

MUSINGS FROM THE OIL PATCH

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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

Note: This issue of the Musings is arriving early to accommodate my travel schedule to locations where I will have limited access to communications. The next issue will not be published until mid-July.

Northeast Electricity Market Struggles To Find Future Fuel Mix

Slowing the growth, or at least capping the rise, of power prices will be an important step forward to boosting the region's economic growth

The Northeast region of the United States, while consisting of only six small states (Maine, New Hampshire, Vermont, Massachusetts, Connecticut and Rhode Island), has always been an important driver of social, economic and political movements. The region, however, has struggled in recent years with weak economic growth and population outflows, partly caused by high energy costs. Addressing those issues has become an important issue for politicians and regulators. Slowing the growth, or at least capping the rise, of power prices will be an important step forward to boosting the region's economic growth. This issue has been behind the battles over expanding existing or adding new natural gas pipeline capacity to the region to enable more low-cost gas into the region's energy fuel mix. It is also behind the battle over the proposed construction of a new natural gas-fueled power plant proposed to be located in Burrillville, Rhode Island.

While the power supply data was region-wide, it has been seized upon by opponents of the Rhode Island power plant

The opposition to the construction of the Burrillville power plant has grown and is now being supported by data showing that maybe the region does not need this additional power supply even after considering planned retirements of existing power plants and possibly even additional generating capacity. While the power supply data was region-wide, it has been seized upon by opponents of the Rhode Island power plant. At the same time, the normal political jockeying at the end of the Rhode Island legislative session exposed the bankrupt ethics policies of the state's legislators that, unfortunately, has been a hallmark of this body. We are referring to the attempt to slip a change into the budget on how clean energy

The provision inserted into the “renewable energy” portion of the budget bill would have been used to sidestep a recent decision by the state Public Utilities Commission that set out how interconnection costs are divided between developers and National Grid

sources might receive incentives that would raise the cost of power for all ratepayers in the state. This episode was reminiscent of the maneuvers the legislature engaged in to force the approval of the Deepwater Wind offshore wind farm after it was judged uneconomic by the state’s Public Utilities Commission based on that body fulfilling its mandate for evaluating new power plants.

An investigation by reporters with *The Providence Journal* showed that a provision inserted into the budget bill that was winding its way through the Rhode Island House would have reversed a decision made by state power regulators and would have increased the cost of electricity for ratepayers. The provision inserted into the “renewable energy” portion of the budget bill would have been used to sidestep a recent decision by the state Public Utilities Commission that set out how interconnection costs are divided between developers and National Grid (NNG-NYSE), the state’s primary electric utility, which owns and maintains the power system in Rhode Island. That decision followed a years-long dispute between Wind Energy Development and National Grid over the costs to upgrade the wires and poles along with making other improvements to accommodate a 10-turbine wind farm being developed in Coventry, Rhode Island. The estimated price tag for these upgrades is \$12 million with the cost being split 50/50 between Wind Energy Development and National Grid. A significant aspect of the proposed language was that it would have been retroactive to January 1, 2015, ensuring that it would sidestep the Public Utilities Commission decision.

The developer of the wind farm, Mark DePasquale, has called the decision “unfair to developers,” and has worked to get it changed. Mr. DePasquale, his wife and his employees have donated over \$64,000 to the political campaigns of the state’s governor, House speaker and House majority leader. These political donations raise questions about whether the insertion of the language to overturn this decision was done in response to a request from Mr. DePasquale.

“They got a decision they didn’t like....They come running to the legislature....We’re not experts in tariffs or electric generation.”

In *The Provident Journal* article exposing this budget bill language maneuver, a representative was quoted who planned to introduce an amendment to “shift the burden back to the developer” and take out the retroactive language. Rep Michael Marcello, (D-Situate) stated, “They got a decision they didn’t like....They come running to the legislature....We’re not experts in tariffs or electric generation.” He went on to say, “It’s just bad policy. And it really has nothing to do with the state budget, which should raise some concerns.” The proposal originally was in a separate bill that had been introduced in 2015 and again earlier this year, passing the House on both occasions but failing to get past the Senate.

If this legislation was approved, it would, according to National Grid, make Rhode Island the only state in the nation where developers

It established a hard-and-fast timeline requiring all the interconnection work to be completed within 360 days of an initial application

would be subsidized by ratepayers for construction of the link between their for-profit electricity generation project and the electric transmission and distribution system.

National Grid also pointed to another provision of the legislation that created an issue. It established a hard-and-fast timeline requiring all the interconnection work to be completed within 360 days of an initial application. No exceptions are allowed, even if the work is delayed because the developer does not provide required information. National Grid would be subject to financial penalties.

In the end, this proposed language was deleted from the final budget bill passed by the Rhode Island legislature. But it does point out the power of political donations and the willingness of politicians in Rhode Island to consider the benefits for donators over the cost to the public. At this point we don't believe political donations are in play with the Burrillville power plant, but there are questions about how future power needs for New England will be determined.

In 2013, New England had 34,422.3 megawatts of electric generating capacity, so the lost capacity equates to 12.2% of the region's total.

The Independent System Operator New England (ISO-NE), the nonprofit that manages the regional electric grid, has assessed the fleet of power plants in the six New England states and found that a third of the grid's generating capacity will have closed or be at risk of closing by 2020. Four major power plants closed in 2013 and 2014 – Salem Harbor Station and Mount Tom Power Station, both coal-fired plants in Massachusetts, and the oil-burning Norwalk Harbor Station in Connecticut and the Vermont Yankee Nuclear Power Plant. Additionally, two more big power plants in Massachusetts are set to close soon – Brayton Point Power Station, the region's largest coal-burning plant, will shut in 2017, and the Pilgrim Nuclear Power Point Station will close in 2019. All totaled, these six power plants account for 4,200 megawatts of generating capacity. In 2013, New England had 34,422.3 megawatts of electric generating capacity, so the lost capacity equates to 12.2% of the region's total.

