

MUSINGS FROM THE OIL PATCH

July 30, 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:

Germans Accept CO2 Cost As Electricity Expense Rises

Germany is aggressively combating carbon emissions by ending coal-fired power generation and using more renewables. The result: serious electricity price rises and emissions trailing the target.

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Nature And Market Cycles In The Energy Investment World

All asset classes experience cycles of investment over- and under-performance. Studying them is critical to know what drives them and when asset classes might switch from winners to losers.

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The Personal Transportation Revolution May Take More Time

Self-driving vehicles are assumed to be the future of personal auto transportation. That has been the hype, but the reality is that their arrival will be much later than anyone thought as late as 2018.

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Rhode Island Electricity Prices And The Region's Gas Market

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Germans Accept CO2 Cost As Electricity Expense Rises

The percent of respondents expressing a spending preference only accounted for 59%, so 41% had no opinion?

According to a survey by German weekly tabloid *Bild am Sonntag*, respondents would be willing to spend an average of €32 (\$35.84) a month on climate action. The respondents were split over whether a CO2 tax should be used to reduce carbon emissions (47% favored; 49% disapproved). Around 16% of the survey respondents said no to spending on climate action, while 21% were willing to pay up to €10 (\$11.20) per month, 12% up to €50 (\$56.00), and 10% more than that. The percent of respondents expressing a spending preference only accounted for 59%, so 41% had no opinion? Depending on how the survey was done, did those with 'no opinion' decide to not respond fearing reactions to their view – spend nothing? It is hard to see the group willing to pay but not share that.

Although we know little about the survey's details, the results were illuminating. More respondents were against employing a carbon tax to drive climate action than favored such a step. Probably not statistically significant, but an important data point in the debate over taxing carbon emissions. Also interesting was noting their spending amounts, especially since Germans pay the highest electricity prices in Europe. The media reporting the survey's results commented: "Germans remain supportive of the energy transition and the switch to a low-carbon economy." That view comes despite expensive electricity and plans to shutter coal mining with large job losses.

Germans are willing to spend 1.1% to 1.8% of monthly after-tax income for climate action

Using wage data from the Organization for Economic Co-Operation and Development (OECD) web site, we found that average annual wage in Germany last year was \$49,813. Applying Germany's 14% tax rate for that income bracket (government web site), average after-tax monthly wages total \$3,187. Thus, Germans are willing to spend 1.1% to 1.8% of monthly after-tax income for climate action.

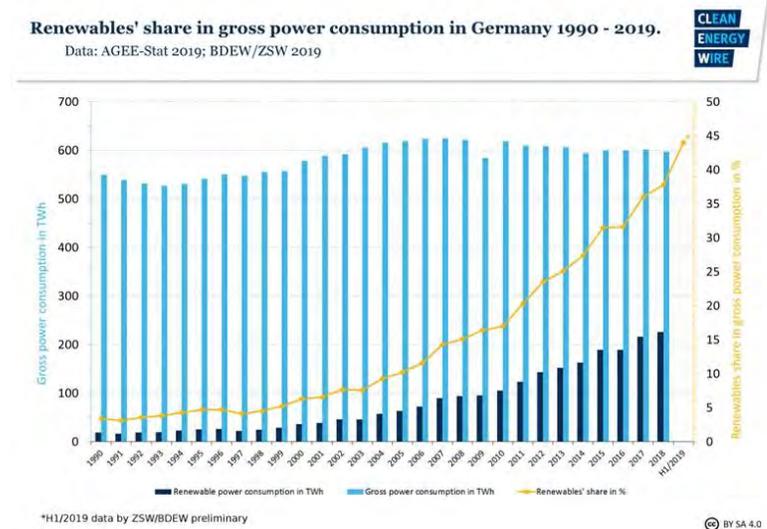
This survey comes as consideration of implementing a carbon tax has become the government's solution to address the country's falling off its track for meeting its emission reduction target. Since implementing its energy transition plan that involved shutting down nuclear power plants, ending coal-fired power generation and investing heavily in wind and solar power, the country has struggled to meet its target. To offset grid stability with its plan, Germany's utilities were forced to restart coal-fired power plants and import coal from the United States. According to studies, the emissions reductions last year and so far in 2019 are due to the use of more gas-fired power plants and fewer coal-powered ones.

At the core of the government's energy transition was new taxes on electricity to fund renewable power

At the core of the government's energy transition was new taxes on electricity to fund renewable power, which has lifted costs sharply in recent years. Residential electric prices rose rapidly, as the taxing structure was designed to favor the manufacturing sector, which is the backbone of the German economy and jobs. The structure has been revamped to help residential users.

What we see in Exhibit 1 is the significant growth in renewables' share of gross power consumption in Germany.

Exhibit 1. Renewables Share Of German Energy

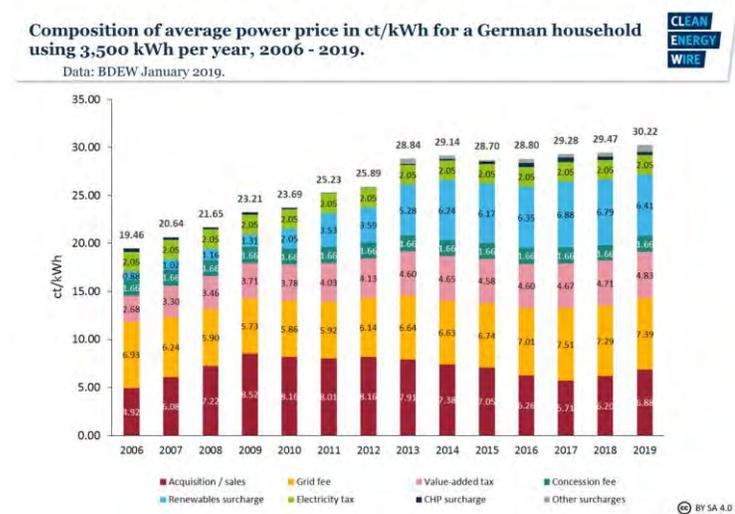


Source: CLEW

Absent the surcharge, electricity rates would have only increased 28% between 2006 and 2019

That growth has come at a cost of higher electricity prices (Exhibit 2). The primary driver for the price rise is the Renewables Surcharge (light blue) that rose steadily through 2017, after which it declined slightly in 2018 and 2019. Absent the surcharge, electricity rates would have only increased 28% between 2006 and 2019, rather than the actual rise of 55%, or half the price increase the average German household has paid.

Exhibit 2. Renewables Have Lifted Electricity Prices



The subsidy of renewables is proving costly, which is sparking the discussion of imposing either a carbon tax or an emissions trading scheme

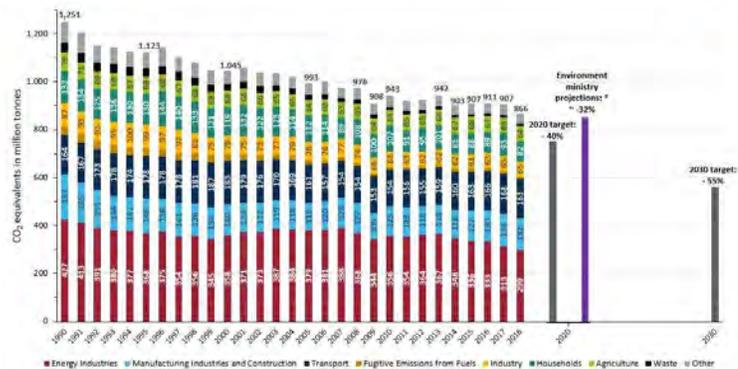
Emissions in 2018 are 13% higher than that 2020 target

It is acknowledged that Germany will fail to meet its goals for reducing carbon emissions, despite its recent aggressive actions. The phase out of coal for generating electricity, and the need for coal mining, especially of dirty lignite, is being planned, but the timetable calls for coal's end in 2038, essentially 20 years from now. The subsidy of renewables is proving costly, which is sparking the discussion of imposing either a carbon tax or an emissions trading scheme. Most trading schemes have proven less successful than envisioned, but there is always a "new" way to structure them to make them fairer. The carbon tax alternative is easier to implement, but it is regressive and requires relief for low-income families to be fair. Most carbon tax schemes being proposed envision the funds being returned to families to help offset their regressive nature.

