, including three with returns between -24% and -45%. Those loss years offset the few years of outstanding performance: +77.94% in 2009 and +45.03% in 2016.

Exhibit 9. How Palladium Scored Top Performance



Source: USFunds

Palladium's record performance over the decades was helped by its 2009-2010 performance of +118.07% and +96.60%, respectively, along with a +56% return in 2017. The real key, however, was palladium posting only two years with negative returns during the ten-year span, even though those losses were in double digits.

Given the concerted efforts of leading oil exporting countries to prevent a repeat of the fourth quarter of 2018, the strong likelihood is that crude oil prices will track higher during 2019

Oil has a good chance of turning in an outstanding year in 2019 by virtue of where it started. Although off to a good start, the assumption of a strong overall year rests on market fundamentals continuing to unfold as forecasters anticipate. Events over the next 11 months will determine how oil ranks for 2019. Given the concerted efforts of leading oil exporting countries to prevent a repeat of the fourth quarter of 2018, the strong likelihood is that crude oil prices will track higher during 2019. Should global economic activity deteriorate this year, the leading oil exporters will be under increased pressure to hold the line on their production cuts, something some of them may not want to do. It is not a given that oil prices will top the commodity rankings this year, but the momentum is behind it.

The Upcoming Oil Market Disruptor: IMO 2020

For those shippers, refiners and bunker fuel suppliers who had been waiting for clarity about the adoption of the more stringent fuel standard before investing in ways to address the shift, the race began

While the oil market may be disrupted by the ongoing collapse in Venezuelan oil production, and now dealing with U.S. sanctions that cut off its primary oil customer, the start of the International Maritime Organization's rule on low-sulfur fuel oil for the global shipping industry in 2020 may create further challenges for the global oil refining business. In 2018, the debate was over whether the United Nations body would actually adhere to its plan to force the international shipping industry to switch from burning fuel with 3.5% sulfur content to one with only 0.5%. By early fall last year, the rule's reality became clear - the low-sulfur fuel oil standard would become effective January 1, 2020. For those shippers, refiners and bunker fuel suppliers who had been waiting for clarity about the adoption of the more stringent fuel standard before investing in ways to address the shift, the race began.

Lastly, if there are inadequate supplies of low-sulfur fuel oil available in a geographic region, ships can request a waiver from having to comply with the new standard

There are multiple ways for the shipping industry to comply with the new standard. First, it can switch to compliant low-sulfur fuel oil, or a blended fuel that meets the lower sulfur content standard. Ships could also install exhaust gas scrubbers that remove the sulfur, convert to liquified natural gas, or employ some other clean fuel. Lastly, if there are inadequate supplies of low-sulfur fuel oil available in a geographic region, ships can request a waiver from having to comply with the new standard. There may be some ships electing to operate without complying or seeking a waiver, we do not expect this to be a large number, and certainly not ships from large, responsible fleet operators as the reputational risk is too great, let alone the financial cost from government fines and lost business.

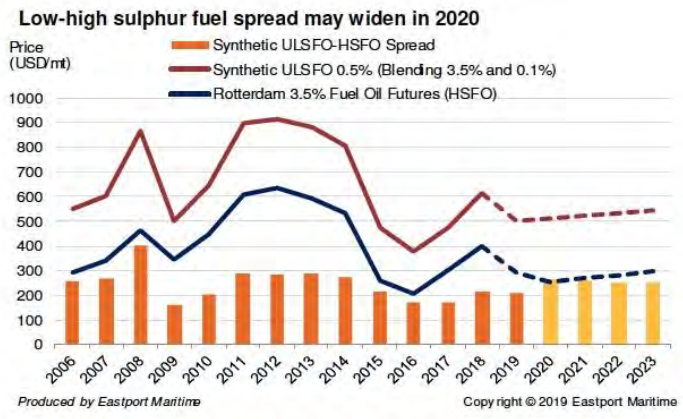
These analyses suggested that global crude oil prices could soar to as high as $250 per barrel due to the anticipated market dislocation

Last year, some forecasters using the simplistic assumption that all the 3.5-4.0 million barrels a day (mmb/d) of high-sulfur fuel oil used by ships would be switched to low-sulfur fuel oil immediately on Jan. 1, 2020. These analyses concluded there would be substantial market dislocations as low-sulfur crude oil prices would rise sharply in response to refiners clamoring to purchase more of this oil to help meet the lower sulfur fuel oil requirement. These analyses suggested that global crude oil prices could soar to as high as $250 per barrel due to the anticipated market dislocation.