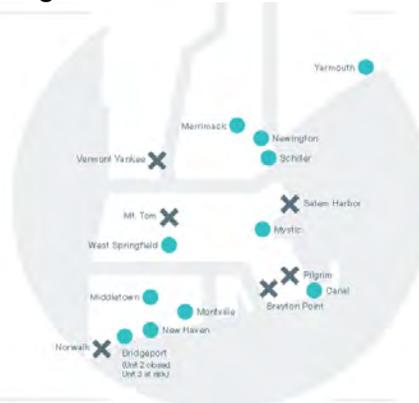
The generating capacity of this group of plants is another 6,000 megawatts, or 17.8% of the region's March 2016 capacity of 33,660.7 megawatts, which includes the two plants scheduled to be retired in 2017 and 2019

More importantly, ISO-NE also characterized a number of other plants that they consider to be "at risk of retirement" because they burn coal or oil. That list includes three of the 10 largest power plants in New Hampshire, four of the 10 largest plants in Connecticut, two of the 10 largest plants in Massachusetts and the largest power plant in Maine. Many of these plants have generating units built in the 1960s and three date from the 1950s. The generating capacity of this group of plants is another 6,000 megawatts, or 17.8% of the region's March 2016 capacity of 33,660.7 megawatts, which includes the two plants scheduled to be retired in 2017 and 2019. So while the percentage of current generating capacity in New England at risk of retirement due to age and efficiency is lower than the percentage number we calculated, the point is that there is a large component of the region's power supply at risk of closure. Some at-risk-of-retirement-capacity would be offset by building the 900-megawatt power plant in Burrillville.

Exhibit 1. New England Power Plants At Risk Of Closure

On the way out

More than 4,300 MW of the region's non-gas generating capacity has retired or plans to retire soon. This includes nuclear and coal-fired units, as well as hydroelectric plants that were part of the region's baseload generation. "At risk" for closing are another 6,000 MW from additional coal and oil-fired generators, which are displaced from the electric energy market on most days by gas-fired units. But they are still critical for meeting the region's demand in winter, particularly when natural gas supplies are limited. In total, about 30% of the region's generating capacity could be gone by 2020. These retiring resources are likely to be replaced by more natural-gas-fired resources.



Source: ISO-NE

The opponents of the new power plant point out that the recent auction to secure future power supply for the region showed that ISO-NE was able to lock in a surplus of generating capacity as well

Exhibit 2. Projected NE Power Consumption

Annual Energy Use With and Without EE and PV Savings



Summer Peak Demand With and Without EE and PV Savings



● The gross load forecast (projected regional energy use) ● The gross load forecast minus forecasted "behind the meter" (BTM) solar photovoltaic (PV) resources ● The gross load forecast minus forecasted BTM PV, minus energy-efficiency (EE) resources in the Forward Capacity Market (FCM) 2016-2019 and forecasted EE 2020-2025

Source: ISO-NE

Invenergy only sold 485 megawatts of generating capacity in the auction, or the output of only one of the two turbines of the Burrillville plant

at a lower price than in recent years. The auction was for power supply for the next three years. Invenergy only sold 485 megawatts of generating capacity in the auction, or the output of only one of the two turbines of the Burrillville plant, which would begin operating in 2019. The opposition is being led by the Conversation Law Foundation, an environmental group that opposes the continued use of fossil fuels for power generation. The group says that with new sources of renewable power coming on line, especially wind power within the region and hydropower from Canada, along with steps to improve energy efficiency that has tempered electricity demand growth, the region does not need the new gas-fueled power plant.

TEC-RI supports a more gradual move towards renewables due to the instability they cause to the power grid in New England

At the end of the day, the key to whether there will be a shortage of power generating capacity as Douglas Gablinske, director of The Energy Council of Rhode Island (TEC-RI), a group that represents some of the largest power users in the state, predicts will occur, will be the mix of types of power the region will use. TEC-RI supports a more gradual move towards renewables due to the instability they cause to the power grid in New England. ISO-NE has provided a set of charts (Exhibit 2, page 4) showing total power demand and then demand after considering the amount of solar (PV) that is anticipated to be installed within the region along with the impact on demand from energy efficiency. What is not factored in is the closure of power plants in the future, especially those considered "at risk of retirement." All of this information will be considered in the Public Utilities Commission advisory opinion for the Energy Facility Siting Board in Rhode Island about the Burrillville natural gas power plant. Sometime in the next few weeks we will get our answer on how the regulators think the future will unfold for energy supply in New England.

Will Oil Market Be All About Supply Or Can Demand Help?

"At a rate of 2.0 percent, incomes double every 35 years. At a rate of 0.44 percent, it takes about 160 years to double."

As oil prices fluctuate in the \$46-\$52 range, analysts are trying to figure out what will drive prices higher, or whether the push to this level has been due to unanticipated supply outages that at some point may return to the market and thus sap any further strength. Global economic growth remains slower than anyone expected a few years ago, but lacks an easy explanation of why it is so slow. A recent analysis by N. Gregory Mankiw, a Harvard economist and columnist for *The New York Times* explained the issue and offered five possible explanations. As Dr. Mankiw explained, over the past decade the growth of U.S. Gross Domestic Production (GDP) was only 0.44% compared with the historical norm of 2.0 percent. As he pointed out, "At a rate of 2.0 percent, incomes double every 35 years. At a rate of 0.44 percent, it takes about 160 years to double."

While the 2008-2009 recession was deep, it was much like the 1982 recession, which was followed by a robust recovery. This time the recovery has been anemic. Why has that been the case? The first

The problem isn't the economy, it's the statistics!

explanation is that it is a "statistical mirage." Some analysts believe that the quality improvements and new products from Silicon Valley are so pervasive and so different that the national accountants who measure GDP might underestimate how much life is getting better. Therefore, the problem isn't the economy, it's the statistics!