Germany's emissions challenge is forcing the government to adjust expectations. As Exhibit 3 shows, the country has reduced total greenhouse gas emissions by 31% since 1990. However, that leaves it well short of its 2020 target of a 40% reduction. Emissions in 2018 are 13% higher than that 2020 target, which is why the Environment Ministry is projecting the actual emissions reduction by 2020 will likely be only 32%, one percentage point higher than 2018's level. Germany has a 2030 target for reducing greenhouse gas emissions by 55% from 1990. Achieving that goal will require not only significant increases in renewables in the electricity sector, but also electrifying the transportation industry. The government is also considering proposals to ban all domestic airline flights, forcing people to either drive, or more likely rely on trains for intercity transit.

Exhibit 3. CO2 Emissions Are Off-track For Target

Greenhouse gas emission trends in Germany by sector 1990-2018. Data: UBA, 2019.



Note: Without emissions from land use, land use change and forestry (LULUCF)
 * First estimate April 2019.
 ** According to environment ministry calculations from October 2017, Germany is set to widely miss its goal to reduce greenhouse gas emissions by 40% by 2020.

Source: CLEW

To better understand Germany's successes and challenges, Exhibit 4 provides a perspective. In the early 1990s, Germany experienced

These emission reductions were referred to as “wall fall profits”

significant emissions reductions due to the combination of East and West Germany after the fall of the Berlin Wall. These reductions came from shutting down the old, inefficient manufacturing plants that dominated the East German economy. These emission reductions were referred to as “wall fall profits.” Another large reduction (-6.9%) occurred during the 2009 economic crisis that forced many German manufacturing industries to scale back activity. The thought that these savings would be permanent was dealt a blow in the following years.

Exhibit 4. Germany’s CO2 Reductions Due To Events

Percentage change in Germany’s greenhouse gas emissions year-on-year 1990-2018.

Data: UBA 2019.



Source: CLEW

The share of total energy represented by natural gas is growing, largely at the expense of coal

Reducing Germany’s future carbon emissions will necessitate a meaningful reshaping of the nation’s energy mix. Currently, fossil fuels account for 86% of Germany’s total energy use. The share of total energy represented by natural gas is growing, largely at the expense of coal, much as is happening in the United States. Here too, it is all about cheaper gas. Natural gas has a 24% share compared to coal’s combined market share of 21%. The nuclear share (6.5%) will eventually evaporate as the country’s remaining plants are shut down.

Germany aims to cut transport emissions 40 percent by 2030 compared to 1990 levels, but has yet to make any progress towards this target

A large emissions’ reduction opportunity exists if oil’s energy share (34%) can be reduced. In fact, it will be required if the country is to meet its emissions target. Germany aims to cut transport emissions 40 percent by 2030 compared to 1990 levels, but has yet to make any progress towards this target. It will need aggressive actions to phase out diesel cars, which is slowly happening as buyers turn against them following revelations of the diesel testing scandal. At the same time, internal combustion engine powered vehicles will need to be phased out and replaced with electric vehicles. Banning

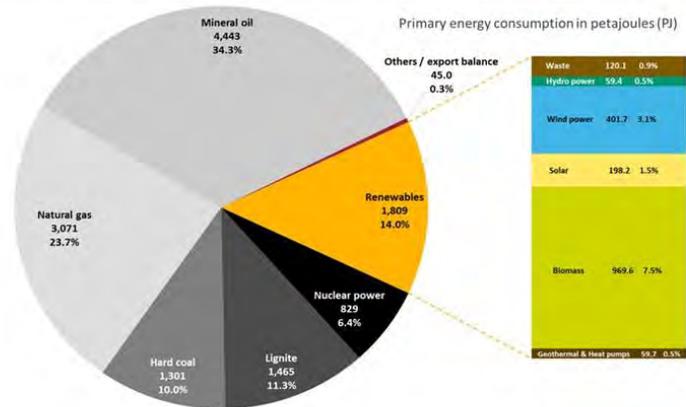
The average CO2 emissions of new cars was up 2% between 2017 and 2018

fossil fuel-powered cars from the city centers of some of Germany's largest cities is the first step in such an effort. Forecasts from the EU Transport and Environment agency says that one in five cars will be electric in 2025, and that Germany will have the second largest per capita gain. The problem is that between 2016 and 2018, new car sales in the highest efficiency category fell 5 percentage points. New car sales were dominated by SUVs and all-terrain vehicles. As a result, the average CO2 emissions of new cars was up 2% between 2017 and 2018.

In the first half of 2019, newly registered electric vehicles increased 41% over a year ago, climbing from 34,000 to 48,000 units. This gain comes while the German automobile market largely stagnated overall. The challenge is that electric vehicles still only account for a 2.6% market share.

Exhibit 5. Germany's Renewables Dominated By Biomass

German energy mix 2018: Energy sources' share in primary energy consumption. Data: AG Energiebilanzen 2019, preliminary.



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Source: CLEW

Half of Germany's renewable energy is accounted for by biomass

A challenge for Germany is growing its renewables power contribution. Although it accounts for 15% of final energy consumption in Europe, up from 14% in 2016, the pricing for electricity, plus issues with grid stability due to the intermittency of solar and wind, is beginning to slow the growth of renewable energy sources. Half of Germany's renewable energy is accounted for by biomass, with wind representing roughly half of biomass's share, and solar half of wind's share. Germany is not blessed with much hydroelectric power, and waste energy has never been a meaningful energy source.

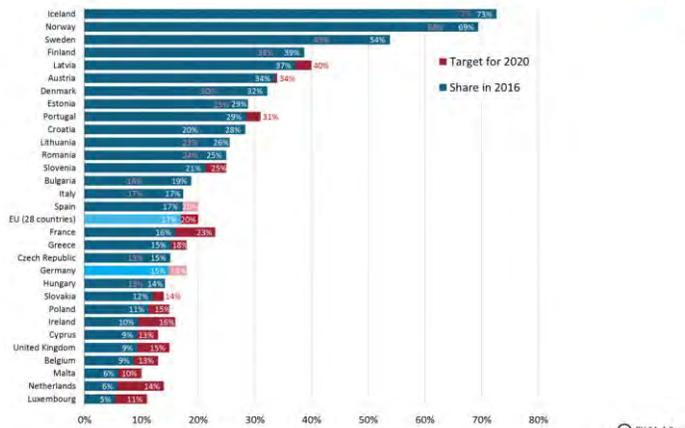
With renewables at 15% of total power consumption, getting to the 2020 goal of 18% may be a real challenge. The target rises to 30% in 2030, 45% in 2040 and 60% in 2050. Interestingly, the coalition

treaty negotiated between Chancellor Angela Merkel’s conservative CDU/CSU alliance and the Social Democratic Party for governing Germany envisions renewables’ share in Germany’s power mix to rise to 65% by 2030, more than twice the current target.

