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ENERGY INVESTMENT BANKING

MUSINGS FROM THE OIL PATCH

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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

California Dreaming, Or Is There A New Oil Reality?

When the oil industry becomes a no growth business represents the initial step in the global economy's transition to a clean energy future

A California journalist who writes on urban development, climate, infrastructure, transport and the energy sector, recently penned an article on how electric vehicles (EV) were in the process of destroying the oil business. While that statement may seem extreme, Gregor Macdonald was not focusing on the target penetration rate of the vehicle fleet by EVs that would produce no growth, or even a decline, in oil use. His view is that the reality of when the oil industry becomes a no growth business represents the initial step in the global economy's transition to a clean energy future. In his view, this transition is happening now, and the oil industry is unprepared for its radically altered future.

The shock of zero growth in oil demand, not recession related, would shake up the leadership of the global oil industry

As we have followed the various forecasts and debates about the future of EVs and their sister cars, autonomous vehicles (AV), we have noticed a fixation by forecasters on the exact date, or certainly a narrow window of time, when non-fossil fuel powered vehicles will dominate either domestic or global vehicle fleets. That obsession intrigued us with Mr. Macdonald's argument that the shock of zero growth in oil demand, not recession related, would shake up the leadership of the global oil industry. Not only would it impact the executives, in Mr. Macdonald's view, but it would also shake up the leadership of the major oil exporting countries.

We found Mr. Macdonald's analysis largely sound, although there are certain aspects of change underway in California that might moderate the timing of EV fleet dominance, and the long-term oil demand erosion he envisions. While Mr. Macdonald's article included an analysis of California's renewable power market, primarily from the perspective of its size and future growth potential relative to the requirement to power the state's EV fleet that he envisions, we are not going to assess that portion of his article. It

isn't because we are not interested in the analysis and data Mr. Macdonald offers, but rather because an assessment would require that we devote the entire issue of the *Musings* to it.

California has always been known for its leading-edge position on most social issues that have swept the United States since the 1950s

California has always been known for its leading-edge position on most social issues that have swept the United States since the 1950s. In our memory, California's climate and population growth were the primary attraction for the two National League's leading baseball teams – the Brooklyn Dodgers and the New York Giants – to hightail it to Los Angeles and San Francisco in the late 1950s from New York City. No longer would the *Musings* author go to the Polo Grounds to watch his favorite Giants battle those Bums, the Brooklyn Dodgers. But what we took away from the move was how California was becoming the nation's social and business trendsetter.

That view of California's role was later cemented by our fraternity brothers who would spend the summer at the University of California - Los Angeles (UCLA) and bring back the latest dress, music and dance crazes to our Connecticut chapter. We would promptly show off those trends at the initial campus party of the fall.

"…by the time global oil demand actually enters outright decline, the damage to oil prices and the oil industry will have been underway for some years"

"We have long assumed the most dangerous moment for the oil industry will arrive when demand for its products enters permanent decline. That's understandable. However, by the time global oil demand actually enters outright decline, the damage to oil prices and the oil industry will have been underway for some years." According to Mr. Macdonald, the pivotal moment for the industry is not the decline, but the transition from positive to zero growth, and prospects for that to continue into decline.

California contains approximately 12% of the U.S. population, and a similar percentage of the nation's vehicle fleet. What happens to California's fuel consumption will be reflective of the trend for the entire nation's fossil fuel use. Approximately 50% of total U.S. EV sales occur in California, further establishing the importance of understanding trends unfolding in the state and their potential to impact the nation's transportation fuels markets. The EV percentage penetration has been achieved with the willing support of California legislators and the governor to subsidize expensive EVs because of the belief that over time, these vehicles will prove good for the state's air quality and thus be a positive for the state's economy.

The cost to operate an EV is about half that of operating an ICE vehicle over similar distances

According to Mr. Macdonald, EVs have achieved 'cost parity' with ICE vehicles. What that means is that due to fuel savings - cheaper electricity versus more expensive gasoline, taking into account the difference in miles that can be traveled using each fuel, - means that the cost to operate an EV is about half that of operating an ICE vehicle over similar distances. There are also operating cost savings with EVs from the simpler electric motors – fewer parts –

meaning less maintenance due to eliminating periodic oil changes. These cost savings can become significant over time, especially as EV and ICE vehicles age.

Buyers are inclined to consider the cost differential as an investment in the future, as the EV will pay off in lower operating costs for many years

What has yet to be attained is 'price parity,' meaning that the initial cost of an EV is substantially more than the cost for a comparable ICE model. That cost differential is explained by the more expensive battery powering the EV. As this situation does not exist, yet, Mr. Macdonald says that buyers are inclined to consider the cost differential as an investment in the future, as the EV will pay off in lower operating costs for many years. But, as he also points out, other considerations are at play in the buying-decision besides the operating cost differential. Those include the generous tax credits California provides, as well as the intangibles such as avoiding fuel taxes and the freedom to drive solo in restricted high-occupancy lanes. For workers commuting in congested Los Angeles, San Diego or San Francisco, those are attractive subsidies.

This new fee applies to all ICE vehicles, new or existing, and is payable each year at the time the vehicle's registration is renewed

The environmental movement in California has always been strong, but with the support of the current governor, Jerry Brown (D), it is gaining greater strength, and its promotion of EVs over ICE vehicles has been embraced by the entire state's governing apparatus. In 2017, the California legislature passed a law that beginning in 2018, buyers of new ICE vehicles will pay a Transportation Improvement Fee (TIF) based on the assessed value of the car. The fee would appear to be a minor imposition, as it is $100 on any car valued between $25,000 and $34,999. For lower valued cars, the fee is less - $50 down to $25. On the other hand, for more expensive ICE vehicles, the fee is higher, ranging between $150 and $175. This new fee applies to all ICE vehicles, new or existing, and is payable each year at the time the vehicle's registration is renewed.