The solution is more government spending

The second explanation offered is that the weak recovery is merely a hangover from the recession since it was the worst financial crisis since the Great Depression of 1930. Hangovers do dissipate, it merely takes time. Another popular explanation has been offered by Lawrence Summers, former economic advisor to President Barack Obama, who argued that the issue predates the recession and relates to reduced demand for capital to fund investment projects. The problem is due to "secular stagnation – a persistent inability of the economy to generate sufficient demand to maintain full employment." The solution is more government spending.

A new academic study concluded that "fiscal stimulus based on tax cuts are more likely to increase growth than those based on spending increases"

Professor Robert Gordon at the University of Chicago attributes the slow recovery to a lack of innovative activity. He believes that many of the current innovations such as smartphones and social media are not as life-changing as electricity and the internal combustion engine and therefore don't drive as much of an economic impact. The final prescription is that it was a series of policy mistakes - fiscal stimulus (shovel-ready government projects) followed by a tax hike to address the government's debt from the prior spending – has led to the slow recovery. A new academic study concluded that "fiscal stimulus based on tax cuts are more likely to increase growth than those based on spending increases," confirming that explanation.

China has fallen off its miracle growth path due to a dangerously rapid increase in debt and a collapse in trade growth damaging China's export industry

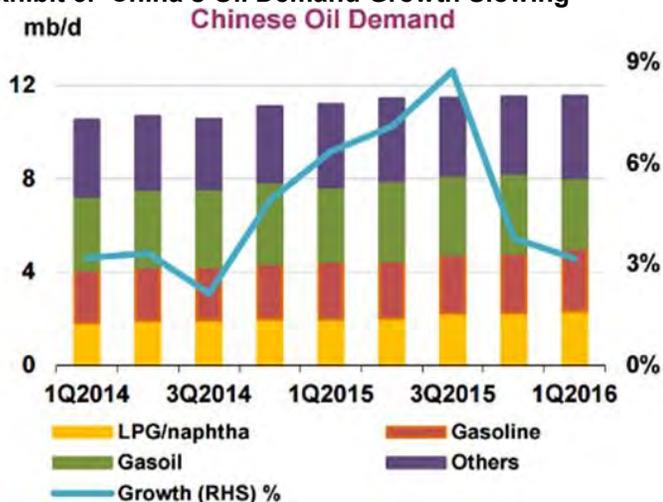
Several of the issues not suggested as a problem for the weak U.S. recovery is an aging population and/or a rapid growth in national debt. Both of these issues are plaguing China's economy and choking off its more robust GDP growth and commensurate oil demand of the past. A study authored by Ruchir Sharma, the chief global strategist at Morgan Stanley (MS-NYSE) Investment Management, suggests that China has fallen off its miracle growth path due to a dangerously rapid increase in debt and a collapse in trade growth damaging China's export industry. China, like many other countries, is relying on autocratic rule, which may also be helping to destroy the country's economy. Possibly the greatest challenge for China is the growth of its working-age population, which turned negative last year.

Since the start of this century to 2050, the median age in China will go from under 30 years old to about 46, making China one of the older societies in the world

Today, China has five workers for every retiree. By 2040, this ratio will fall to about 1.6 to 1. Since the start of this century to 2050, the median age in China will go from under 30 years old to about 46, making China one of the older societies in the world. At the same time, the number of Chinese older than 65 years of age will rise from roughly 100 million in 2005 to more than 329 million in 2050. That aged population will be more than the combined populations of Germany, Japan, France and Britain. The implications for China's

finances are profound. Demographics are already helping to slow China's growth.

Exhibit 3. China's Oil Demand Growth Slowing



Source: *oilprice.com*

For the first four months of 2016, demand has fallen by 0.3% versus an 8.5% increase for the same period in 2016

What does that mean for China's appetite for crude oil? Chinese apparent oil demand according to Platts was 11.36 million barrels per day, a decline of 1.3%. This marked the third consecutive monthly decline. For the first four months of 2016, demand has fallen by 0.3% versus an 8.5% increase for the same period in 2015. Platts is forecasting that the country's oil demand will grow by less than 2% for 2016.

The country is working to build its strategic petroleum storage reserves to 550 million barrels

One aspect of China's oil demand has been to fill its four new storage sites of its petroleum reserve while oil prices remain cheaper than experienced in 2012-2014. The country is working to build its strategic petroleum storage reserves to 550 million barrels to ensure a 90-day supply to offset any supply shock.

Exhibit 4. China's Strategic Storage Centers

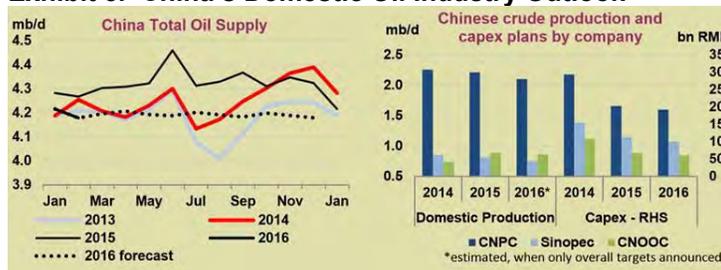


Source: *oilprice.com*

If the company does experience a decline in output as projected, it will be the first time since 1999

The International Energy Agency (IEA) focused on Petro China, a subsidiary of CNPC, China's largest producer. It experienced a 0.2% production decline in April. The IEA sees the company's production possibly falling by 4.1%, or as much as 200,000 barrels per day as it shuts down aging and high-cost fields. If the company does experience a decline in output as projected, it will be the first time since 1999.

Exhibit 5. China's Domestic Oil Industry Outlook



Source: oilprice.com

As teapot refiners are able to produce gasoline and diesel at around \$10 a barrel cheaper on average than the country's large refiners, according to BMI Research, it puts them in a highly competitive position

What else is happening in China is that its gasoline consumption increased by only 5% in March versus 10% growth experienced in 2015. China's diesel demand was also weaker, a sign of soft economic activity. With these results, China's government has shifted into a stimulus mode investing in new plants and boosting basic industry output, which is a stimulus for energy consumption. Additionally, the growth of small refiners – referred to as teapots – has boosted China's crude oil imports. Until the government modified its import policies last summer to allow the teapots to enter into oil import contracts directly rather than having to deal with the large Chinese oil companies their imports were lower. They have now ramped up. According to Energy Aspects, in May, China's teapot refineries imported 1.2 million barrels of oil a day. That is estimated to account for 15% of the country's total crude oil imports for the month. As teapot refiners are able to produce gasoline and diesel at around \$10 a barrel cheaper on average than the country's large refiners, according to BMI Research, it puts them in a highly competitive position. One aspect of these teapot refiners is that a substantial volume of gasoline and diesel output is being exported to Asian markets, reshaping this regional market.