Exhibit 6. Where Germany Ranks In Renewable Power

Share of renewables in gross final energy consumption in Europe 2016 and country target share for 2020.

Data: Eurostat 2018.



Source: CLEW

We suspect the recent pushback from households against the sharp rise in electricity prices may be a signal that consumers are reaching their limits to higher costs

In response to the question of whether Germany can/will impose a carbon tax to get the country back on track with its greenhouse gas reductions, many say it will not be an issue with the public since few have any idea about what they pay for electricity. They also suggest that utility bills are a small portion of Germans’ income, so if prices go up due to a carbon tax, it won’t be a problem. That logic, however, belies the goal of changing consumer behaviors toward energy by increasing costs by installing a carbon tax. We suspect the recent pushback from households against the sharp rise in electricity prices may be a signal that consumers are reaching their limits to higher costs. How Germany moves forward to address its greenhouse gas emissions problem will be interesting to watch.

Nature And Market Cycles In The Energy Investment World

How well and how long various investment categories perform, along with their frequency of over- or under-performance, is key to the results for investors

The history of investing is marked by cycles. Their existence is used to support the expression “history doesn’t repeat but it does rhyme.” Types of investments – physical commodities, types of companies, classes of assets, and periods of euphoria – have all had their “day in the sun” as far as investing success. How well and how long various investment categories perform, along with their frequency of over- or under-performance, is key to the results for investors. In essence, it is all about cycles. Understanding influences on them is key to judging changes in investment cycles.

Mastering these timing shifts depends on understanding investment cycle history and studying the factors driving the cycles

While it appeared to many that Mr. Dudley was talking about oil prices, in reality he was expressing a view that the fundamental relationships between oil prices, production and consumption were changing

Commodities represent one of the largest asset classes in the investment world. Their performance is often counter-cyclical to other assets classes such as financial assets. The challenge for investors is not only to understand which asset class is in investor favor, but also when that favoritism might move to another asset class. Mastering these timing shifts depends on understanding investment cycle history and studying the factors driving the cycles. For energy investors, the past five years have been extremely trying – so much so that many investors have abandoned the playing field due to the apparent breakdown in historical relationships. If they no longer work, the logical question is whether movements between energy asset prices and energy equities are telling investors that new relationships exist. If so, then investors need to figure out what these new relationships are, and importantly, their meaning for investing in the future in the asset class. Of course, it is entirely possible that the relationships haven't been broken, just that it will take time for them to reestablish their dominance in the market.

When OPEC abandoned its decades-long willingness to adjust its output to manage the global supply of crude oil, and thus oil prices, the energy world changed. Not only did the energy world change, but its stability was in doubt. When BP plc's (BP-NYSE) CEO Bob Dudley uttered the phrase "lower for longer" with respect to his company's planning for global oil prices, little did he realize the power of these three words. While it appeared to many that Mr. Dudley was talking about oil prices, in reality he was expressing a view that the fundamental relationships between oil prices, production and consumption were changing. It was almost 15 months after OPEC's move before global oil prices hit bottom, so significant market changes often don't happen quickly.

Exhibit 7. Oil Prices Are Better Than in 2014-2017



Source: EIA, PPHB

When oil prices fell in late 2014, a struggle emerged between industry players who expected a sharp oil price drop and a sharp rebound, much like what happened in 2008-2009 following the

U.S. production has climbed 47% over the past three years, to levels never thought possible during the prior 40 years

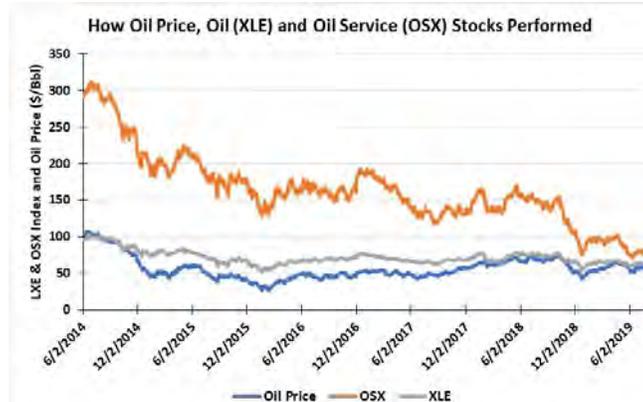
A new model is evolving in response to investor demands that energy companies be profitable and return cash to investors

financial crisis. Countering that expectation was the view that the global oil market had entered a new era marked by lower oil prices sustained for a long time, such as happened after the mid-1980s oil price collapse. Those low prices needed 16 years to fully recover.

Four and three-quarter years after that fateful OPEC meeting in Vienna, the global oil market is still struggling to recover. Yes, oil prices have doubled since the cycle low in February 2016 at \$28 per barrel. They have been meaningfully higher than now, but have also spent substantial time lower. The U.S. has moved from a huge oil importer to a significant oil exporter. U.S. production has climbed 47% over the past three years, to levels never thought possible during the prior 40 years. That dynamic has upset OPEC’s operational model, forcing it to seek a formalized working relationship with Russia, the world’s other major oil producer. This new group – OPEC+ – has cut its output to help balance oil supply and demand and lift oil prices to levels producer governments need to balance their financial affairs.

Today’s energy world is nothing like what it was prior to OPEC’s move. It is even moving away from the model that evolved immediately after the price collapse. Both of those models have been shunned by investors. A new model is evolving in response to investor demands that energy companies be profitable and return cash to investors. This new model is evolving in response to the disconnect between energy company fundamentals and their share prices. That disconnect is evident in Exhibit 8, which tracks oil prices and stock indexes reflecting oil and oil service companies since mid-2014 when oil prices began sliding, before OPEC delivered its coup de grâce. Oil company stocks (XLE) performed better during this period, largely because they pay dividends, offering investors income while waiting for share values to reflect higher oil prices. Oil service stocks (OSX) fell steadily in this period, because of too much debt and shrinking market activity leading to substantial asset impairment and eroding company values.

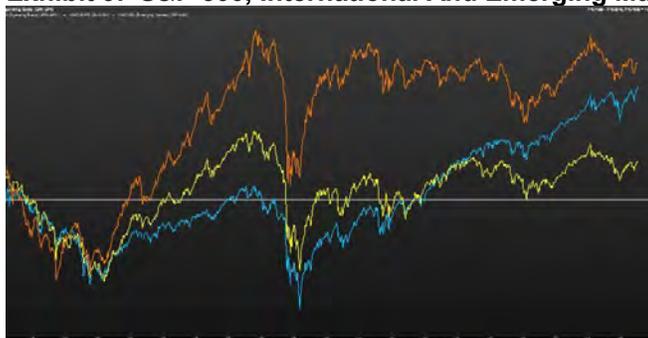
Exhibit 8. Oil Stocks Perform Closer To Oil Prices



Source: EIA, Yahoo Finance, PPHB

Although it appears that better oil prices have done little for oil and oil service stocks, to better understand investing cycles and whether better days lay ahead for this sector, we should consider longer time periods and other investment cycles for perspective. For example, Exhibit 9, from *FactSet* data and prepared by RBC, showing the performance of two international stock indexes versus the Standard & Poor's 500 index for the past 20 years offers some guidance. The S&P 500 index (blue line) is plotted against the MSCI Emerging Markets index (orange line) and the MSCI EAFE large cap stocks (yellow line) from 21 developed economies, excluding the U.S. and Canada. Following the technology stock bust of 2000, all three indices recovered and performed in-line until 2003. From then until 2007, which marked the bull market leading up to the financial crisis, international stocks outperformed the S&P 500.

