

MUSINGS FROM THE OIL PATCH

June 18, 2019

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

Summary:

Is It Really Going To Be Different This Time?

The commodity index relative to stocks is at the lowest point it has been in 50-years, suggesting that either there has been a significant disruption of commodity markets, or they may be set to soar.

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Electric Cars: The Future Is Now Or Maybe In A Decade

BNEF says EVs will reach price parity with ICE vehicles in 2022, two years earlier than its forecast last year. This requires cheaper batteries. Will it happen? The future of EVs remains a mystery.

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Japan's Demographics Highlight Energy's Challenge

Japan's ageing population is creating social and economic challenges for the country. It is also opening a new market for robots, and may also impact the amount of energy Japan needs.

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New England Offshore Wind Farm Reaches New Milestone

A new offshore wind farm power purchase contract won approval from the Rhode Island PUC even though it wasn't the cheapest option. The economic benefits will depend on the values of RECs.

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Do We Need Another Government Energy Jobs Program?

Congress is considering establishing a new training grant program for offshore wind workers. Why? We already have an underused offshore construction industry struggling in the Gulf of Mexico.

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Is It Really Going To Be Different This Time?

“The four most dangerous words in investing are, it’s different this time”

American-born, British investor Sir John Templeton is noted for having said: “The four most dangerous words in investing are, it’s different this time.” This was his mantra as he perfected the art of contrarian investing by seeking out under-valued and investor-hated stocks that retained growth potential. Sir Templeton was famous for seeking out investment opportunities well beyond the shores of America, for example, Japanese stocks in the 1970s and 1980s. His investment success swelled his firm’s assets under management to \$13 billion at the time he sold it in 1992. He spent the remainder of his life (died in 2008) engaged in philanthropic endeavors.

We are presently at a 50-year low valuation for commodities relative to stocks

Sir Templeton and his acolytes did not just buy cheap stocks, they bought stocks unloved or undiscovered because their earnings potential was not recognized by investors. We were reminded of his investment philosophy and mantra by a chart similar to the one accompanying this article that was sent to us by a friend. It shows the ratio of the commodity index to the broad stock market index. According to the chart, we are presently at a 50-year low valuation for commodities relative to stocks. Is it different this time, or are commodity stocks merely reflecting the “buggy-whip” phenomenon? When the automobile arrived and the horse-and-carriage transportation business was disrupted, some 13,000 firms associated with buggies were put out of business. Well, not exactly.

Today, Westfield Whip is the only surviving whip manufacturer of the 42 companies that existed there at the industry’s height

In western Massachusetts in the 19th century, Holyoke was known as “Paper City,” because it was once one of the world’s largest centers for paper manufacturing. The city was located along the Connecticut River, which allowed loggers to float logs to Holyoke where the mills and cheap labor existed to turn them into paper. About half an hour west of Holyoke is Westfield, a town with the nickname “Whip City.” It was the center of the whip manufacturing business in the late 1800s. Today, Westfield Whip is the only surviving whip manufacturer of the 42 companies that existed there at the industry’s height. Today, it serves those few involved in dressage and similar horse activities.

Both the paper and horse-and-carriage industries were impacted by disruptive forces. For papermaking, it was the dwindling supply of timber and rising labor costs, while disruption of the whip manufacturing business came via the arrival of the automobile. The use of the buggy-whip analogy for every product that becomes obsolete by new technologies is probably an overworked analogy. Several business professors, who have studied the horse-and-carriage industry, find the companies that successfully survived disruptions, changed their businesses by understanding that they were involved in broader business enterprises. However, they need to remain focused on what that broader business is. As one professor put it, the companies successful in transitioning were not thinking they were in the “personal transportation” business, but

rather were in the “carriage parts making business.” True carriage-makers were involved in wooden structures, so they lacked the equipment and skills to switch to metalworking that was necessary for automobiles. Companies making axles and carriage lamps, however, were able to switch their focus from horses to horsepower.

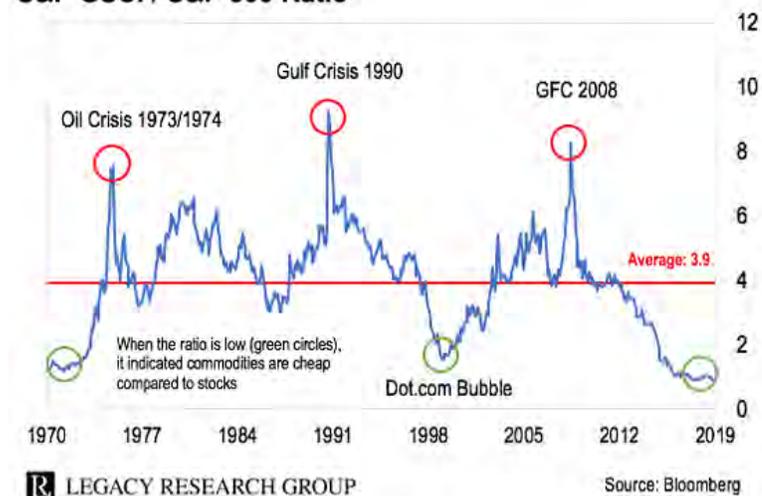
The standout carriage company that succeeded was the Studebaker Brothers Manufacturing Company. It started in 1852 as a blacksmith shop, but it possessed the financial resources to acquire smaller companies that brought it the precision metalworking expertise needed to be successful in the automobile manufacturing business. By 1913, Studebaker’s auto production was second only to that of Ford Motor Company (F-NYSE). By the 1960s, Studebaker was unable to scale up its production to match that of the Big Three automobile manufacturers and eventually it disappeared.

Each peak was associated with spikes in oil prices caused by geopolitical events such as the Arab Oil Embargo, the First Gulf War and the Global Financial Crisis

When we contemplate the market’s assessment of commodities versus stocks, we find the former, which includes oil and gas, to be at the lowest valuation point in at least 50 years. Does this mean that the commodity market is being disrupted? Peak valuation points occurred in 1973-74, 1990 and 2008. Each peak was associated with spikes in oil prices caused by geopolitical events such as the Arab Oil Embargo, the First Gulf War and the Global Financial Crisis, which happened as oil prices traded in excess of \$100 per barrel. Likewise, each low has been associated with low oil prices – either absolute lows, or lows below more recent oil price ranges.