Fossil fuels will represent 53% of this growth, while renewable fuels will account for the balance

If the Chinese government continues to stimulate its economy with cheap money, car sales should benefit along with basic industry energy demand. According to the recent BP (BP-NYSE) energy outlook, it sees China's energy consumption growing by 48% to 2035, at which point the country will represent 25% of global energy consumption. Fossil fuels will represent 53% of this growth, while renewable fuels will account for the balance. BP sees the country's energy production growing over this time period by 40%, with China ultimately supplying 20% of the world's total energy production. BP sees China becoming the second largest shale gas producer after

BP believes that China's economy will expand by 174% between 2014 and 2035

the United States. It also sees fossil fuel production rising as a result of the growth in gas and coal, offsetting declines in oil. BP believes that China's economy will expand by 174% between 2014 and 2035. The world's oil and gas industry cannot wait for that growth to kick in as it would go a long way to solving the current oversupply situation, but more importantly underpinning healthy demand growth for many years into the future. We will keep our fingers crossed for this scenario to unfold, because it is much better than that outlined in the Morgan Stanley outlook.

Understanding \$100 A Barrel Oil And The Shale Revolution

Last year was a disaster for ExxonMobil as Standard & Poor's cut its AAA credit rating to AA after 67 years

In the most recent issue of *Fortune* magazine, the editors presented its annual ranking of 500 companies. Exxon Mobil Corp. (XOM-NYSE) was the second largest company when measured by 2015 revenues of \$246 billion, trailing Walmart (WM-NYSE) by almost an equal amount. Last year was a disaster for ExxonMobil as Standard & Poor's cut its AAA credit rating to AA after 67 years as a result of the company paying out 40% more of its cash flow and income from asset sales in the form of dividends and capital spending.

As oil prices settled at \$48.95 on June 21st, up 86.8% from the earlier low, the NYSE ARCA Oil and Gas Index has climbed by 24.3% while the Philadelphia Oilfield Service Index is up 31.9% over the same period

The rebound in oil prices since February 11 when West Texas Intermediate (WTI) fell to \$26.21 a barrel has excited many investors who see the price recovery leading to outsized profit gains for energy companies and, of course, higher stock prices. As oil prices settled at \$48.95 on June 21st, up 86.8% from the earlier low, the NYSE ARCA Oil and Gas Index has climbed by 24.3% while the Philadelphia Oilfield Service Index is up 31.9% over the same period. The reality is that commodity traders have benefitted from a shift in the value of the U.S. dollar to weakness from strength following the Federal Reserve Board's increase in short-term interest rates by a quarter of one interest point last December. As we entered January 2016, expectations were that the Fed would be raising short-term interest rates a minimum of four times during this year, which convinced investors that the U.S. dollar would remain strong.

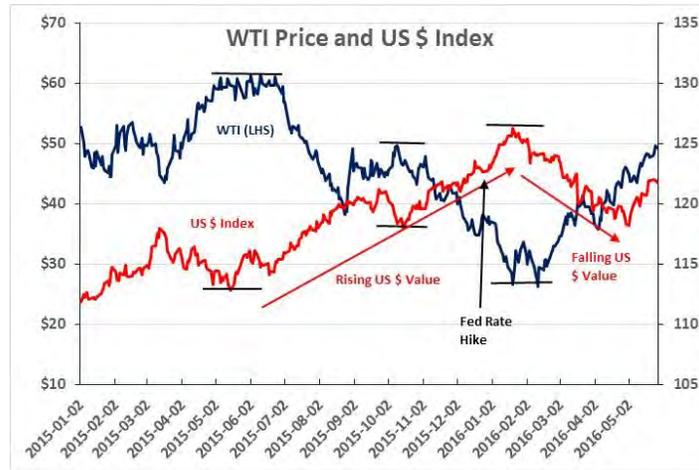
A higher U.S. dollar hurts commodity prices

Higher interest rates cause foreigners to want to invest in the U.S. to capture that higher interest than they could earn in their home countries. To do that they have to sell their own currency and buy dollars, which drives the value of the U.S. dollar higher. A higher U.S. dollar hurts commodity prices as foreigners have to use more of their local currency to purchase goods that are priced in U.S. dollars.

The value of the U.S. dollar started falling and crude oil prices rose

As shown in Exhibit 6, in anticipation of higher U.S. interest rates during 2015, the U.S. dollar value rose and crude oil prices fell. After it became conventional wisdom that the Fed would not be raising short-term interest rates as many times in 2016 as initially anticipated, the value of the U.S. dollar started falling and crude oil prices rose.

Exhibit 6. U.S. Dollar Value vs. WTI Oil Price



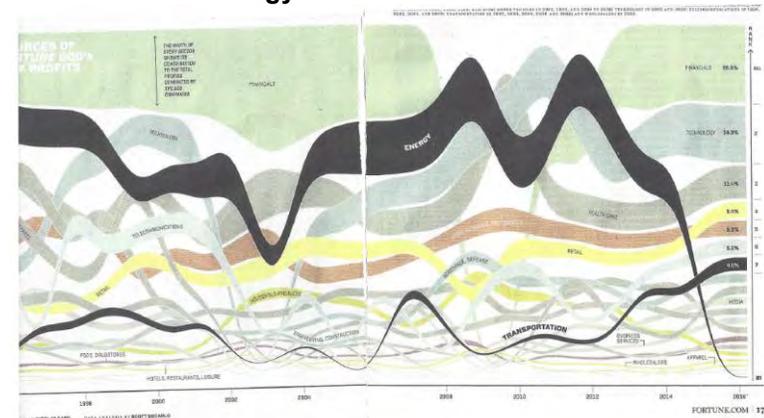
Source: Federal Reserve, EIA, PPHB

One could virtually answer the question of what happened to oil prices each day if you were told what happened to the value of the U.S. dollar that day

This inverse relationship between the value of the U.S. dollar and the price of crude oil has been very clear for most of this century. Will it continue in the future? More than likely it will, partly because, while the relationship is logical, it has become a short-term trading indicator. In the past several weeks, after WTI reached and surpassed the \$50 a barrel threshold, one could virtually answer the question of what happened to oil prices each day if you were told what happened to the value of the U.S. dollar that day.