Exhibit 9. S&P 500, International And Emerging Markets



Source: *FactSet*, PBC

Despite the strong S&P 500 index performance in recent years, it has yet to catch up with the huge performance gain of emerging stocks built up in the pre-crash period

Following the crisis stock market crash, the S&P 500 outperformed foreign stocks. The S&P 500 pulled even with international stocks in 2012, surpassing the MSCI EAFE. Despite the strong S&P 500 index performance in recent years, it has yet to catch up with the huge performance gain of emerging stocks built up in the pre-crash period. Another way of looking at the international versus domestic stock performance is in the following charts. The charts show the ratios of the Dow Jones Europe Index and the MSCI Emerging Markets index compared to the S&P 500 index.

Exhibit 10. How International Stocks Fared Vs. Market



Source: RBC

Exhibit 11. Emerging Market Stocks Vs. Stock Market



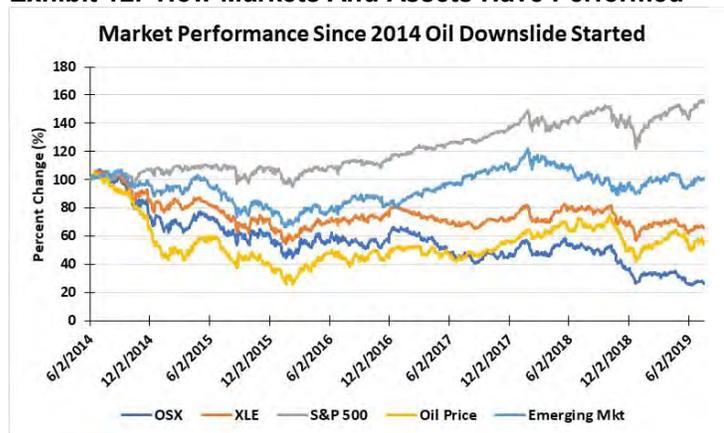
Source: RBC

What is unknown, and thus indeterminable, is when reversals of current trends will happen, if ever

What we see in the charts is how the international stocks are either below or approaching the low ratios established during the tech stock bust around 2000. Does that mean these stocks are poised to reverse the performance patterns of the last decade? Maybe, if you accept that cycles oscillate between highs and lows. What is unknown, and thus indeterminable, is when reversals of current trends will happen, if ever. We remain confident stating that the trends will reverse because that has been their history. What we don't know is when or by how much any reversal will mean.

If we broaden our review of market performance since mid-2014, Exhibit 12 shows not only the performance of indexed values for the XLE, OSX and oil prices, we have added similar indexed values for the S&P 500 and the MSCI Emerging Markets. This gives us a broad perspective on how poorly energy has performed over the past five years.

Exhibit 12. How Markets And Assets Have Performed



Source: Yahoo Finance, EIA, PPHB

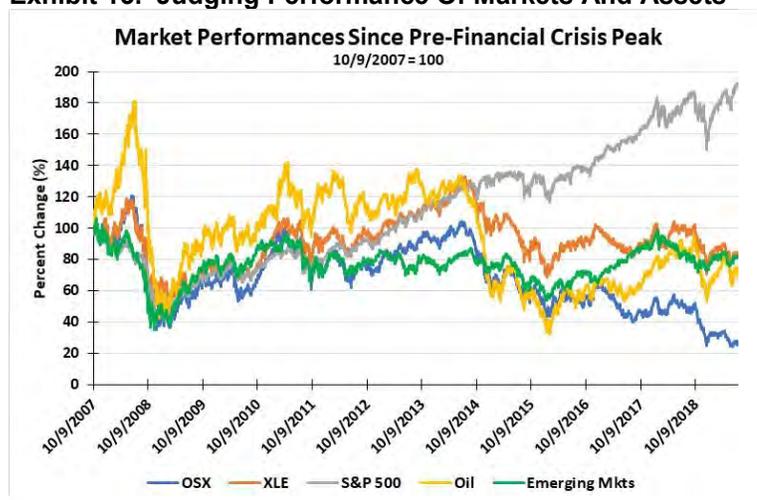
Essentially, anything to do with energy (XLE, OSX and oil price) has declined since June 2014. On the other hand, the Emerging

Emerging Markets index is unchanged after five years, while the S&P 500 has soared nearly 160%

Markets index is unchanged after five years, while the S&P 500 has soared nearly 160%. This performance, which for energy began to really deteriorate following the late November 2014 OPEC meeting, is an explanation for why investors have increasingly shunned energy investments. We have two additional charts showing the challenges energy has been dealing with for a decade.

A popular analytical technique is to tie comparative performance to specific market events. In one case, we tied the performance of our market measures to the last peak in the S&P 500 index in 2007. The other example tied performance to the 2008 peak in crude oil prices. The pictures are similar with the S&P 500 outperforming everything else by wide margins.

Exhibit 13. Judging Performance Of Markets And Assets

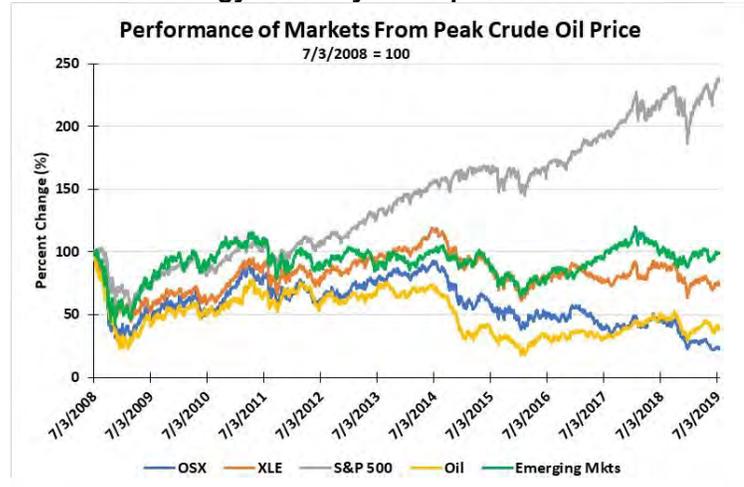


Source: Yahoo Finance, EIA, PPHB

When we examine the post stock market peak chart, the S&P 500 and all other measures tracked both the downturn due to the financial crisis and recovery up to late 2014 when OPEC changed the rules of the oil market. Since late 2014, the S&P 500 outperformance soared relative to energy and emerging markets indices.

The 2014 OPEC market move sent energy and emerging market indices down with only the latter recovering in 2015 and outperforming energy until fall of 2017 before beginning to decline

When we look to the post oil price peak of 2008, the S&P 500 outperformance started in mid-2011 and has been greater than the index posted in the analysis of performance following the S&P 500 peak. It is interesting that in the period marked by the recovery from the recession/oil price peak, emerging markets performed in-line with the S&P 500, only to begin diverging following the mid-2011 stock market correction. Since then, the 2014 OPEC market move sent energy and emerging market indices down with only the latter recovering in 2015 and outperforming energy until fall of 2017 before beginning to decline.

Exhibit 14. Energy Woefully Underperforms Stock Market

Source: Yahoo Finance, EIA, PPHB

Do all these charts tell us anything definitively? No, but their histories show that all the measures fluctuate, some much more than others. That reinforces, in our mind, the nature of investment cycles with varying lengths. As stated earlier, we fully expect future cycles without any conviction of when current market trends may change.