Exhibit 1. How Commodities Are Severely Undervalued

S&P GSCI / S&P 500 Ratio



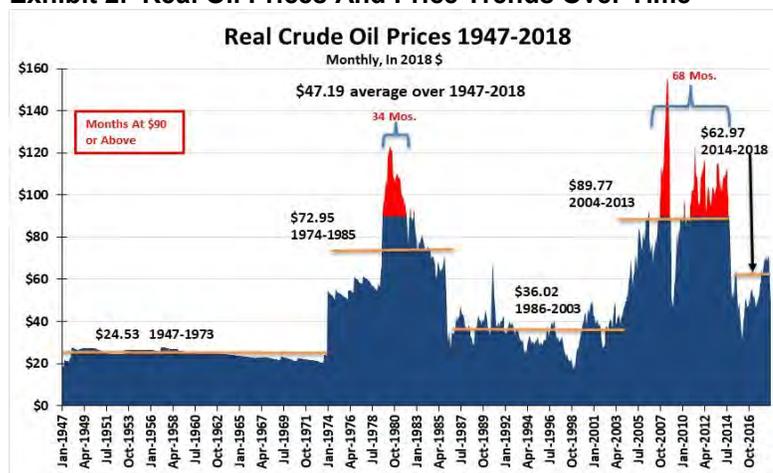
Source: *Bloomberg*

With respect to the low points in the valuation of commodities versus stocks, the prior two lows were marked by excess stock market speculation about super-growth stock future earnings. The 1998-99

The 1970-73 low was marked by the market bubble created by the Nifty-Fifty growth stocks

Dot.com Bubble, which saw companies brought public with barely any revenues and no earnings, but lots of “eyeballs” on web sites or clicks on shopping sites, happened to also be associated with oil prices falling to \$11 per barrel as the Asian currency crisis unfolded and a brief global recession occurred. The 1970-73 low was marked by the market bubble created by the Nifty-Fifty growth stocks, as price-to-earnings ratios for these 50 super-growth companies soared to ratios in excess of 50 times next year estimates for earnings per share. Of course, two energy service companies – Schlumberger Ltd. (SLB-NYSE) and Halliburton Companies, Inc. (HAL-NYSE) – were part of this Nifty-Fifty stock group. Crude oil prices at that point were in the \$3 per barrel range, and there was a battle brewing between the seven largest global oil companies that ruled the international oil business and the Organization of Petroleum Exporting Countries over the value of a barrel of oil for tax and royalty calculations. That tax battle lit the fuse that exploded after the Yom Kippur War involving Israel and Egypt in 1973, leading to the Arab Oil Embargo and the explosion in global oil prices.

Exhibit 2. Real Oil Prices And Price Trends Over Time



Source: WSJ, EIA, BEA, PPHB

Very recently, oil prices have been in a downward trend driven by fears of a growing global oil glut due to weakening demand and rapidly growing production

Currently, stock market speculation has been centered on the FAANG (Facebook, Apple, Amazon, Netflix and Alphabet's Google) stocks and newly-public, multi-billion-dollar unicorn companies such as Lyft, Uber, Airbnb, and others, backed by private equity. WTI oil prices are in the low-\$50s per barrel, after having recently been to \$70, which remains substantially higher than the most recent low established in 2016 (\$28), but nowhere near the inflation-adjusted low oil prices reached in 1998 (\$17) and 1973 (\$20) that marked the two earlier lows. Very recently, oil prices have been in a downward trend driven by fears of a growing global oil glut due to weakening demand and rapidly growing production. At the same time, investors are beginning to fear the energy transition away from fossil fuels may leave crude oil reserves stranded with little or no value, thus destroying the companies that own them.

Exhibit 3. Global Oil Price Trend For 2019 YTD

Oil renews its slide

Brent crude (\$)



Source: Refinitiv (formerly Thomson Reuters)

© FT

Source: FT

The current span mirrors the underperformance period in the early 70s, rather than the sharp rebound observed at the time of the Dot.com Bubble

Based on history, the commodity-to-stock valuation chart suggests commodities have the potential to outperform stocks for an extended period. What we don't know, and is impossible to know, is when that outperformance may start. The uncertainty is reflected in the extended flat underperformance being experienced now. The current span mirrors the underperformance period in the early 70s, rather than the sharp rebound observed at the time of the Dot.com Bubble. Is today's extended commodity underperformance a reflection of fears of permanent disruption for fossil fuels and other dirty minerals, or are we only marking time before investors "come to their senses"? Will it really be different this time?

Electric Cars: The Future Is Now Or Maybe In A Decade

One of the most important issues shaping energy markets in the future is the speed with which electric vehicles (EV) gain market acceptance

For those in the energy business, one of the most important issues shaping energy markets in the future is the speed with which electric vehicles (EV) gain market acceptance. While this may seem to be a slam against the remarkable progress EVs have already made in regional markets in recent years, we must acknowledge that most of the gains have come due to government support, as well as an appeal to the techy, first-movers living in such hip locales as California.

In the United States, the EV market has been dominated by Elon Musk's Tesla, Inc. (TSLA-Nasdaq) with its stylish designs and impressive engineering. The idea of a car that can be updated to the latest version of its safety systems via a computer download has wowed buyers desiring to be impressed and to impress their friends and neighbors. The initial Teslas were designed to demonstrate the potential for cracking the EV code, a technology that dominated the domestic automobile industry in its early years until technological innovations and government road building obsoleted EVs in favor of

Knowing that the subsidy would be cut further this summer, Tesla decided it needed to cut costs and vehicle prices early this year – both steps necessary to help bolster sales and cash flow

internal combustion engine (ICE) cars. Today, governments are working to build up EVs by making it harder for ICE vehicles to be sold and used.

The star of the EV industry is Tesla. That was until 2019, when it appeared that the wheels might be literally coming off the company. Having continually failed to meet production quotas (goals), even after adding a third assembly line based under a tent and putting cars together by hand, deliveries fell off the charts in the early months of the year. The excuse was that deliveries were being shipped abroad and the company was having greater difficulty in getting them to buyers on schedule. At the same time, the federal government's tax credit largess was ending, as Tesla had crossed the threshold of 200,000 fully-subsidized car sales and buyers were thus limited to only half the subsidy. Knowing that the subsidy would be cut further this summer, Tesla decided it needed to cut costs and vehicle prices early this year – both steps necessary to help bolster sales and cash flow - given the company's levered balance sheet and lack of profitability. At the same time, corporate drama played out with Mr. Musk likely having crossed the line of stock price manipulation via his tweeting, which led to his confrontation with the Securities and Exchange Commission (SEC). The result was an agreement for Mr. Musk's communications to be subject to review by internal legal officials. There was also a demand for a more independent board of directors, as another check on Mr. Musk's free-lancing management and governance style.

The share's low was reached as negative investment sentiment over Tesla's problems built

For Tesla shareholders, 2019's operating, financial and corporate drama have taken a serious toll. Tesla's share price through June 3rd, showed a 42.3% loss since the opening of the year, but an even worse 48.5% decline from the share's peak price this year, reached on January 17th. The share's low was reached as negative investment sentiment over Tesla's problems built, and the anticipation that more recent sales results would confirm the continuing deteriorating performance of company sales.

June 4th was the day that the automobile industry's sales results for the month of May were released. Although neither Tesla nor General Motors (GM-NYSE) reports monthly vehicle sales, the people who track the details of individual company and vehicle model sales estimate those two companies' monthly unit sales. Over the years, these auto sales trackers have become very proficient in estimating monthly sales that are then squared with the actual quarterly sales totals.

June 4th turned out to be a very good day for Tesla

June 4th turned out to be a very good day for Tesla. According to *InsideEVs.com*, Tesla's combined Model 3, X & S sales in May were estimated at 16,350 units, a 37.1% gain over April's estimated sales of 11,925. The market cheered, and the results likely forced Tesla short-sellers to race to buy back shares, causing the stock to jump

For May, Tesla's market share climbed to an impressive 59.7%, up from 56.1% in April

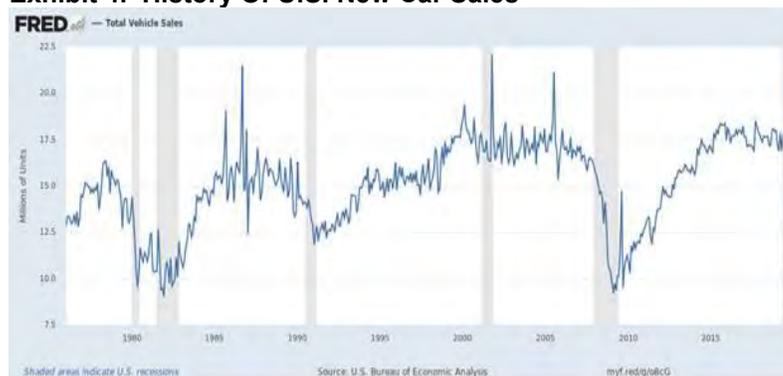
Assuming that pace continues, the domestic EV industry will deliver 404,000 units this year

\$14.63 per share, or 8.2%. By the close of trading four days later, Tesla's share price was sitting at \$204.50 per share, a 14.3% rebound from its 2019 low on June 3rd.