After watching this ying and yang of oil price movements and the value of the U.S. dollar, we were interested in the two-page chart on the profits of the Fortune 500 companies by sector over the past 20 years. We cut out the pages and scanned the chart (Exhibit 7 below), shrinking it to fit on one page. Unfortunately, we lost the 1995-1996 part of the chart, but the visual impact of the chart remains relevant.

Exhibit 7. How Energy Profits Went From Boom To Bust



Source: Fortune

As Energy profits mushroomed during the era of high oil prices and the shale revolution, it was easy for Wall Street to convince investors to throw money at exploration and production and oilfield service companies who were leading America to the promised land of energy independence

Many investing in Energy today are hopeful that one day in the foreseeable future that thin black line will once again become a thick black line

What struck us while looking at the chart was the huge bulge in energy profits during 2005-2012 before they started contracting and then collapsed after oil prices dropped at the end of 2014. The Energy sector profits during that period were driven by high oil prices - \$80-\$100+ per barrel, even after adjusting for the 2008-2009 financial crisis and recession. As Energy profits mushroomed during the era of high oil prices and the shale revolution, it was easy for Wall Street to convince investors to throw money at exploration and production and oilfield service companies who were leading America to the promised land of energy independence. The Energy stocks were soaring as analysts and investors fell in love with the shale revolution that married horizontal drilling with massive hydraulic fracturing to produce huge volume of natural gas, natural gas liquids and tight oil. Remember that it was during this era that we were assured that we had hundreds of years of cheap natural gas supply. One Wall Street firm even wrote a report explaining how this revolution was turning us into 'Saudi America.'

The chart shows clearly what happens when an ill-founded boom collapses. As you scan the lower right hand corner of the chart, it is very difficult to see the thin black line reflecting current Energy sector profits, or what is left of the thick line that existed throughout most of the 2000s. In fact, if oil prices hadn't climbed back to \$50 recently, it is possible that the thin line would become impossible to see as there wouldn't be any profits. Many investing in Energy today are hopeful that one day in the foreseeable future that thin black line will once again become a thick black line. We are comfortable is saying the line will be thicker, we just don't know how thick it will eventually grow and when that will be.

Driver Surveys Show Support For Self-driving Cars Lacking

It appears that the greatest support for autonomous driving technology lies among managers within the technology and automobile companies

More than two-thirds of the engineer members said they weren't ready for self-driving cars

A recent automotive column in *The New York Times* reviewed the results of a handful of surveys of various groups of drivers in this country about their views of self-driving cars. Amazingly, this technology is not gaining popular acceptance despite the immense publicity about its benefits. It appears that the greatest support for autonomous driving technology lies among managers within the technology and automobile companies. The article quoted Jeffrey Miller, an associate professor of engineering practice at the University of Southern California. He said, "I have no problem letting a car take control. But having a car take my kids to school? You're talking about people who don't have the ability to take over it something goes wrong. I'm not that comfortable with it."

According to a survey of 400 respondents by the Institute of Electrical and Electronics Engineers (IEEE), which grew out of a round table meeting found that more than two-thirds of the engineer members said they weren't ready for self-driving cars. Another study conducted by the Massachusetts Institute of Technology's AgeLab in conjunction with The Hartford Insurance Company's

Roughly two-thirds of the consumers would not feel confident enough in a self-driving car to take their eyes off the road

Self-driving cars are perceived as just another consumer technology product, and one that can be integrated into all the other interconnected technology the companies sell

He also pointed out that these younger drivers had not spent hundreds of hours stuck in traffic or had to endure endless hours of monotonous commutes

Harford Center for Mature Market Excellence of people who ranged in age from 50 to 69, found that they were not averse to technology-assisted driving, but they were hesitant to give up total control. They were less likely to accept automatic parking and cruise assistance systems because they worried about becoming overly reliant on these technologies at the expense of maintaining their driving skills.

In another survey examining the attitude of consumers toward automobile technology two-thirds of consumers were switch brands to get the specific technology they want. The 2016 Autotrader Car Tech Impact Study also found that roughly two-thirds of the consumers would not feel confident enough in a self-driving car to take their eyes off the road. Of course that won't work in a Google (GOOG-Nasdaq) self-driving car since it is designed to not have a steering wheel and pedals, so what good will it be to watch the road since there is nothing a rider could do.

In a survey of generational attitudes toward autonomous vehicle technology, a Nielsen automotive study of over 1,100 participants 8 to 18 years old found there was as much interest in buying a self-driving car from a technology company as from a traditional automaker. It is this trend of greater acceptance of technology by younger people that is behind the push by technology companies into developing autonomous vehicle technology and ultimately into building and selling self-driving cars. Self-driving cars are perceived as just another consumer technology product, and one that can be integrated into all the other interconnected technology the companies sell. Unfortunately, based on the fact that roughly three out of four drivers of high school age would prefer to drive themselves, this is a questionable thesis. Moreover, fully one-third said self-driving cars were unnecessary.