The spread is between $40 and $100 per metric ton (MT), considerably less than the expected doubling in fuel prices that imply hikes of $200-$300/MT

Although the market impact is still 11 months away, the one surprise so far has been that the spread between high and low sulfur fuel oil prices is much narrower than anticipated. Based on the early price indications, the spread is between $40 and $100 per metric ton (MT), considerably less than the expected doubling in fuel prices that imply hikes of $200-$300/MT. The question is what happens when there is a significant demand for the compliant fuel, will prices spike then? As Eastport Maritime suggests in its analysis, the low-to-high-sulfur fuel oil spread may widen in 2020 and possibly 2021, the market doesn't appear to be poised for an explosion in prices. The firm also sees the price spread shrinking after 2021 as the market adjusts to the new standard and refineries and fleets are modified.

Exhibit 10. Low-Sulfur Fuel Oil Prices Likely To Rise



Source: ***Splash 247***

Refiners operating in other parts of the world are also investing in upgraded facilities to produce more compliant fuel

We know the American refining industry is prepared to supply more low-sulfur fuel oil to international markets, as an even more stringent fuel (0.1% vs. 0.5% sulfur) is required for ships operating in U.S. waters. Refiners operating in other parts of the world are also investing in upgraded facilities to produce more compliant fuel. ExxonMobil (XOM-NYSE) is completing upgrades to its refineries in Europe and Asia to be able to supply more low-sulfur oil. The decision by ExxonMobil to expand its Gulf Coast refinery to use more of the Permian Basin light oil output, as well as Chevron's move to purchase the Petrobras refinery for the same reason signal

more light-oil product volumes in the future. China's Sinopec announced that its Shanghai refinery has produced its first batch of low-sulfur bunker fuel. Sinopec is Asia's biggest oil refiner. It indicated that the Shanghai refinery was the first in China to produce the new compliant fuel. A ship broker in Southeast Asia said in a report that fuel oil storage capacity in the region is tightening as refiners are securing tanks to handle increased fuel oil volumes.

These refineries lack the ability to produce low-sulfur fuel oil in volume, without upgrades, which will take time and require substantial investment

The greatest challenge for the shipping industry will be the unsophisticated refineries predominantly located in Russia and Africa. These refineries lack the ability to produce low-sulfur fuel oil in volume, without upgrades, which will take time and require substantial investment, in some cases beyond the capability of their owners. As a result, we may see ships operating primarily in those geographic regions filing for waivers due to a lack of fuel.

The market for exhaust scrubbers has exploded, and it is estimated about 2,000 ships will be retrofitted with them by 2020, but this is below the IMO's projection for 3,800 installations. That failure to meet the IMO forecast may make the organization less aggressive in enforcing the rule change in its initial phase. Many of the ships being retrofitted are being matched with term charters where much of the estimated scrubber cost can be recouped. Scrubbers are being installed in newly constructed ships, too, which is a bet that high-sulfur fuel oil will continue to be available in ports, and at a reduced cost, as a result of a decline in demand.

Over a third of the global orderbook by tonnage has a scrubber ordered

According to the latest data from *Clarkson Research*, over a third of the global orderbook by tonnage has a scrubber ordered. Certain specific classes of ships have higher percentages, such as for capsize tankers where the orderbook is around 50%, while for VLCCs [very large crude oil carriers] it is over 70%, and for VLGCs [very large gas carriers] at around 75%. It is estimated that around 14% of the global orderbook tonnage is now LNG fuel capable, with the majority of these being LNG carriers.

The new ships entering the fleet will replace older, less efficient ones, meaning total fuel oil demand may not grow as fast as in the past

There is no doubt that the marine transportation industry is about to undergo a significant transformation. Not only will the preferred fuel be shifting, but there will likely be many vessel scrapings that will change the age make-up and operational capability of the global marine fleet as a way to comply with the new fuel standard. The new ships entering the fleet will replace older, less efficient ones, meaning total fuel oil demand may not grow as fast as in the past. If there is a global recession in 2020, as the economic forecasters are now suggesting, global trade will slow. That will come as marine transportation costs rise to help sustain industry profitability given greater transportation costs. The shipping industry will work to reduce costs, and slow-steaming is an option because it uses less fuel. We are certainly prepared for market dislocations as a result of the start of IMO 2020, but we fail to see the wholesale chaos predicted by others.