Equally impressive was the overall EV industry's sales for May. Led by Tesla, total EV sales for the month totaled 28,386 units, a 33.5% gain over April's results. For May, Tesla's market share climbed to an impressive 59.7%, up from 56.1% in April. Moreover, the strong May results helped boost Tesla's year-to-date market share to 52.5% from 50.7% through April. Maybe the tarnished Tesla was getting its momentum back.

The question is what does the balance of 2019 hold for Tesla and, importantly, for the EV industry. Through the first five months of the year, EV sales are 11.7% ahead of those recorded last year. Assuming that pace continues, the domestic EV industry will deliver 404,000 units this year. Currently, the total annualized new vehicle sales rate is somewhere around 17.5 million units, where it has been consistently since 2015. If our EV sales estimate is attained this year, it would put EV's 2019 market share at around 2.3%, up from 2.03% last year.

Exhibit 4. History Of U.S. New Car Sales

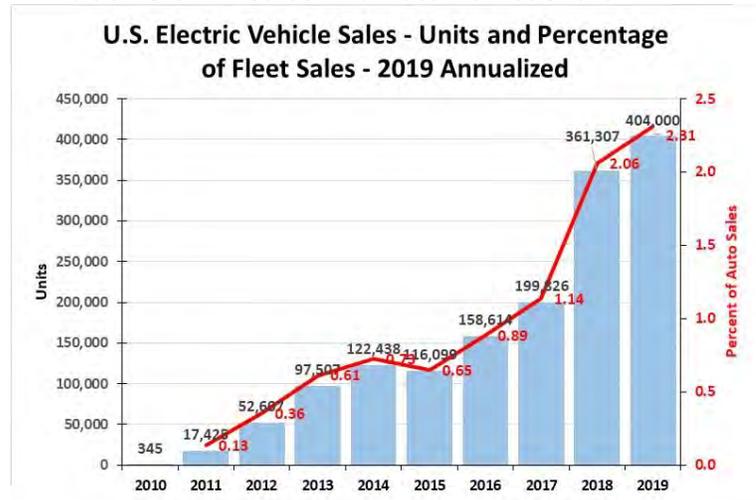


Source: St. Louis Federal Reserve

The big unknown is whether Tesla's sales in the second half of 2019 will exceed those of last year's second half

The big unknown is whether Tesla's sales in the second half of 2019 will exceed those of last year's second half. At that time, buyers knew the full \$7,500 federal tax credit would be cut in half starting January 1, 2019, and then be cut in half again at mid-year 2019, before ending completely in 2020. That was a significant financial incentive that likely created a rush of buyers during the second half of 2018 that will likely not be present this year. The reduction in the tax subsidy is in addition to the ending of a substantial number of Tesla vehicles that have been on leases, creating a more robust used-car market, which could further cut into new vehicle sales, as these used Teslas will be considerably cheaper than new ones.

Exhibit 5. U.S. EV Sales And Auto Market Share



Source: *InsideEVs.com*, PPHB

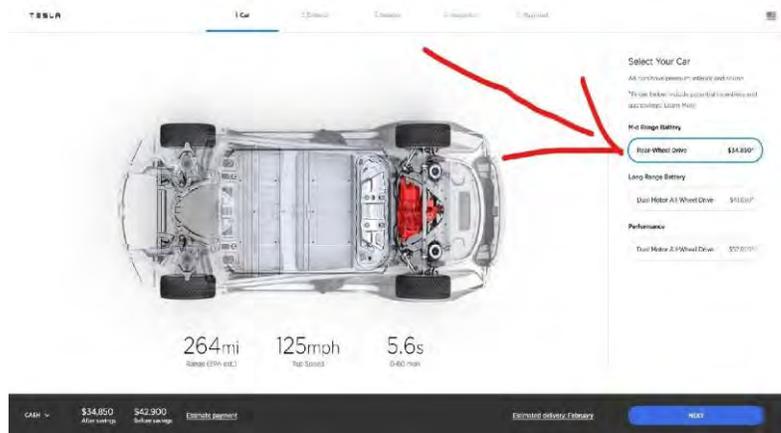
A \$35,000 Tesla could become the “people’s car,” as Volkswagen translates in German

One of the great challenges for Tesla has been meeting its goal of developing a model that can profitably retail for \$35,000, something Mr. Musk has promised almost since the company commenced operations. That price target is believed to be the threshold at which an EV would be highly competitive with the average American new car purchase. In other words, a \$35,000 Tesla could become the “people’s car,” as Volkswagen translates in German. When the car was initially built in 1937 in Germany, during the early years of Nazi-Germany, its appeal was what led to the “people’s car” moniker.

The key to the lower price was the inclusion of “potential incentives and gas savings” into the calculation

A recent article in the *Financial Times (FT)* caught our eye about Tesla’s people’s car. The reporter based the article on advertising by Tesla in February for a Model 3 vehicle (the company’s planned mass-market model) with a price tag of \$34,850 – slightly below the elusive \$35,000 threshold. The key to the lower price was the inclusion of “potential incentives and gas savings” into the calculation. In fact, the price of the particular car in the advertisement, absent the federal tax credit and the estimated gasoline cost-savings, was \$42,900. One wonders whether Tesla was using the price of gasoline in California, where the car is built, or in Texas where state taxes and gasoline distribution costs are much lower, when they calculated the gas savings? Smart marketing by Tesla for those buyers hooked by the advertised price, but who failed to read the ad’s fine print or do their own cost analysis. Those buyers also better have a federal tax liability that will utilize the tax credit, even though it has been reduced, since it can’t be carried over. We do understand that the Tesla web site no longer lists the Model 3 at that low price, primarily due to the critique from the *FT*.

Exhibit 6. How Tesla Marketed A Cheap EV



Source: FT

Volkswagen acknowledged it would lose approximately \$3,500 per vehicle

At the end of the day, the automobile industry is still dealing with unprofitable EVs. Volkswagen (VWAPY-OTC) recently announced it was making a significant investment in its EV business, but acknowledged it would lose approximately \$3,500 per vehicle. At what point will the cost of EVs, primarily due to the cost of the batteries, come down to rival an ICE vehicle? Beyond that issue is the challenge of competing with used ICE vehicles, which are lasting much longer due to the improvements made by automobile manufacturers over the years. In recent years, used car prices strengthened as wage growth stagnated and new car prices rose.