What was interesting in the article was reading the explanations of why the surveys didn't endorse autonomous vehicle technology. Mr. Mike VanNieuwkuyk, vice president, automotive, at the Nielsen Company, suggested that the young drivers who didn't favor self-driving cars were merely reflecting that since they had only recently received their driver's licenses they were reluctant to give up their newly found independence. He also pointed out that these younger drivers had not spent hundreds of hours stuck in traffic or had to endure endless hours of monotonous commutes. But he also said that these youths were the ones who are going to be the beneficiaries of the technology, and they will eventually adopt the technology because they are already technology sophisticated and engaged. This point showed up in other surveys that showed marked differences between those who love to drive and those who find it particularly stressful.

According to the article, "most of the researchers and automotive experts say driver attitudes will shift as more advance safety and

It may be that autonomous vehicle technology will not prove to be as ubiquitous as presently assumed

semiautonomous systems are introduced into new models. Education about how the systems work and their benefits will also help.” In fact, one engineering professor said that when you’re stuck in traffic the light will go on as to the benefits of self-driving vehicles. We are hard pressed to accept that explanation given the miles and miles of traffic jams that people have been in for years. By that logic it should be the older drivers who are more accepting of autonomous technology because they have been subjected to the force that will shift people’s views – traffic jams. It may be that autonomous vehicle technology will not prove to be as ubiquitous as presently assumed.

Changing Power Fuel Mix Will Have Energy Repercussions

In 1957, the country’s first commercial nuclear power plant began operating

The power of the atom brought the end of World War II in Japan. Post the war, efforts were undertaken to develop peaceful commercial uses of nuclear power, and since the United States was the only nuclear power at the time, the development initiative fell under the auspices of the United States Atomic Energy Commission created during the administration of President Dwight Eisenhower. As a result, in 1957, the country’s first commercial nuclear power plant began operating. The Shippingport Atomic Power Station, located on the Ohio River, was owned and operated by Duquesne Light Company and reliably supplied nuclear power to the Pittsburgh, Pennsylvania area for 25 years before being retired in 1982. By the time the Shippingport Atom Power Station was decommissioned in 1989, the United States was operating 109 nuclear reactors at 64 power plants. At that time, those nuclear power plants were generating about 19% of the nation’s electricity, becoming the second-largest power source in the U.S. behind coal.

The initial licensing wave of 1967-1970 was followed by a brief lull in the early 1970s before surging again in the later 1970s

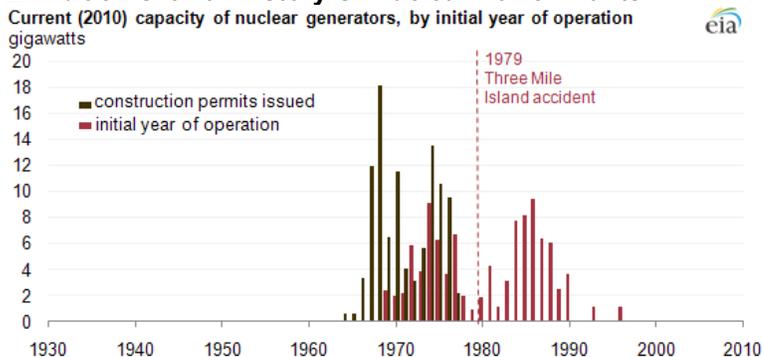
Beginning in the mid-1960s, a wave of nuclear power plant licenses were being issued as this energy source was perceived as the best future for the electric power industry. Nuclear power grew along with energy generated from natural gas. The initial licensing wave of 1967-1970 was followed by a brief lull in the early 1970s before surging again in the later 1970s as America began realizing that its reliance on fossil fuels other than coal might become a problem. That fuel supply issue was further impacted by the initial environmental push to restrict the use of dirty fossil fuels, best exemplified by the creation of the Environmental Protection Agency (EPA) under President Richard Nixon in 1970, which brought together under one Federal agency all the environmental programs within the government. Its importance and power was solidified with the 1970 extension of the amended 1963 Clean Air Act. Many people are surprised to learn that a Republican president was the person behind the creation of the EPA.

The growth of the nuclear power industry slowed in the late 1970s by decreasing growth in electric power demand, higher nuclear plant construction costs, higher investment risk from the licensing

The average power plant construction time increased from seven years for plants with construction licenses issued between 1965 and 1970 to 11 years for those with licenses issued between 1973 and 1977

challenges being mounted by anti-nuclear activists, higher cost of capital as interest rates rose sharply during the 1970s, and design changes resulting from the Three Mile Island accident in 1979. That accident also created further concern among citizens about the inherent safety of nuclear power plants. Due to the lengthening of the construction and permitting processes, considerable amounts of nuclear power capacity, previously licensed and committed to, didn't come online until the 1980s and early 1990s. The average power plant construction time increased from seven years for plants with construction licenses issued between 1965 and 1970 to 11 years for those with licenses issued between 1973 and 1977. Construction costs for nuclear power plants also escalated sharply, which impacted the competitive cost for new nuclear power plants.

Exhibit 8. Growth History Of Nuclear Power Plants



That supply shortage resulted in critical power and energy shortages during winters in the late 1970s and endangered the rapidly growing gas markets in the Northeast, Southeast and Midwest regions of the country

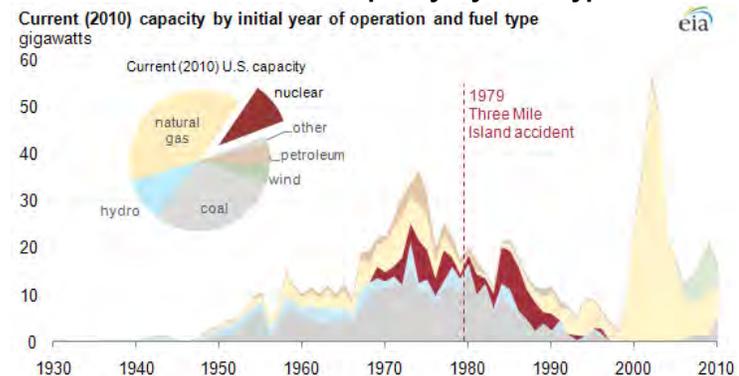
One of the other significant energy industry developments in the 1970s that helped drive nuclear power was the recognition of a peaking in domestic oil output in 1971 and subsequently the realization that natural gas supplies from the federal waters of the Gulf of Mexico were in decline. That supply shortage resulted in critical power and energy shortages during winters in the late 1970s and endangered the rapidly growing gas markets in the Northeast, Southeast and Midwest regions of the country. Those markets had been opened in the 1950s when several companies purchased the pipelines stretching from the oil fields in Texas and Oklahoma to the Northeast. These oil pipelines had been built as part of the war effort and for insurance to make sure that effort succeeded. Those pipelines moved crude oil to refineries in the eastern half of the country and refined oil products to ports on the East Coast, reducing the exposure of ships moving oil cargos from the Gulf Coast to Europe from being sunk by German submarines. The oil pipelines didn't prevent the sinking of oil tankers, but it did reduce the time of their exposure.