More disciplined management by oil and gas producers of their cash flows, which will deliver improved returns to shareholders, will likely influence the next energy cycle

It is also important to note that the mere existence of cycles does not tell us anything about their magnitude nor their duration of either periods of underperformance or outperformance. More disciplined management by oil and gas producers of their cash flows, which will deliver improved returns to shareholders, will likely influence the next energy cycle. The critical ingredient, and one about which we can only guess, is how long the new financial management philosophy must be demonstrated before investors reward those companies with higher stock market valuations.

The Personal Transportation Revolution May Take More Time

The anticipated benefits for the economy, society and human lives from such a transportation revolution have driven significant investment in autonomous vehicle, or self-driving, technology

If you have been following transportation, the global energy transition and technology trends in Silicon Valley, you will be familiar with the belief that the history of people's use of cars is about to be permanently altered. The anticipated benefits for the economy, society and human lives from such a transportation revolution have driven significant investment in autonomous vehicle, or self-driving, technology. That money has come from traditional automobile companies, software companies developing artificial intelligence (AI), and private equity investors, all hoping to ride the first-mover value creation model.

Some commentators believe the industry needs a better name than autonomous vehicles or self-driving cars, much like horseless

As envisioned, a fully-autonomous vehicle fleet with few or no accidents would save upwards of 90% or more of the 37,000 lives a year lost on America's roads

It helped drive views that the likelihood of this technology being widely adopted by consumers was near and would revolutionize the automotive industry

Futurists projected significant growth for self-driving vehicles as people were projected to fall in love with the prospect of having their own personal chauffeur

carriages became automobiles and cordless phones became cell phones. However, it might be better to worry more about the pace of development of the technology that allows vehicles to drive themselves without human input than what we call it.

The key promise of self-driving cars is safety. Cars driven based on computers monitoring sensors and intelligence continually being gathered about road conditions and the surrounding environment are assumed to avoid accidents. As envisioned, a fully-autonomous vehicle fleet with few or no accidents would save upwards of 90% or more of the 37,000 lives a year lost on America's roads. While an admirable objective, it should be noted that since 1945, vehicle safety has improved significantly, despite the U.S. fleet mushrooming in size and miles-driven exploding. Over that time, American automobile deaths declined from 10 per 100 million vehicle miles traveled to less than one.

Seven years ago, a major white paper published by KPMG LP and the Center for Automotive Research (CAR) examined the forces of change, as well as the current and emerging technologies and the path to bring these innovations to market. It helped drive views that the likelihood of this technology being widely adopted by consumers was near and would revolutionize the automotive industry. The introduction to the report stated the following:

“For the past hundred years, innovation within the automotive sector has brought major technological advances, leading to safer, cleaner, and more affordable vehicles. But for the most part, since Henry Ford introduced the moving assembly line, the changes have been incremental, evolutionary. Now, in the early decades of the 21st century, the industry appears to be on the cusp of revolutionary change—with potential to dramatically reshape not just the competitive landscape but also the way we interact with vehicles and, indeed, the future design of our roads and cities. The revolution, when it comes, will be engendered by the advent of autonomous or “self-driving” vehicles. **And the timing may be sooner than you think.**” (highlight added)

The 2012 KPMG/CAR report was representative of many of the autonomous vehicle reports published at that time. Although the authors were dealing with speculative predictions about how quickly the technology and hardware would be developed, futurists projected significant growth for self-driving vehicles as people were projected to fall in love with the prospect of having their own personal chauffeur. Not only would someone else be responsible for getting you from point A to point B, during the trip you could engage in virtually any other activity, or none at all, such as sleeping.

Electric vehicles and autonomous vehicles became entwined in the thinking and discussions about how the personal transportation and the automobile industries would be changed

Coupled with self-driving technology were thoughts that personal transportation could be altered to improve urban environments and deal with climate change if the cars were powered electronically. Thus, electric vehicles and autonomous vehicles became entwined in the thinking and discussions about how the personal transportation and the automobile industries would be changed.

Exhibit 15. Self-driving Scenarios



Source: KPMG/CAR

The KPMG/CAR report presented three theoretical projections for consumer adoption. The three scenarios - Aggressive, Baseline and Conservative – were presented with only nebulous time frames. Since there was actually no idea when this report was being prepared as to how many vehicles could be introduced and over what time period, the lines on the charts were to be representative of how market shares might change.

The Conservative scenario finds consumers less enthusiastic about the benefits of self-driving vehicles and the regulatory support is disappointing

We presented the three charts (Exhibit 15) showing the uptake of autonomous vehicles, but without the accompanying detailed commentary on consumer acceptance, the regulatory environment and the technology development. In summary, the Aggressive and Baseline scenarios assume consumers embrace the perceived benefits and the regulatory environment is positive, including a mandate for Vehicle-to-Vehicle (V2V) technology to be included in all cars. The Conservative scenario finds consumers less enthusiastic about the benefits of self-driving vehicles and the regulatory support is disappointing. Has this become the reality?

With a typical four-year vehicle development cycle, the first vehicles with V2V technology would appear on the roads in 2019, or perhaps sooner

The report's authors suggested the government would aggressively work to develop a framework that would allow self-driving vehicles nationally and without burdensome rules. Their optimism came from the fact that the U.S. Department of Transportation (USDOT) was launching a Connected Vehicle Safety Pilot Program, which would use the data collected as input for determining a Notice of Regulatory Intent (NRI) regarding V2V safety. A timetable assuming a positive NRI in 2013 would lead to the release of specifications in 2014 and 2015. With a typical four-year vehicle development cycle, the first vehicles with V2V technology would appear on the roads in 2019, or perhaps sooner if automobile manufacturers opted to move forward without a mandate from the government.

Earlier this year, Jim Hackett, the CEO of Ford Motor Company told an audience at the Detroit Economic Club, "We overestimated the arrival of autonomous vehicles."

In October 2018, the USDOT released version 3.0 of proposed rules for autonomous vehicles. This was five years behind the scenario presented in the KPMG/CAR report. Earlier in 2018, automobile manufacturers and Silicon Valley technology companies announced plans to put thousands of self-driving taxis on the road in 2019. However, earlier this year, Jim Hackett, the CEO of Ford Motor Company (F-NYSE) told an audience at the Detroit Economic Club, "We overestimated the arrival of autonomous vehicles." And last week, General Motors (GM-NYSE) announced it was slowing its Cruise's subsidiary's deployment of an autonomous ride-hailing service that was targeted to start-up late this year.

"You see all kinds of crazy things on the road, and it turns out they're not all that infrequent, but you have to be able to handle all of them"

Another somber outlook for self-driving cars came from Bryan Salesky, the CEO of Argo AI, a Pittsburgh start-up in ride-sharing services planning to have autonomous vehicles operating in a few urban zones as early as 2021. Mr. Salesky said the promise of self-driving cars going anywhere was "way in the future." He attributed the delay to human behavior. As proof, he cited examples such as confronting a bicyclist riding the wrong way on a busy street or a street sweeper that suddenly turned a giant circle in an intersection, touching all four corners and crossing lanes of traffic that had a green light. In an interview, Mr. Salesky commented, "You see all kinds of crazy things on the road, and it turns out they're not all that infrequent, but you have to be able to handle all of them. With radar and high-resolution cameras and all the computing power we have, we can detect and identify the objects on a street. The hard part is anticipating what they're going to do next."

That challenge reminded us of President John F. Kennedy's Moon speech on September 12, 1962, at Rice Stadium in Houston. He said: "We choose to go to the moon. We choose to go to the moon in this decade and do the other things, not because they are easy, but because they are hard, because that goal will serve to organize and measure the best of our energies and skills, because that challenge is one that we are willing to accept, one we are unwilling to postpone, and one which we intend to win, and the others, too." Will autonomous vehicles become the next Journey to the Moon quest?