The less-profitable vehicle sales mix is further hurt by the inclusion of a growing number of EVs with their money-losing status

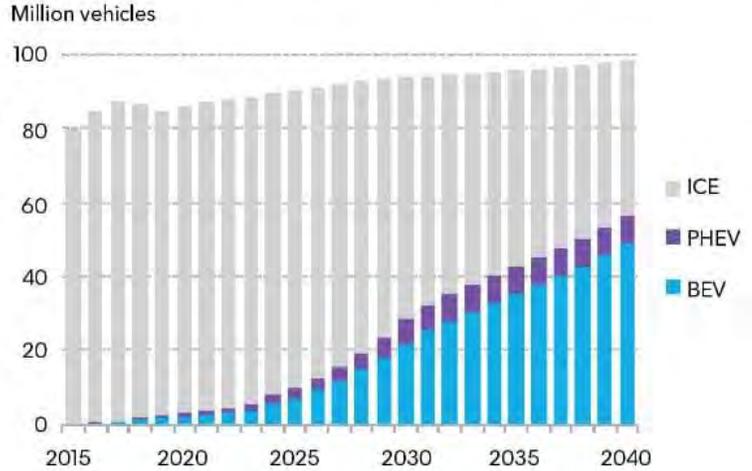
Due to the strength of new car sales in recent years, the automobile industry is forecasting less robust sales in the future. U.S. light vehicle market sales peaked in 2016 at 17.46 million units and have declined since. Prospects for 2019 are reflecting a weaker outlook, after stabilizing the past two years at around 17.2 million units. Most forecasts call for this year's sales to fall about 4%, to roughly 16.5 million units. As a result, automobile companies are cutting their manufacturing capacity, to the chagrin of President Donald Trump, as well as streamlining their organizations, in order to help sustain profit margins as the mix of vehicles produced will be different in the future from recent years. The less-profitable vehicle sales mix is further hurt by the inclusion of a growing number of EVs with their money-losing status.

An emerging issue is the growing number of states moving to tax EVs in an effort to raise funds for highway and bridge maintenance

As every forecast in recent months suggests, the pace of EV sales is projected to accelerate. The question is which year will become the take-off point? What is seldom highlighted in these forecasts is their sensitivity to the amount and continuation of tax subsidies. An emerging issue is the growing number of states moving to tax EVs in an effort to raise funds for highway and bridge maintenance. These fees will add to the total cost to operate EVs, which recently has become the focus in predicting the EV sales take-off point. For the future: more EVs in the fleet mean less gasoline taxes and

Exhibit 7. BNEF’s Latest EV Market Forecast

Global long-term passenger vehicle sales by drivetrain



Source: BloombergNEF

Source: BNEF

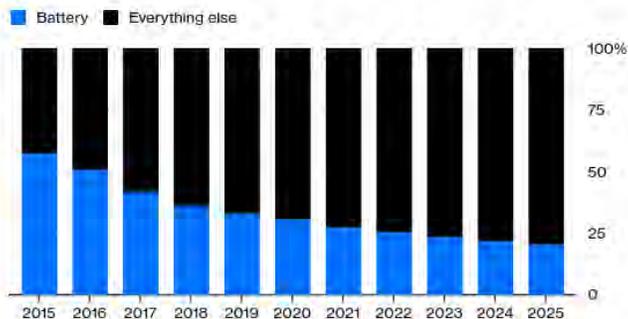
Taxing EVs is another way to raise money

reduced funds for road maintenance, necessitating greater pressure to increase fees assessed to EVs, making them more costly to operate. How quickly states will ramp up EV fees is unknown, but given the continuing deterioration of state and local financial health, it will likely happen sooner than previously anticipated. As legislators have found, once a citizen buys a vehicle, boosting fees – taxes and registration fees, along with installing tolls on highways (a new and growing phenomenon in New England) – is an easy revenue generating measure. Taxing EVs is another way to raise money.

Exhibit 8. How BNEF Sees EV Battery Cost Trend

The Incredible Shrinking Car Battery

EV battery cost for U.S. medium-size car as a percentage of retail price



Source: BloombergNEF

Note: Includes profit margins and costs other than direct manufacturing costs.

Source: BNEF

Its most recent forecast says parity will arrive in 2022

Do we really have any idea what battery costs are, let alone whether there are technology breakthroughs on the horizon that may change the EV pricing equation?

Lithium prices are down, reaching a level commensurate with prices of three years ago

We are thus left with figuring out when battery costs will decline sufficiently to make EVs price-competitive with ICE vehicles. This measure has been adopted by various forecasters, especially Bloomberg New Energy Finance (BNEF) who in 2017 predicted price parity between the two technologies being reached in 2026. Then in 2018, BNEF moved that parity back to 2024. Its most recent forecast says parity will arrive in 2022. Of course, closing the parity-gap depends on additional emission costs inflating the price of ICE vehicles, but most of the parity gap closing comes from assumed EV battery cost reductions. BNEF’s forecast for battery cost improvement is shown in the accompanying chart (previous page).

The question of battery cost is interesting given what has happened in recent years. In 2017, energy consultant Wood Mackenzie predicted that battery costs, which they said were \$174 per kilowatt-hour (kWh) would fall to \$100/kWh in a decade. At the same time, General Motors (GM-NYSE) announced that its new Bolt EV had a battery cost of \$145/kWh and they anticipated reducing it to \$100/kWh by 2021. Our understanding is that GM was getting its batteries from LG Chem, the huge Korean enterprise. LG was supposedly upset with GM for disclosing the battery price, since it was a special below-market price, reflecting a special deal struck with the auto manufacturer. So, do we really have any idea what battery costs are, let alone whether there are technology breakthroughs on the horizon that may change the EV pricing equation? Those answers will tell the future of EVs.

Exhibit 9. How Lithium Prices Have Trended Recently



Source: *Benchmark Mineral Intelligence*

We were intrigued to find the Benchmark Lithium Price Index chart. What it shows is that from early 2016 until the end of 2017, prices were rising. This came as forecasters were telling us that battery costs were falling. Now, lithium prices are down, reaching a level commensurate with prices of three years ago. Is this because lithium supply has expanded, or was much of the earlier increase a reflection of euphoria about the demand for lithium? The current threats by China to withhold rare earth minerals from the United States in retaliation for the latter’s imposition of tariffs have already sparked efforts to open new mines in the U.S. and elsewhere. Will

Volkswagen says their EV batteries will last the life of the vehicle

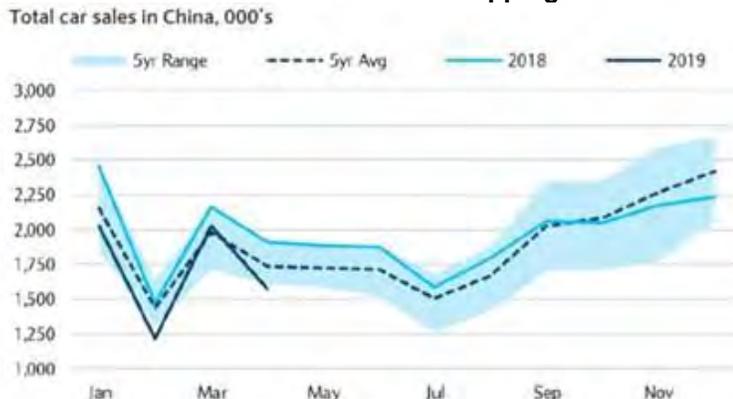
there be sufficient rare earth minerals to support EVs and other industry uses of lithium-ion batteries? Will this rare earth minerals threat actually lead to the development of a new battery chemistry that radically alters the EV industry?