Those oil pipelines that were converted in the late 1940s and began hauling natural gas, which was then considered almost a waste product from the nation's growing oil output, to the large consuming markets for distillate and residual oil and coal for home heating and

It is also interesting to note how much coal power plant capacity was being added during the 1970s and 1980s

power plant use. Clean, cheap natural gas was heavily promoted and grew into a meaningful market, which eventually became a critical problem when the gas supply shortages emerged. The impact of the shortage is evident in the chart in Exhibit 9. Both natural gas-fueled and nuclear power plant generating capacity grew rapidly during the first half of the 1970s. However, during the latter half of the 1970s, the amount of natural gas-powered plants declined. It is also interesting to note how much coal power plant capacity was being added during the 1970s and 1980s.

Exhibit 9. Electric Power Capacity By Fuel Type Over Time



Nuclear plants are finding themselves being undercut by cheap gas-fired power plants

The concerns from the 1979 Three Mile Island and the 1989 Chernobyl nuclear power plant accidents drove citizen fears about nuclear power safety and which nuclear power technology and its costs would prove acceptable. In recent weeks, we have seen numerous announcements about the impending closures of nuclear power plants due to economic issues. Originally, nuclear power plants were granted 40-year operating licenses by the federal regulatory agency and were subject to extensions following technical reviews. Many of the operating plants were granted 20-year operating extensions and are continuing to work. Today, however, just as cheap natural gas has undercut the economics of more expensive coal-fired power plants, especially those needing extensive investment in equipment to address environmental issues that will further lift their high power costs, nuclear plants are finding themselves being undercut by cheap gas-fired power plants.

Today, nuclear power supplies about 20% of America's electricity and 60% of our carbon-free electricity

Nuclear energy, however, represents one of the avenues to a cleaner overall power supply for the U.S. as it does not emit any carbon when the power is generated. Today, nuclear power supplies about 20% of America's electricity and 60% of our carbon-free electricity. Besides fighting cheap natural gas, nuclear power is also fighting state mandates, coupled with federal and state tax incentives, promoting wind and solar energy generating capacity.

The economics of electricity generation and delivery are changing and a large component of our base power generation capacity is at

The electricity output from the six plants targeted for closure exceeded the amount of zero-carbon electricity produced by every solar-energy installation in the nation during 2015

risk with potentially terrible cost implications for rate payers. Energy writer Robert Bryce recently wrote in *The LA Times* about the impact of the announcements regarding the closing of six nuclear power plants by 2019 that followed on the heels of the closure of five other plants. The electricity output from the six plants targeted for closure exceeded the amount of zero-carbon electricity produced by every solar-energy installation in the nation during 2015.

To replace the six reactors slated for closure, we'd need to cover about 1,400 square miles of land with rows and rows of 500-foot-high turbines

Mr. Bryce went on to write that "Based on calculations done by the Breakthrough Institute, wind energy requires about 500 times more land than nuclear. To replace the six reactors slated for closure, we'd need to cover about 1,400 square miles of land with rows and rows of 500-foot-high turbines. That's a land area larger than Rhode Island." This solution ignores the economics of wind that are hurt by both its intermittency necessitating backup power sources and the fact that wind resources are usually located far away from where the power is needed. Estimated costs for replacing the power lost by the closure of these plants run into the billions of dollars with no clear true cost figure because not all the potential economic costs can be initially determined.

A recent paper suggests that the construction cost for replacement energy sources for the Diablo Canyon (California) nuclear power plant will reach \$15 billion

A recent paper suggests that the construction cost for replacement energy sources for the Diablo Canyon (California) nuclear power plant will reach \$15 billion. That cost estimate doesn't include the potential costs of new transmission lines nor back-up power sources for solar power, or the potential tax credits for renewable energy investments. This is just one example of the magnitude of the costs of shutting down our current nuclear fleet of approximately 100 units.

The owner of the two nuclear power plants in Illinois targeted for closure has lost \$800 million over the past seven years

At the same time, the owner of the two nuclear power plants in Illinois targeted for closure has lost \$800 million over the past seven years due to the lost price of wholesale power due to cheap coal and now natural gas, which explains why they are being forced to make the economic decision to shut the plants. Mr. Bryce supported his arguments about the economic impact of closing nuclear plants on climate change targets by pointing to recent comments from leading environmental scientists.

"They added that those who claim we should rely solely on wind and solar to reduce our emissions 'downplay or ignore the intermittency' of those sources and make 'unrealistic technical assumptions.'"

He wrote: "In December, four of the world's top climate scientists -- James Hansen, of Columbia University; Kerry Emanuel, of MIT; Ken Caldeira, of the Carnegie Institution for Science; and Tom Wigley, of the University of Adelaide in Australia -- wrote in the *Guardian* that nuclear energy 'will make the difference between the world missing crucial climate targets or achieving them.' They added that those who claim we should rely solely on wind and solar to reduce our emissions 'downplay or ignore the intermittency' of those sources and make 'unrealistic technical assumptions.'"