The major event that reset expectations about the pace of acceptance of autonomous vehicles was the death of a women in Phoenix walking her bicycle across the street when she was hit by an Uber self-driving test car

The major event that reset expectations about the pace of acceptance of autonomous vehicles was the death of a women in Phoenix walking her bicycle across the street when she was hit by an Uber self-driving test car. There have also been three deaths involving Tesla vehicles employing the company's Autopilot driver-assistance system when they crashed. These accidents have highlighted that while 80% of the technology to put self-driving vehicles into routine use has been developed, the remaining 20%, involving software that can reliably anticipate what other drivers, pedestrians and cyclists are going to do, has yet to be proven.

Although it is generally acknowledged that the hardware for self-driving cars has been developed, there remain some technical issues that have yet to be resolved. They were pointed up in several reader responses to an article about self-driving vehicles in *The New York Times*.

'Show me an autonomous car driving in the northeast during winter and then I'll believe you'

A technologist from Boston wrote: "I've been in the robotics field for decades. Anyone who's been in robotics more than 5 years knew how difficult this problem is and how unrealistic the promises have been. There's even a joke about it: 'Show me an autonomous car driving in the northeast during winter and then I'll believe you.'" This comment gets to the challenge of keeping sensors and Lidar laser devices clean. Moreover, other comments noted the need for mapping roads, which often lose their points of reference in snow storms and heavy rain, making it difficult or even impossible for an autonomous vehicle to drive since it has no controlling mechanism.

The issue of the software development, i.e., programing the morality of driving an autonomous vehicle, was commented on by several commentators. One specific comment proposed a hypothetical scenario in asking how the vehicle/software would deal with the choices. The commentator, a technologist from California, wrote:

"California law says cars must not cross double yellow lines, must remain three feet from bicyclists, and must pull over when there are more than five cars following.

"On smaller two-lane highways, it is impossible for a car to remain three feet from a bicyclist without crossing a double yellow line.

"To accommodate these requirements, a driverless car would need to drive behind the bicyclist. But this might cause more than five cars to follow the slow (5 mph?) vehicle.

"Which California law would the driverless car choose to violate? Would it illegally cross a double yellow line, illegally approach a bicyclist too closely, or illegally allow more than five cars to build up behind it?

The Apollo fire nearly killed the space program, but following an 18-month reassessment of the equipment and technology, the program moved forward

“AI can never ‘judge.’ This is the problem with any driverless car--all it can do is react based on preprogramming. How can you program it to break laws? and in what situations? Judgement is more than brake, accelerator, and steering control.”

Someone might equate the Uber-pedestrian death in Phoenix in 2018 with the January 27, 1967, Apollo 1 fire that killed astronauts Roger Chaffee, Ed White and Gus Grissom as the event forcing a reset of expectations. The Apollo fire nearly killed the space program, but following an 18-month reassessment of the equipment and technology, the program moved forward. Ten missions and two and a half years later, we landed men on the Moon. What makes that event different is that it involved skilled fliers who volunteered for a highly risky mission, and who had minimal backup support. That is not a risk the average American, or world citizen, would be willing to take when getting in a self-driving car.

While the KPMG/CAR report didn't offer anything more than rough timetables and indications of market penetration, we would suggest that the reality of self-driving car penetration since 2012 has been well below even the Conservative scenario. While we are not saying that self-driving cars will never make an impact on the automobile and energy industries, we are suggesting that their success will take much longer than the early optimists touted, and be limited to unconventional operations. Will this also prove true for electric vehicles?

Rhode Island Electricity Prices And The Region's Gas Market

National Grid plc has requested the state's Public Utility Commission to approve a residential power cost increase from 9.24 cents per kilowatt-hour to 10.95 cents

The dominant electricity supplier in Rhode Island, National Grid plc (NGG-NYSE), has requested the state's Public Utility Commission to approve a residential power cost increase from 9.24 cents per kilowatt-hour (kWh) to 10.95 cents. The increase follows the usual pattern of price moves heading into the winter months of October 1 to March 31. Last year's winter rate was 10.99 cents/kWh. These prices relate to the "standard offer," which represents National Grid's energy cost bought on wholesale power markets and, by law, passed on to ratepayers without adding profit.

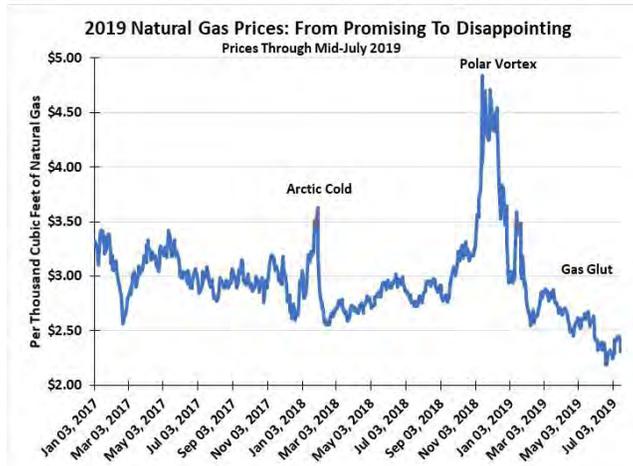
Electricity generators see their gas supply cut when cold weather dictates it be directed to home heating needs

Rates generally drop during the summer months of April 1 through September 20, due to lower natural gas prices. This price cycling reflects the need to adjust electricity rates for the seasonal increase in natural gas prices experienced during the New England winter where the region has limited gas pipeline delivery capacity, inadequate gas storage, and the inability of power companies to enter into long-term gas supply contracts. Given this market structure, electricity generators see their gas supply cut when cold weather dictates it be directed to home heating needs. This forces power companies to purchase significantly more expensive imported liquefied natural gas (LNG).

The trend in progressively lower retail electricity price increases reflects the ongoing weakness in natural gas prices

The requested rate change means the typical Rhode Island residential electricity customer, who uses 500 kilowatt-hours, would see his/her monthly bill rise by \$8.95, or 8%. That increase would be lower than the 2017 increase of 19% approved by the regulators, and last year's increase of 13%. The trend in progressively lower retail electricity price increases reflects the ongoing weakness in natural gas prices.

Exhibit 16. Natural Gas Price Remain In The Doldrums



Source: EIA, PPHB

Think what will happen to Rhode Island electricity prices when natural gas prices climb back toward \$3.50 per thousand cubic feet? Nearly 94% of the state's electricity is generated from natural gas with the balance from renewables. Biomass is 3% of renewable power, with wind and solar representing the balance, according to the Energy Information Administration's (EIA) 2018 data.

More than half the gas consumed in Rhode Island goes to the power sector

The EIA's write-up of Rhode Island's energy profile noted that natural gas comes to the state via two pipelines hauling supplies from the Marcellus and Utica formations in the Appalachian region. All the gas comes through Connecticut, and almost two-thirds entering Rhode Island is sent on to Massachusetts. More than half the gas consumed in Rhode Island goes to the power sector. Additionally, more than half the state's households heat with natural gas, which is why their use has preferential treatment in the winter.