Renewables Challenged By Battery Storage Economics

For renewable fuels to become ubiquitous, battery storage needs to become both cheaper and longer-lasting

If you have been paying attention to the revolution in power generation markets by the increased use of renewable fuels, their bright future is keyed to the expectation that power from their facilities will continue to fall as they have in recent years. For renewable fuels to become ubiquitous, battery storage needs to become both cheaper and longer-lasting. According to NextEra Energy, Inc. (NEE-NYSE) that day is rapidly approaching.

On the company's January earnings call with investors and analysts, NextEra Chairman Jim Robo said, "In 2018, more than 40% of the solar projects that were added to our backlog included a battery storage component, highlighting the beginning of the next phase of renewables development (that) pairs low-cost wind and solar energy with a low-cost battery storage solution." He went on to state, "With continued technology improvements and cost declines, we expect that without incentives, wind is going to be a $0.02 to $0.025 per kilowatt per hour product, and solar is going to be $0.025 to $0.03 per kilowatt hour product early in the next decade. Combining these extremely low costs with one-half to three-quarter cent added for a four-hour storage system, will create a nearly renewable generation resource that is cheaper than the operating cost of coal, nuclear and less fuel-efficient oil and gas-fired generation units. We continue to believe that this will be massively disruptive to the nation's generation fleet and create significant opportunities for renewables growth well into the next decade."

So how come Elon Musk of Tesla, Inc. has raised the price of the Powerwall 2.0 home battery?

Ah, just over the horizon, things are going to be beautiful. But wait, isn't this tied to low-cost battery storage that will continue to fall? So how come Elon Musk of Tesla, Inc. (TSLA-Nasdaq) has raised the price of the Powerwall 2.0 home battery? Up until April 2018, the battery cost (without installation) was $5,500. Today, the same unit costs $6,700, a nearly 22% increase. That is not the full cost for a home battery installation, as additional equipment and wiring (inverter) adds about $1,100. Actual battery installation costs range between $2,000 to $8,000. *EnergySage* users report installation costs running between $5,000 and $8,000, before any financial incentives. Total costs for a home battery installation therefore run between $9,800 and $15,800.

Most home batteries only provide about four hours of power, which is considerably less than a full night

The biggest problem with home battery storage is its limited capacity. Most home batteries only provide about four hours of power, which is considerably less than a full night. Admittedly, a home at night does not need the same power as during the day. Home batteries also need to be recharged, which is assumed to happen the next day with solar and/or wind providing the power. That ignores the possibility of multiple days of no sun and/or low wind power. That means less power will be available overnight.

Based on the Powerwall sale price to Australia, A$150 million or $110 million, the backup investment would cost $550 million

Several energy experts have cranked up their calculators to determine what battery storage might cost in response to various renewables-powered proposals. In the UK, there is a proposal to locate a fleet of wind turbines along a new rail line to power the trains. Paul Homewood, using data from the Tesla Powerwall unit sold to Australia last year, calculated the cost to back up one 5-megawatt (MW) wind turbine, such as those proposed in the rail power scheme. At a 28% utilization factor, the turbine produces 1,022 megawatt-hours (MWh) of power per month. If wind energy decreased such that the turbine's utilization was only 10%, it would only produce 365 MWh/month of power, leaving a 657 MWh shortfall. The 100-MW Powerwall produces 129 MWh, so to offset the wind turbine shortfall there needs to be five units installed. Based on the Powerwall sale price to Australia, A$150 million or $110 million, the backup investment would cost $550 million.

Since each Powerpack is the size of a small refrigerator, the land mass necessary to support 3,000 small refrigerators would be significant

The Australian Powerwall is made up of 600 Powerpacks with capacity of 210 kilowatt-hours each. This means the UK wind turbine would need 3,000 Powerpacks. Since each Powerpack is the size of a small refrigerator, the land mass necessary to support 3,000 small refrigerators would be significant, along with the visual impact of the facility. Importantly, in the UK example, this installation would need to be replicated hundreds of times along the rail route at a cost of billions of pounds.

Tesla's Powerwall only provides power for about 80 minutes

Tesla's Powerwall sale to Australia received incredible publicity at the time, but the company's battery price hike may suggest that massive battery storage plants are just not that cheap. The extreme heat recently experienced in South Australia created a significant power blackout as transformers cratered, ultimately tripping a substation, throwing 25,000 properties into the dark. While utility crews worked through the night to restore power to avoid a forced power-shedding in the morning, the utility was forced to rely on its back-up diesel generators during the night for the first time ever. Tesla's Powerwall only provides power for about 80 minutes. This episode may highlight that the nirvana of renewables with battery backup is further in the future than touted by its proponents. It also raises questions about NextEra's power storage cost estimates.

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

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