In the background of the nuclear power issue has been opposition to it from environmental groups, partly because they have been concerned that endorsing nuclear power would muddy their

The Sierra Club, the nation's oldest and largest environmental group, is reportedly debating whether to change its policy of pushing for closing nuclear power plants

“But the point I was trying to make is that the new fact in the world is the remarkably rapid fall in the price of renewable energy”

We read that Mr. McKibben has acknowledged that nuclear power should play a greater role in our future energy supply but he could not endorse it because it would send a confusing message to his members

argument against fossil fuels as dirty energy sources. We are now witnessing some reassessments of these positions due to recognition that wind and solar power cannot provide all the energy needed in the U.S. today and in the future even with an improved energy-efficiency economy.

The Sierra Club, the nation's oldest and largest environmental group, is reportedly debating whether to change its policy of pushing for closing nuclear power plants before their initial federal operating licenses expire. Other environmental groups including the Environmental Defense Fund and The Natural Resources Defense Council are actively working with the owner of nuclear power plants in Illinois that have been targeted for closure to develop a plan to keep them open. While not all environmental groups are onboard with this policy shift, the rationale behind the shift is because it is becoming more evident from the data that in regions where large nuclear power plants have been closed, carbon emissions have risen in subsequent years.

This shifting support landscape for nuclear power sent us back to reviewing the comments from a meeting between Bill McKibben, a professor, author and founder of environmental group 350.org and Anthony Watts, the sponsor of the web site “Watts Up With That?,” a leading site reviewing and commenting on the science of global warming and climate change back in June 2015. One of the points in the comments from the meeting authored by Mr. Watts was: “We both talked about how nuclear power especially Thorium-based nuclear power could be a solution for future power needs that would provide a stable base electrical grid while at the same time having far fewer problems than the current fission products based on uranium and plutonium.” After reviewing Mr. Watts' comments, Mr. McKibben wrote the following: “I don't think thorium or cold fusion or anything like it is the future of power; I'd wager all things nuclear are mostly relics of the past, in no small part because they cost like sin. But the point I was trying to make is that the new fact in the world is the remarkably rapid fall in the price of renewable energy. That solar panels cost so much less than they did just a few years ago strikes me as a destabilizing factor for anyone's world view.”

We found this exchange interesting since later we read that Mr. McKibben has acknowledged that nuclear power should play a greater role in our future energy supply but he could not endorse it because it would send a confusing message to his members, possibly weakening their resolve against the banning of fossil fuels. This is where we get into the real issue that underlies much of the global warming and climate change debate – facts and science are often distorted or ignored on both sides of the debate in order to focus on the emotional considerations.

Mr. Watts summed up this divide in his comments about his impressions of Bill McKibben following their meeting when he wrote:

“I can’t really fault him for feeling these things and expanding on them but I did note he seemed quite resistive to factual rebuttals because they didn’t assuage the feelings he harbored.”

“But I came away with the impression that Bill [McKibben] feels such things more than he understands them in a physical sense. This was not unexpected because Bill is a writer by nature, and his tools of the trade are to convey human experience into words. I can’t really fault him for feeling these things and expanding on them but I did note he seemed quite resistive to factual rebuttals because they didn’t assuage the feelings he harbored.” Never let facts confuse your emotions, especially when it has to do with climate change and fossil fuels.

Understanding What Lies Behind Climate Change Movement

“We redistribute de facto the world’s wealth by climate policy”

We were intrigued to read comments from a former United Nations climate official about the true nature of the issue. Ottmar Edenhofer, a German university economics professor and the co-chair of the U.N.’s Intergovernmental Panel on Climate Change working group on Mitigation of Climate Change from 2008 to 2015, has made a series of disarming comments about the agenda behind the climate change movement. “One has to free oneself from the illusion that international climate policy is environmental policy. This has almost nothing to do with the environmental policy anymore, with problems such as deforestation or the ozone hole,” he said. Opposition to this effort explains some of the more violent pushback from climate “deniers” who see the climate change movement as an effort to install government control over the global economy and, in turn, on how income and wealth is distributed. In fact, Dr. Edenhofer said so much when he said, “We redistribute de facto the world’s wealth by climate policy.” These shocking statements are not a sudden revelation, because they are consistent with other previous statements. Five years ago, Dr. Edenhofer said that “the next world climate summit in Cancun [2010] is actually an economy summit during which the distribution of the world’s resources will be negotiated,” again confirming the underlying climate change agenda.

“This is probably the most difficult task we have ever given ourselves, which is to intentionally transform the economic development model for the first time in human history”

This economic philosophy was reinforced by Christiana Figueres, executive secretary of the U.N.’s Framework Convention on Climate Change leading up to the conference in Paris last November, when she stated: “This is the first time in the history of mankind that we are setting ourselves the task of intentionally, within a defined period of time, to change the economic development model that has been reigning for at least 150 years, since the Industrial Revolution.” To understand how significant this issue is, Ms. Figueres further commented, “This is probably the most difficult task we have ever given ourselves, which is to intentionally transform the economic development model for the first time in human history.”

Changing the world’s economy is what really lies behind the climate change movement, which has greater ramifications than merely the cost of energy or what types of fuel we utilize. This issue will also impact the way we travel and how we move our goods around the world. But the policy enforcement may also dictate in what size

His extensive use of this authority has been rejected by the federal courts on numerous occasions because the justices determined that President Obama was incorrectly usurping legislative authority

home you may eventually live and how that home is equipped. The universal disrespect for the power of market forces to change human behavior over time by the climate change promoters is troubling because according to them, the only way we can limit carbon emissions is to accept authoritative government rule. In the United States, we are experimenting with this form of government as demonstrated by President Barack Obama's extensive use of executive authority to change legal rules and policies as he sees fit, and without the ruling of laws passed by our congressional representatives. His extensive use of this authority has been rejected by the federal courts on numerous occasions because the justices determined that President Obama was incorrectly usurping legislative authority. This separation of Constitutional powers issue is a core point of philosophical disagreement between the presumptive presidential nominees of the Democratic and Republican parties as we head into the fall elections. The debate will manifest itself in many areas including what our energy policy should be, and even if we should have an energy policy at all.

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

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