In that regard, it was interesting reading that Volkswagen says their EV batteries will last the life of the vehicle. We assume they are planning for a 12-year vehicle life and 12,500 miles of driving per year, or 150,000 miles total, when making such a statement. These are typical marketing points. The interesting thing is that ICE vehicle lives are now extending well beyond that timeframe and mileage total. Cars are routinely lasting for 15-20 years, with engines producing 200-300,000 miles. Will EV owners be happy if their battery only lasts for 150,000 miles when they are used to ICE cars lasting twice as long? How much will a replacement battery cost? Of course, it assumes one can actually secure a replacement battery without essentially “rebuying” a used EV down the road.

It is now working to restructure the Chinese EV industry by backing more established companies

The key to EV success is the belief of an unwavering commitment from the Chinese government to this industry as part of its Made in China economic initiative. At one point, recently, we were told that there are over 450 EV manufacturers in China. This huge number of EV manufacturers was based on the largess of the Chinese government. There are a number of them that have yet to build or deliver an EV. With auto sales sliding in China, the government has shifted its support effort. It is now working to restructure the Chinese EV industry by backing more established companies. Given this recent shift in economic policy, one wonders whether the optimistic projections for the China EV market will be realized or be revised? Will China continue to subsidize EV development, given the economic problems bedeviling the country given the U.S. tariffs and financial strains the government is under.

Exhibit 10. Chinese Auto Sales Are Slipping In 2019



Source: Thomson Reuters DataStream, Barclays Research

Source: Barclays Research

Seldom, in our experience, do all the most optimistic assumptions underlying forecasts actually come to pass

The most optimistic forecasts for the EV industry are based on assumptions about the continued decline in battery costs and the sustainability of EV subsidies, as well as further mandates for their purchase and use. Seldom, in our experience, do all the most optimistic assumptions underlying forecasts actually come to pass. Continuing to project EV sales based on models of the uptake in cell phones may prove way too optimistic, given that cars, like houses, are not purchased in the same way. There are too many moving parts in the economy, personal transportation business, automobile and EV battery technology to blindly assume that we know how the future will unfold. Our assumption is that the pace of EV sales will continue, but since we talking about such a small market share, its impact on the global oil business will remain marginal for many years to come. The wildcard remains government policy. Will the public tolerate continued subsidization of EV sales? Will the public accept the personal restrictions on their transportation choices government policies are currently projecting? Or, will the public demand greater government support for EVs?

Japan's Demographics Highlight Energy's Challenge

We have just returned from a weeklong trip to Tokyo. It was the destination chosen by our youngest granddaughter for her high school graduation trip, a promise we have made to each of our four granddaughters. This granddaughter has been focused on visiting Japan for the four years since we made our promise. The destination reflected her dedication to anime art and Japanese history. We spent five days with a private guide exploring temples, shrines and other cultural and historical sites in Tokyo, as well as extended anime-shopping expeditions. (Should you ever desire to undertake a similar trip, let us know, as we found an outstanding guide, who told us she had never organized such a dedicated trip but did a great job for our granddaughter.)

We had several discussions with our guide about the ageing of Japan and the societal pressures and economic challenges it was creating

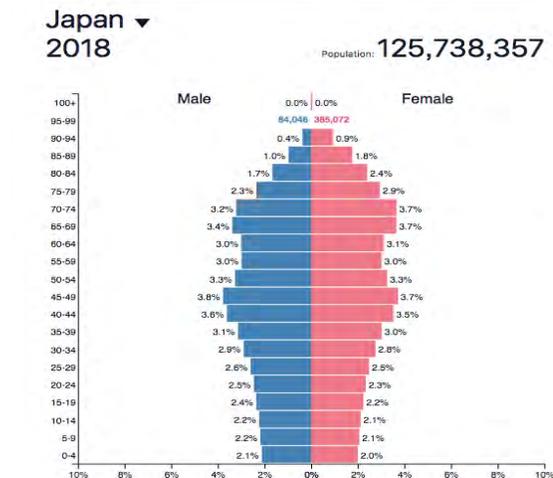
During our time in Tokyo, we had several discussions with our guide about the ageing of Japan and the societal pressures and economic challenges it was creating. As a former history teacher, she talked about Japanese schooling and the fallout it has caused. Students attend school for ten months a year, with 10-hour days the routine. Despite the extended school time, according to our guide, the students never dive deeply into history topics, but rather skim subjects. In her view, students are graduating from high school, and even college, with few skills and knowledge to succeed.

Our discussions about Japan's demographics focused on daily family life, as well as issues young couples face. These two issues are interconnected and contribute to the ageing of Japan, which is increasing its economic challenges. Japan has now become the oldest country in the world, which will significantly impact its future economic growth rate as well as its social stability.

The share of Japan's population 65-years-old or older was 27.4%, split into 12.0% of men versus 15.4% for women

Examining the population pyramid of Japan, one sees that the elderly has become a significant share of total population. Japanese males represent only 48.7% of the total population of 125.7 million Japanese. That is not surprising, as Japanese women have an average lifespan of 87.1 years, while men live only 81.1 years. The share of Japan's population 65-years-old or older was 27.4% in 2018, split into 12.0% of men versus 15.4% for women. Collectively, that population segment represents 34.9 million people.

Exhibit 11. Japan's Current Population Distribution

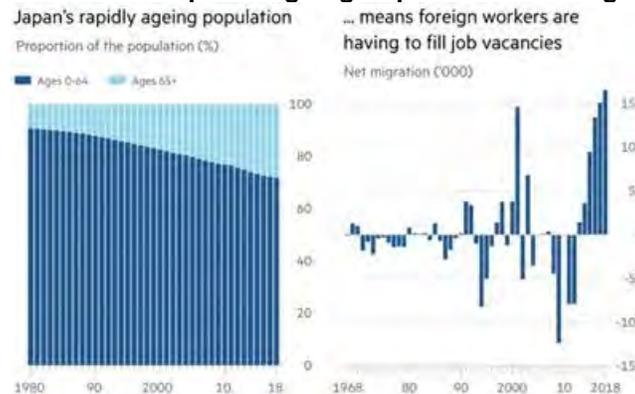


Source: UN

One showing the country's rapidly ageing population; the other showing how this ageing has led to the importation of labor

While we were in Tokyo, we were surprised to read a small article in the *Financial Times* dealing with the ageing of Japan. The article included two graphs: one showing the country's rapidly ageing population; the other showing how this ageing has led to the importation of labor, particularly recently. This influx of foreign workers will eventually change the country's social homogeneity.

Exhibit 12. Japan's Ageing Population Challenge



Sources: Refinitiv, Japan's Ministry of Internal Affairs and Communications © FT

Source: FT

Today's employment demands and housing costs have resulted in increased family separation, as youths have moved to cities for work, thereby disrupting the historical childcare system

The ageing issue has become more acute for Japan's society and its social fabric due to the concentration of jobs in urban areas, where population density and living costs are high. As a result, young couples have a hard time finding affordable housing for raising a family, creating commuting challenges. According to our guide, there is also a significant issue in finding affordable childcare, which discourages starting families. Traditionally, a Japanese household has included three family generations living together. Thus, the grandparents were able to watch the young children, allowing the parents to work. Today's employment demands and housing costs have resulted in increased family separation, as youths have moved to cities for work, thereby disrupting the historical childcare system. This phenomenon often forces young couples to either become one-income families, as the mother has to remain home to care for children, or either postpone or elect not to have children.