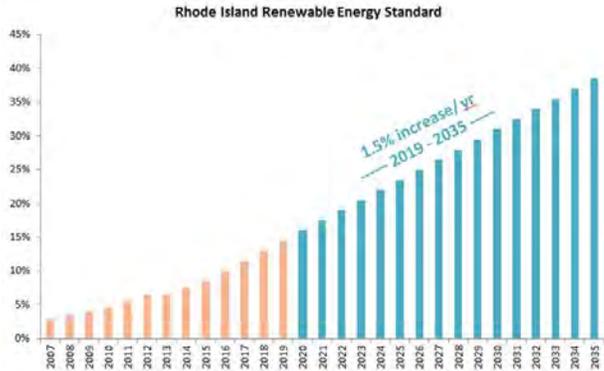
In 2016, the Rhode Island legislature dictated that the RES increase at a 1.5% per year rate through the end of 2035

One trend pressuring electricity prices is the state's Renewable Energy Standard (RES), which is a dictate for local generators to produce increasing amounts of power from renewable fuels, or to purchase renewable energy certificates (REC) from other producers of renewable power. The RES was adopted in 2004. In 2016, the Rhode Island legislature dictated that the RES increase at a 1.5% per year rate through the end of 2035. From then on, retail electricity providers are required to keep securing 38.5% of their output from renewables unless there is a change in policy. By this

Only one in ten households use electricity for heating during the winter

measure, fossil fuels will still have a significant market share in Rhode Island’s power sector. It is important to note that only one in ten households use electricity for heating during the winter. Changing that dynamic requires forcing residents to switch their oil or natural gas heating systems, a questionable mandate. Otherwise, impacting renewables share will wait for the state’s housing stock to turn over, something likely to take years to accomplish.

Exhibit 17. Rhode Island’s RES Peaks At 38.5%

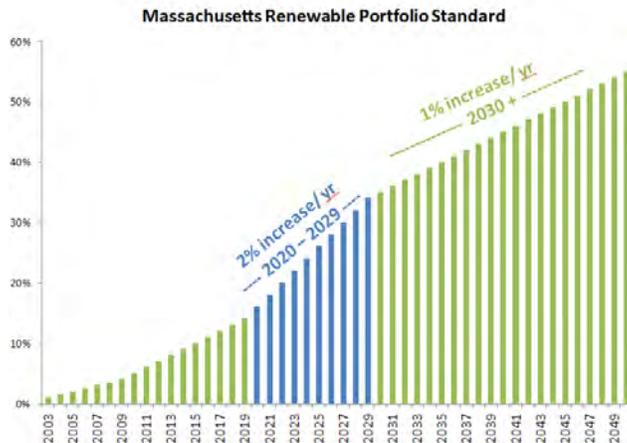


Source: Green Energy Consumers Alliance

Under the new policy, Massachusetts will have an RPS mandate equal to Rhode Island’s in 2035, but then it will climb toward 55% of green energy by 2050

Massachusetts has been more aggressive than Rhode Island in pushing for a decarbonized electricity system. The state enacted its RPS in 2003, and after seeing initial benefits, modified the standard in 2008, mandating its rise by 1% every year indefinitely. In 2018, the standard reached 13%. The legislature then changed the RPS to reflect a mandated 2% annual increase from 2020 through 2029, before returning to the 1% per year policy. Under the new policy, Massachusetts will have an RPS mandate equal to Rhode Island’s in 2035, but then it will climb toward 55% of green energy by 2050.

Exhibit 18. Despite Early Start, MA Needs Higher Rate

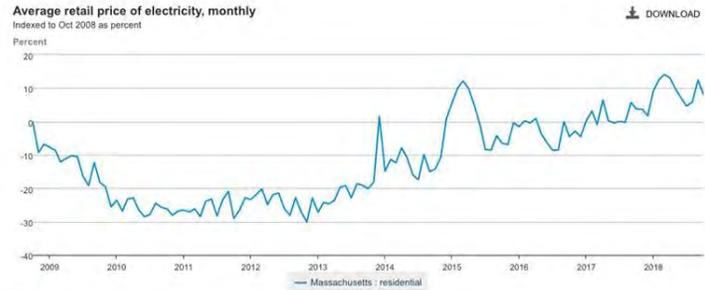


Source: Green Energy Consumers Alliance

Since then, average monthly electricity bills have climbed sharply

What is interesting is seeing a chart of the monthly residential customer bills in Massachusetts since late 2008 when the RPS was increased. As Exhibit 19 shows, monthly electricity bills were in a declining trend that lasted until 2013. Since then, average monthly electricity bills have climbed sharply.

Exhibit 19. Massachusetts RES Driving Prices Up



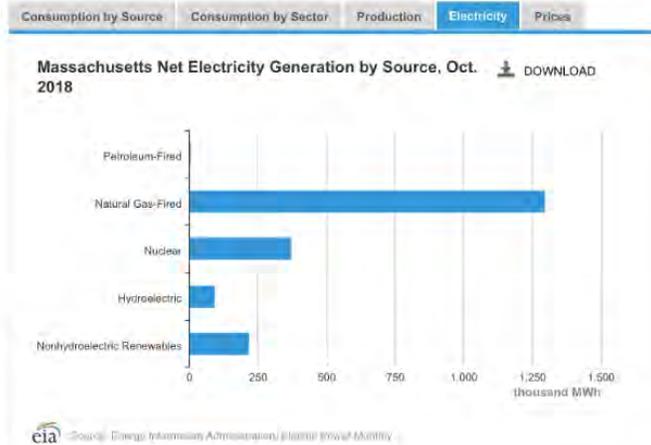
Source: U.S. Energy Information Administration

Source: EIA

“As coal-fired and petroleum-fired power plants are retired, their capacity is being replaced by natural gas-fired power plants”

According to the EIA, “Among the New England states, Massachusetts has the most natural gas-fired generating capacity.” The EIA went on to say, “As coal-fired and petroleum-fired power plants are retired, their capacity is being replaced by natural gas-fired power plants.” As the nearby chart shows, nuclear was a meaningful contributor to the state’s power sector. However, the state’s only nuclear power plant is shutting down this year, meaning that other fuel sources will need to step up their contribution. In the winter, we have seen mothballed coal power plants come back into service to meet the state’s electricity needs.

Exhibit 20. Nuclear Contribution Close To Ending



Source: EIA

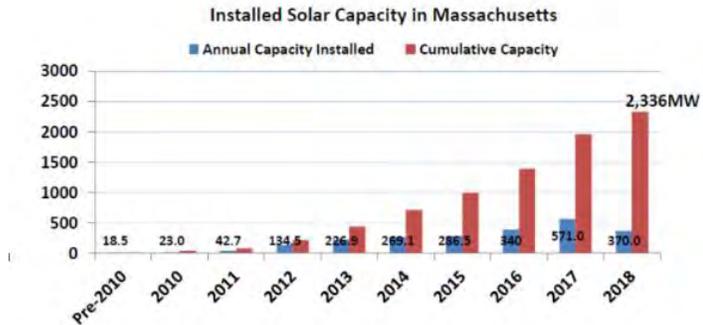
Renewables have powered one-sixth of Massachusetts electricity production since 2017. The state is making a significant push to get

Given the timing aspects of constructing the 84 wind turbines, such a delay could prevent the project from coming on line in 2021 as scheduled and costing the developer some of its planned federal tax credit income

offshore wind farms developed, but that effort was dealt a setback several weeks ago when the Edgartown Conservation Commission (Martha’s Vineyard) denied Vineyard Wind a permit for an underwater cable route off the town’s coastline, citing the potential disturbance to marine habitats and other conflicts. While Vineyard Wind vowed to seek a “superseding order” from the more sympathetic Massachusetts Department of Environmental Protection to overturn the commission vote, it may set up a legal battle that would delay the project from moving forward. Given the timing aspects of constructing the 84 wind turbines, such a delay could prevent the project from coming on line in 2021 as scheduled and costing the developer some of its planned federal tax credit income. Vineyard Wind is already dealing with a delayed EPA Environmental Assessment that could also delay its timing.

Another source of green energy that both Massachusetts and Rhode Island have been counting on is hydroelectric power from Canada. That power was planned to come through high-tension power lines running through New Hampshire. Recently, the New Hampshire Supreme Court upheld the decision to block these power lines for environmental reasons.

Exhibit 21. Expensive Solar Power Grows in MA



Massachusetts has surpassed its aggressive target of 1600 MW of solar power installed for 2020. The above figures represent the cumulative amount installed as of December 2018 in 89,460 projects.

Creating a Clean, Affordable and Resilient Energy Future for the Commonwealth



Source: Massachusetts Dept. of Energy Resources

The state’s push for wind power as well as solar is contributing to the cost increase

So, while Massachusetts is benefitting from lower natural gas prices, its push for expensive renewables is contributing to increasingly more expensive residential electricity. The state’s push for wind power as well as solar is contributing to the cost increase. Massachusetts is proud of its progress in growing solar power, as shown in the accompanying chart. However, this is expensive and intermittent power, requiring battery storage and fossil fuel back-up power, adding to the cost. The struggle in New England to secure increased natural gas supplies, which is being fought by the

governors of New York and New Jersey, and the recent delays in getting planned renewable power supplies could easily lead to residents facing brownouts at times of high electricity demand. Who will be held responsible for that outcome?

A Snapshot Of Energy Infrastructure Battles Nationwide

There are a number of energy infrastructure battles underway across the United States that will impact the oil, gas and power markets, energy’s future availability and the cost to consumers

Without going into great depth, there are a number of energy infrastructure battles underway across the United States that will impact the oil, gas and power markets, energy’s future availability and the cost to consumers. In the past few days we have been reading about the following battles: Vineyard Vines offshore wind farm; the Northern Pass hydroelectric power line delivering electricity to New England; the Williams natural gas pipeline across New York Harbor to Long Island; and the replacement of Line 5 owned by Enbridge Inc. (ENB-NYSE) delivering oil from Canada. While none of these projects are connected, each one will have an impact on consumers in various regions of the country and in Canada.

For offshore wind farms, especially the new ones being developed off the New England coast, cables to bring the electricity to the onshore grid are crucial for their success. For Vineyard Wind, it has proposed a cable route passing Martha’s Vineyard (yellow line in Exhibit 22) that requires a local permit that was rejected, forcing it to appeal for relief. It is seeking an overriding permit approval from the State of Massachusetts, but as we know, locals hate being overruled by higher agencies, risking a legal battle. The wind farm is also facing a longer completion time for the federal environmental assessment report, something that often becomes a legal target, in

Exhibit 22. Cable To Shore Crucial For Wind Farm



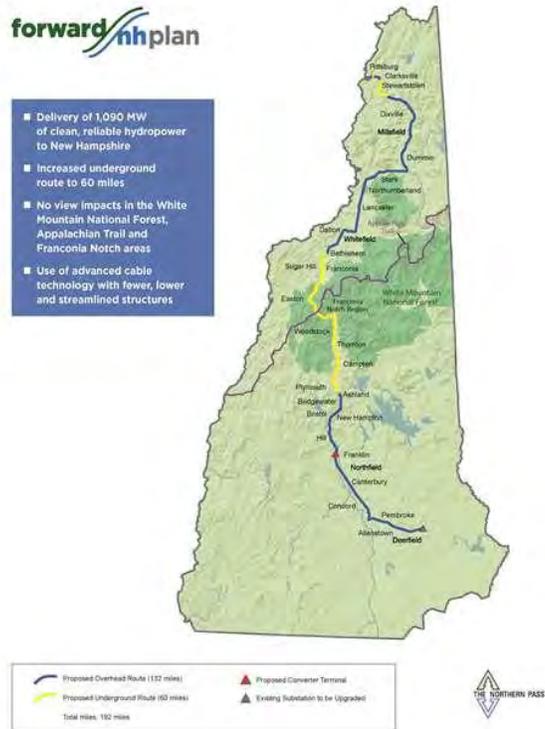
Source: Vineyard Wind

The SEC’s surprising decision, and then the Supreme Court’s decision, came after the EPA’s Final Environmental Assessment report called the project the “preferred alternative”

this case, wind power opponents, environmentalists and fishermen. While it is unlikely either of these issues will derail the project, the greater risk is to the timing of the in-service date for the wind farm. That could impact the project’s economics, since the wind production tax credit is ending soon making construction timing key to qualifying for the credit. Both Massachusetts and Rhode Island are counting on the 800-megawatt, 84 turbine offshore wind farm to deliver clean power enabling the states to meet their emissions reduction goals.

The \$1.6 billion, 192-mile Northern Pass hydroelectric transmission line was dealt a death blow last week when the New Hampshire Supreme Court unanimously rejected its appeal of the state’s Energy Citing Commission (SEC) rejection of the project. This power line was to bring hydroelectric power from Quebec, Canada to Massachusetts helping the state meet its clean energy agenda. While the developer suggests it may make changes to the project and reapply, the SEC rejection came after examining only one of the four tests each project must pass. The SEC’s surprising decision, and then the Supreme Court’s decision, came after the EPA’s Final Environmental Assessment report called the project the “preferred alternative.”

Exhibit 23. Power Line Denial Hurts NE Energy Supply



Source: Northern Pass

The governors of New York and New Jersey are opposed to allowing the pipeline to be built, fearing methane contamination in the harbor area

The new pipeline would enable additional combined-cycle natural gas generators to operate in the region

For natural gas consumers and potential consumers in New York City area and on Long Island, their ability to secure new hookups is in jeopardy if the proposed Williams pipeline across New York Harbor is rejected. Already, the governors of New York and New Jersey are opposed to allowing the pipeline to be built, fearing methane contamination in the harbor area. This is also part of a strategy to restrict additional gas flowing through the region and to bolster the case for more renewable power projects.

The environmental arm of 350.org published a report earlier this year saying the pipeline is unneeded. While opportunities to convert homes, apartment buildings and commercial sites currently burning fuel oil to cleaner burning natural gas exist, the report's rationale is keyed to stopping any fossil fuel market expansion even if it leads to reduced emissions. The new pipeline would enable additional combined-cycle natural gas generators to operate in the region, which would prove helpful if New York State can't develop sufficient renewable power sources to offset the impending closure of the Indian Point nuclear power plant.

Exhibit 24. Helping Expand Gas Supplies In NYC Region



Source: Williams

Closure of the pipeline would force the refineries to seek oil supplies from elsewhere

In Michigan, the governor and attorney general are fighting to force closure of Enbridge's Line 5, which the company is working to remediate. The 65-year-old oil pipeline is part of Enbridge's Mainline/Lakehead crude oil pipeline system. The 540,000-barrels-per-day pipeline transports "batches" of either light crude, light synthetic crude or mixed NGLs 645 miles from a terminal in Superior, Wisconsin, through Michigan to fuel refineries in Sarnia, Ontario, and in Montreal, Quebec. Most of Line 5's volumes come from Canada, although a minority comes from North Dakota and Montana. Closure of the pipeline would force the refineries to seek oil supplies from elsewhere. That would likely add to input costs, reducing refining margins and/or forcing customers to pay higher prices.

Exhibit 25. Enbridge's Line 5 Key To Refinery Supplies

Source: RBN Energy

The new twist is the use of climate change arguments to fight projects

Regardless of where energy infrastructure is being revamped or expanded, it is always being challenged by neighbors or property owners whose land is crossed. This has been a traditional challenge for logistics departments of energy companies. The new twist is the use of climate change arguments to fight projects – another sign of greater energy industry challenges.

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