The ageing population will necessitate a sevenfold increase over the next decade in the number of care workers from the 1.5 million currently active

This social choice has translated into an extremely low Japanese birth rate, which has contributed to the country's rapid ageing. This is clearly evident from the demographic pyramid. Beginning with the 45-49-year-old tier, each younger age group accounts for progressively smaller segments of the total population, such that the 0-4-year-old segment is the smallest, outside of the very elderly.

The *FT* article dealt with the use of robots in Japan to help in the care of the elderly, as many of the tasks necessary to assist these people are becoming stressful for care workers. According to the article, the ageing population will necessitate a sevenfold increase over the next decade in the number of care workers from the 1.5 million currently active. That will mean there will be nearly a tenth of the Japanese workforce dedicated to caring for its elderly. Filling those jobs will become a serious challenge due to a lack of younger workers and the language challenges for immigrant labor. Robots are being touted as the answer.

There are two types of robots involved in health care – mobility helpers and emotional supporters

There are two types of robots involved in health care – mobility helpers and emotional supporters. There are robots that can lift and carry elderly people, reducing the physical strain a care worker experiences if having to do the heavy lifting. As the article pointed out, actions such as the feeding of elderly people who are unable to care for themselves needs human interaction. Leading elderly people in physical activity sessions, or having machines that can talk to people, can be and is being done by robots.

The article discussed the Japanese companies building these robots. While there is a growing domestic market, forecasters also believe there are growing export opportunities for robot companies as the ageing needs in countries such as Germany, Italy, Finland and China will increase care worker demand.

While robots will likely play a greater role in countries with ageing populations, they will not meet all the needs of the elderly, especially

A shortage we observed, which will become a problem in the future, was a lack of elevators and escalators in many of the train and subway stations

those segments remaining active. For example, Tokyo, with its 13 million residents, has an extensive subway and rail system for getting around. The country is famous for train workers whose job it is to push the last passengers into the sardine-like packed rail cars. While we didn't see that done, we did witness subway workers trying to prevent crowds from pushing their way into overcrowded subway cars, which was delaying the train's departure. With Japanese precision, the train stops are highly choreographed, so keeping on schedule is of high priority. What every passenger knows is that the frequency of subway trains is high, so failing to get on a particular train is not catastrophic. A shortage we observed, which will become a problem in the future, was a lack of elevators and escalators in many of the train and subway stations. This will need to be remedied if the elderly is to remain as mobile in the future as they are currently. Without that mobility, the lives of elderly people will become more limited, adding additional pressure on care workers and/or family members.

Elderly people do not travel as much as younger people do, so their transportation energy use usually declines with age

Recently, we have seen studies proclaiming that household energy consumption increases with ageing populations. While that is counter-intuitive to what most energy forecasters have assumed, the analyses may be overstating the magnitude. Elderly people do not travel as much as younger people do, so their transportation energy use usually declines with age. This pattern might change significantly, if and when autonomous vehicles become a reality. That possibility was demonstrated in a study we highlighted several *Musings* ago. Cars and drivers were dedicated to people to closely mirror the features of autonomous vehicles and see how vehicle use changed. The most surprising outcome was that the elderly took more trips at night and longer trips with autonomous cars than they did without them. Thus, the share of transportation energy consumption represented by the elderly population may increase in the future if this population segment is offered a reasonably-priced autonomous transportation option.

As a result, an ageing population segment would consume more energy than younger age segments

In addition, the elderly may watch more television, cook more, use more power for health appliances, and keep their homes warmer in winter and cooler in summer, thereby boosting their energy consumption compared to younger people. As a result, an ageing population segment would consume more energy than younger age segments. But will the increase be significant enough to materially change overall energy consumption? As we read several studies making the elderly energy claim, we found that the analyses were based on creating models to supposedly represent populations whose energy consumption was then based on 6,000 calculations with the results published in a scatter plot with a line marking the central tendency.

We had hoped to find a clear analysis backed by data with specific estimates. Instead, we were left with mostly subjective observations. However, one conclusion we found startling,

especially since the particular research report was central to an article talking about ageing and global warming being two trends that will impact energy consumption. The observation was:

“In general, the age-energy consumption profiles showed a higher energy consumption in the cold region. This finding that supports previous research, is specially highlighted as age increases – i.e., the slope of growth in energy consumption is steeper in cold regions.”

This observation came from a paper published in 2018 in the journal Energy Research & Social Science entitled “Evaluating the Age-Energy Consumption Profile in Residential Buildings.” The paper was authored by Hossein Estiri of Harvard University and Emilio Zagheni of the University of Washington.

Does this conclusion suggest that in a warming world energy consumption might trend lower as more regions with large populations in cold climates moderate? That’s a novel thought!

Every study shows peak household energy consumption comes when the family is headed by a middle-aged person

The idea that energy consumption in households headed by elderly people is greater than in those headed by slightly younger people is not difficult to accept. Every study shows peak household energy consumption comes when the family is headed by a middle-aged person. That is likely due to the family containing children. Another point the studies make is that the size of the home plays a major role in household energy consumption. As new studies work to hold house size and family incomes and size constant, the results become less clear as to what drives energy consumption.

It is possible that aging populations will result in more household energy being consumed by that segment of the population

When the analysis is based on per capita household energy consumption, whenever a two-person elderly household becomes a one-person one, energy consumption per capita rises sharply. All the household energy consumption is now assigned to the surviving spouse. There may be some modest energy consumption reduction due to the death of a spouse, but it is likely only a marginal decline. Therefore, it is possible that ageing populations will result in more household energy being consumed by that segment of the population. But that increased energy consumption may be offset by less total energy consumption among the smaller middle-aged family segments, which tends to be the largest power consumption group, due to more energy-efficient appliances and smart energy management.

During our trip, which included extensive use of the subways and trains (it is really the only way to move around Tokyo both cost- and time-efficiently), we were surprised and delighted to see as many elderly Japanese people still traveling. In that regard, we experienced an amusing incident on our trip to Hino City, in the suburbs of Tokyo. We shared an elevator with an elderly gentleman who we estimate was well into his 80s. He looked at us and asked

We must have made his day!

in broken English: “American?” We responded: “Yes, from Texas,” which he promptly repeated and smiled. As we were exiting the station, the gentleman was being greeted by his daughter, to whom he announced: “I spoke English. They understood me.” He told her that in Japanese, which our guide translated for us. We must have made his day!

New England Offshore Wind Farm Reaches New Milestone

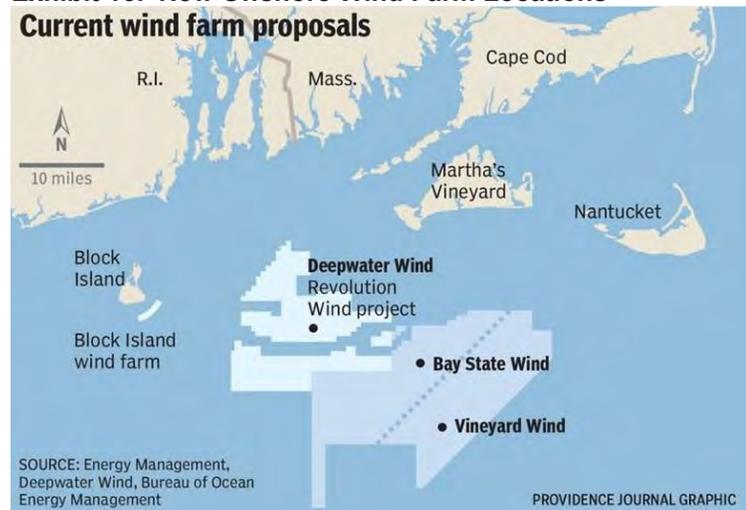
The offshore wind facility will be positioned 15 miles south of the Rhode Island coast in a federal lease area between Block Island and Martha’s Vineyard

The Rhode Island Public Utility Commission (PUC) approved National Grid’s (NGG-NYSE) Power Purchase Agreement (PPA) for 400 megawatts (MW) of wind energy from the Revolution wind farm to be located off the coasts of Massachusetts and Rhode Island. The offshore wind facility will be positioned 15 miles south of the Rhode Island coast in a federal lease area between Block Island and Martha’s Vineyard. This is a significant development for the fledgling United States’ offshore wind business. However, the terms of the PPA were not totally what National Grid had requested, and the touted economic benefits of the contract for consumers depend on the realization of key assumptions.

Commercial operations are envisioned for some time in 2024-2028

The Revolution wind farm is a project of Deepwater Wind, the developer of the Block Island 5-turbine wind farm, who was acquired recently by Danish power company Ørsted, formerly DONG, the state oil company of Denmark. The 50-turbine, 700 MW, offshore wind farm will sell, in addition to the 400 MWs to National Grid, 300 MWs to Connecticut utility companies. The current schedule calls for the project’s construction to commence during 2020 with completion targeted for 2023. Commercial operations are envisioned for some time in 2024-2028.

Exhibit 13. New Offshore Wind Farm Locations
Current wind farm proposals



Source: *The Providence Journal*

That translates into a price of \$0.098 per kilowatt-hour (kWh) for customers of National Grid

In a hearing on May 28th, the Rhode Island PUC approved the terms of the PPA between National Grid and Ørsted for electricity at a cost of \$98.425/MW. That translates into a price of \$0.098 per kilowatt-hour (kWh) for customers of National Grid. There will also be charges for delivering the electricity from the wind farm to the National Grid system, as well as getting it to customers. So far, we have not been able to identify how that transmission will be accomplished, i.e., where a cable or cables will be run from the offshore turbines to shore. Will there be separate cables for Rhode Island power versus Connecticut power? Who will pay the cost of the cables?

Much has been made about the low cost of the wind electricity from Revolution compared to the Block Island project. That one started out at \$0.24/kWh with a guaranteed 3.5% annual escalation for the 20-life of the contract. The expensive power price was justified by Block Island being a demonstration project to demonstrate the feasibility of offshore wind. The economics were helped by the fact that this electricity was replacing power generated from diesel-fueled units, which had a cost anywhere from 50-cents/kWh to as much as 65-cents/kWh, depending on the price of diesel. That cost umbrella deflated many arguments against the offshore wind project.

Another aspect of the Block Island wind farm was that the cable to bring surplus electricity from the island to the Rhode Island mainland was financed separately. What was initially proposed to be a part of the Block Island project, was assigned the responsibility of National Grid. The cable's initial cost was estimated at \$40-\$50 million, but wound up costing more than \$150 million. It is still a problem as the shifting sands on both Block Island and the Rhode Island mainland have left the cable exposed where it comes ashore. Reburial efforts, especially on Block Island have necessitated various approaches, all proving inadequate. Now, a more permanent solution has been proposed that will require directionally drilling a tunnel to bring the line ashore from a much deeper point offshore. Unfortunately, that project will not be done until 2021. In the interim, National Grid is having lighted buoys deployed to keep ships from coming near the unburied cable. In the shallow waters, the buoys will keep swimmers away, even though they are not at risk from the 32,000-volt cables, but could inflict damage to the cable's protective sleeve.

It noted that the contract was not the cheapest nor the most expensive for offshore wind power, but there was approximately \$90 million of economic benefits

When the Rhode Island PUC voted 3-0 to approve the new National Grid PPA, it noted that the contract was not the cheapest nor the most expensive for offshore wind power, but there was approximately \$90 million of economic benefits for ratepayers over the life of the contract, or approximately 50-cents per month for the average customer's bill. This benefit comes from the assumption that National Grid will be able to sell the Renewable Energy Credits (REC) from the power generated by the wind farm at a higher price

In her view, solar projects could be built more quickly and less expensively than an offshore wind project

in 2027 and 2028 than those credits currently sell for. If that assumption proves wrong, it is entirely possible the cost to customers for the offshore wind will be higher than estimated.

Rhode Island PUC commissioner Abigail Anthony stated, “It’s clearly not a sure bet that the economic benefits will exceed the costs.” Because of the contracting process, National Grid wasn’t required to procure the least-cost option, which favors lower-cost, energy-efficient measures be taken before new sources of power are created. In her view, solar projects could be built more quickly and less expensively than an offshore wind project. Adhering to that view would not help build an offshore wind energy industry.

The planned sale of RECs at higher prices down the road is based on projections from ISO New England, the regional operator of the power grid. Those projections assume that summer power demand will rise and increase the value of RECs, but these assumptions have regularly been overestimated. Ms. Anthony pointed out that the financial benefit disappears if the REC price increase happens six months later than predicted. That is a pretty narrow benefit window, some 8-9 years in the future.

Surplus RECs will likely keep their prices from increasing, according to Ms. Anthony

Surplus RECs will likely keep their prices from increasing, according to Ms. Anthony. “The market value of RECs turns on a dime and ... so do the direct economic benefits of this PPA,” she said. However, the price of RECs may also increase if the New England states increase their demand for renewable energy by establishing higher renewable-energy targets.

PUC commissioner Marion Gold agreed with Ms. Anthony that there is a risk in National Grid’s achieving the proposed benefits. But she noted that the PPA price is warranted given that the prices are dropping and large amounts of renewable energy are needed to achieve energy and climate mandates.

Exhibit 14. Price History of Renewable Energy Credits

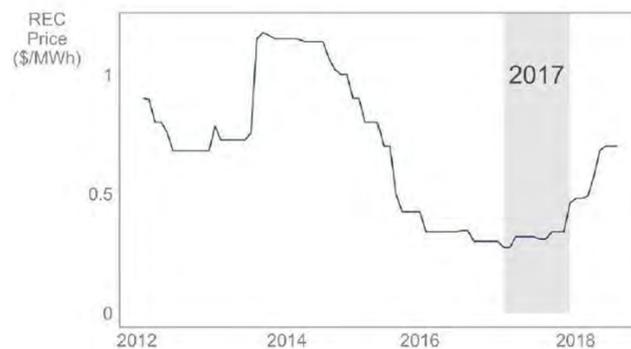


Figure 19. Voluntary national REC prices, January 2012–August 2018

Based on data from Spectron (2018)

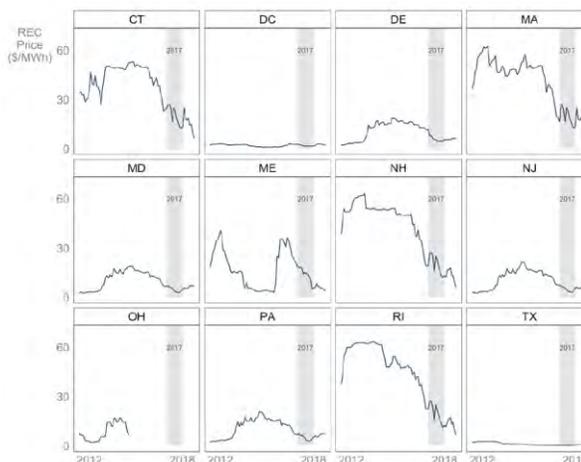
Source: NREL

REC values were shown for five of the six New England states, and each has experienced a sharp decline since 2017

According to a 2017 study by the National Renewable Energy Laboratory (NREL) dealing with the voluntary REC market, after a sharp drop in their value in 2014, prices recovered in the first half of 2018, although they remain slightly below those of 2013. (See chart on prior page.) Although the report dealt with voluntary RECs purchased by non-residential customers, it did touch on how this market differed from the compliance market where RECs are used to meet state mandatory Renewable Portfolio Standards (RPS), which is the case in Rhode Island.

There was a chart in the NREL report showing how compliance REC prices have performed for states in the same 2012 to August 2018 period. There were sharp contrasts among the states, with Texas and the District of Columbus showing flat REC values for the period. Several other states showed increases before declines. Most notably, REC values were shown for five of the six New England states, and each has experienced a sharp decline since 2017, although Rhode Island’s peak REC value occurred even earlier, in 2014, it has thus experienced a much longer declining price trend. These declines have come as the New England states have upped their PRS requirements and have aggressively been contracting renewable energy projects.

Exhibit 15. How State RECs Have Traded



Source: NREL

From the National Grid PPA document it is not possible to accurately assess what REC values are being assumed. Our only clue is from Exhibit D – PRODUCTS AND PRICING. This exhibit is part of the contract submitted to the PUC for its approval. The relevant sections state:

- (a) Product Price - Commencing on the Commercial Operation Date, the Price per MWh for the Products shall be \$98.425/MWh.

The Price will be allocated between Energy and RECs as follows:

(i) Energy = The \$/MWh price of Energy for the applicable month shall be equal to the weighted average of the Real-Time or Day Ahead Locational Marginal Price (as applicable consistent with Section 4.2(s)) in that month (also on a \$/MWh basis) for the Node on the Pool Transmission Facilities that is the Delivery Point. to which the Facility is interconnected.

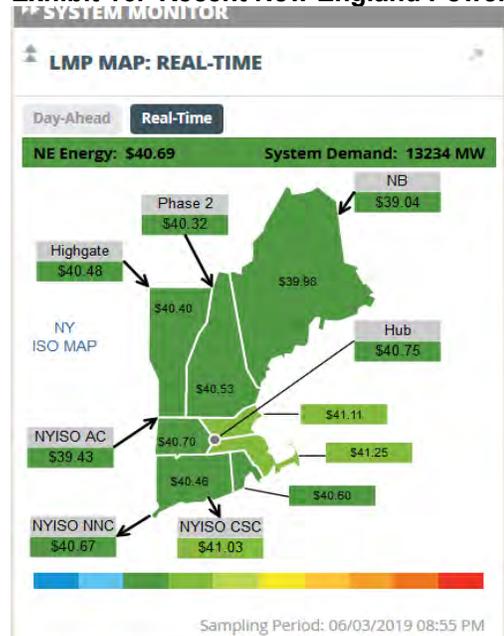
(ii) RECs = The Price less the Energy allocation determined above for the applicable billing period, expressed in \$/MWh.

(b) The Adjusted Price shall be as follows: \$71.925/MWh

In that case, the cost of the electricity is reduced to slightly over 7-cents/kWh

The Adjusted Price is the value of the electricity if the RECs "...fail to satisfy the Renewable Energy Standard as an Environmental Attribute associated with the specified MWh of generation from an Eligible Renewable Energy Resource and Buyer [National Grid] does not purchase the RECs..." In that case, the cost of the electricity is reduced to slightly over 7-cents/kWh. Will that happen? Most likely not, but the interesting analysis is to appreciate what values are assumed for the RECs. Exhibit 16 shows the real-time

Exhibit 16. Recent New England Power Costs



Source: ISO-NE

REC values in Rhode Island appear to be closer to \$10-\$15/MWh

price for locational marginal prices (LMPs) on June 3, 2019, at 8:55 pm. The data is taken from ISO New England's web site. What it shows is that for Rhode Island, the LMP is \$40.60/MWh. That means that the value attributed to the RECs would be \$57.825 (\$98.425 - \$40.60). As shown in Exhibit 15 (page 21), the REC values in Rhode Island appear to be closer to \$10-\$15/MWh. Interestingly, Rhode Island RECs haven't been worth \$57/MWh since 2014, when the great REC value slide began throughout New England.

As we will not know the outcome of the new contract's value proposition, there is a risk that the PPA becomes more onerous for ratepayers

The more important point is that under the PPA approved by Rhode Island's PUC, the assumed \$90 million in value accruing to the ratepayers as a benefit is dependent on the RECs reaching the value National Grid and Ørsted anticipate. When the Block Island PPA was negotiated, objectors and the Rhode Island PUC calculated that customers would over-pay for power by more than \$400 million during the 20-year life of the contract, before the recent oil price decline. On that basis, the Rhode Island PUC denied the contract. That outcome caused the PUC law to be rewritten to eliminate cost-benefit analysis of PPAs. As we will not know the outcome of the new contract's value proposition, there is a risk that the new PPA becomes more onerous for ratepayers. We will likely know the outcome for about five years, after hundreds of millions of dollars are expended on building the Revolution wind farm. As a ratepayer, we are keeping our fingers crossed.

Do We Need Another Government Energy Jobs Program?

We were surprised to read the following blurb in one of the daily government monitoring newsletters we monitor. The item stated:

"Tuesday, June 11"

"U.S. Congress American Offshore Wind Workforce Hearing"

"The U.S. House Committee on Natural Resources will discuss H.R. 3068 introduced by Democratic Representative Bill Keating, which seeks to establish an offshore wind career training grant program. The committee will review it before sending it to the House floor for consideration. U.S. wind power has more than tripled over the last decade, surpassing hydropower to become the nation's single-largest source of renewable capacity. Mid-Atlantic and northeastern states have timed plans for nearly 4 gigawatts of offshore wind solicitations."

It would seem this represents a forward-looking Congressional action

It would seem this represents a forward-looking Congressional action. We have a fairly vibrant onshore wind industry, which presumably has trained the workforce necessary to create this large renewable energy business. This was done without a government

We already possess a large, trained offshore energy workforce currently waiting to service the oil and gas business

training program. In fact, a number of technical schools and community colleges seized the opportunity and established wind technician training programs.

What makes offshore wind turbines different from onshore ones that necessitates establishing a federal granting program? Yes, the turbines are larger than onshore, but the mechanisms of their operation are the same. Assembling offshore wind turbines is more difficult because of the need for offshore equipment and expertise, however, we already possess a large, trained offshore energy workforce currently waiting to service the oil and gas business, which is in the early stages of a recovery from the 2014 oil price collapse, but which is capable of building offshore wind farms. In fact, it was segments of this workforce that built the Block Island offshore wind farm several years ago, the only offshore wind project operating in the United States.

I am sure, given the current offshore industry weakness, that there are offshore workers from the Gulf Coast region who would be happy to work rotating shifts off the East Coast installing wind turbines, just as they do for production platforms for oil companies in the Gulf of Mexico or elsewhere around the world. HR 3068 sounds like another government sponsored boondoggle, and another way to spend federal money when a perfectly good labor force already exists - and it was created by the private sector.

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