We predict there will be legal battles over the establishment of the assessed value of used cars because they lag reality

One aspect of this TIF that may go awry is the projected income if the tax works as expected. If ICE vehicles are to be phased out, their values will plummet, erasing some, and eventually most, of the expected income to be derived from the TIF. We predict there will be legal battles over the establishment of the assessed value of used cars because they lag reality. Remember the admonishment about buying new cars – their value depreciates sharply as the car is driven off the dealer's lot. We have watched first-hand how these vehicle valuation debates unfold, as a few years ago Rhode Island instituted a tax on vehicles based on their assessed value. Each town in the state was to assess the vehicles registered to residents/homeowners in their boundaries. Immediately following the first year's vehicle tax bills being sent out, taxpayers objected to the assessed values and threatened suit. Eventually, calm was restored. But, Rhode Island has only slightly more than one million in population, so there are a lot fewer cars than the 25 million in California. Percentage-wise, we would postulate that there are many more highly valued vehicles in California than all the vehicles in Rhode Island, setting up the potential for bigger legal battles.

The EV TIF of $100 per vehicle, will start in 2020

While the new ICE vehicle fees will provide additional revenue to California, the government has projected that its revenues from fuel sales will decline as the transition from ICE cars to EVs occurs. To offset the revenue decline, and to acknowledge that EVs also create wear and tear on the state's highways, California is instituting a new flat fee on EVs. The EV TIF of $100 per vehicle, will start in 2020. Note the disparity in that the ICE fee starts this year, while the EV fee doesn't begin until 2020. This is one more way in which the State of California's politicians tilt the playing field in favor of EVs.

In 2019, gasoline taxes will rise again, but this time by 7.5-cents a gallon, bringing the total state gasoline tax up to 49.2-cents per gallon

Another way in which California politicians are favoring EVs is through the gasoline and diesel fuel taxes. Included in the early 2017 legislation, gasoline and diesel taxes were increased over the next 24 months. In 2018, gasoline taxes increased by 12-cents per gallon, rising from 29.7 to 41.7-cents. Diesel prices were increased by 20-cents a gallon, from 16 to 36-cents. In 2019, gasoline taxes will rise again, but this time by 7.5-cents a gallon, bringing the total state gasoline tax up to 49.2-cents per gallon. These taxes represent the highest assessed by a state government, and partly explain why California's pump prices are the highest in the land.

Today, EVs have captured 10% of car sales in Silicon Valley. They are at the 6% level for San Francisco proper, and have reached 4% in the state's largest auto market – Los Angeles. According to Mr. Macdonald, Los Angeles is in a take-off phase that will see EV sales accelerate.

This is the largest number of EVs in any city, with Beijing gaining rapidly

Los Angeles is already the largest urban market for new EVs, not only in California, or the United States, but globally. Cumulatively, there are 100,000 EVs registered in Los Angeles, as of the end of 2016. This is the largest number of EVs in any city, with Beijing gaining rapidly. According to data from the State of California, registered automobiles in Los Angeles County peaked in 2006 at 5.92 million, before falling back during the financial crisis and recession of 2008-2009, but they have recovered to reach a new peak of 6.48 million vehicles in 2016. What has happened, however, is that the pace of new vehicle registrations has slowed during the past ten years.

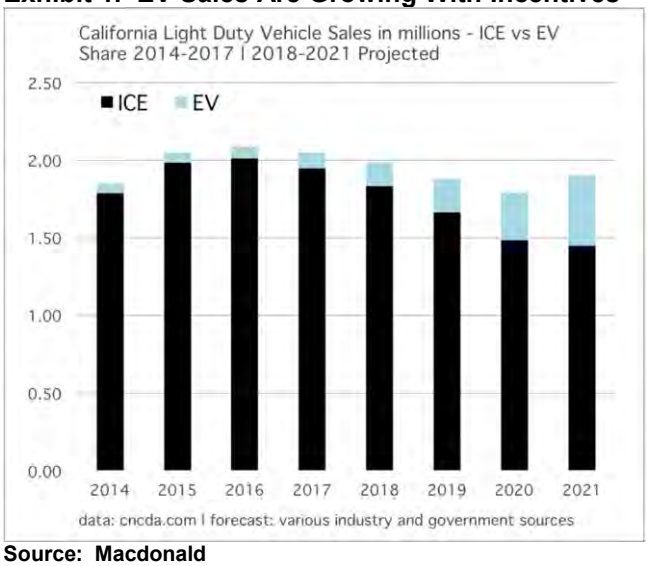
Importantly, 1.5% of those cars are already EVs. Between now and 2025, Los Angeles is expected to add 700,000 new EVs to the county's vehicle fleet. Is that achievable?

It shows that only 144,000 EVs per year need to be sold

Recently, California Gov. Brown re-committed the state to the policy goal of having 1.5 million EVs on the road by the end of 2025. As there are already 350,000 EVs in the fleet, it means only an additional 1.15 million EVs need to be sold over the next eight years. If you divide the total of new EV sales necessary by eight, it shows that only 144,000 EVs per year need to be sold. Forecasts call for that many vehicles to be put on the road this year, suggesting that unless there is some disruptive force, the goal should easily be

attained. In fact, the most recent car sales forecast projects 150,000 EVs to be registered in 2018, 215,000 in 2019, with 310,000 new EVs in 2020, and 450,000 in 2021.

Exhibit 1. EV Sales Are Growing With Incentives



Source: Macdonald

If Mr. Macdonald is right in his assessment of the EV and gasoline market trends in California over the next few years, then his outlook for the energy industry needs to be considered. He summarized the importance of these trends this way:

> "Here's what really matters though for the auto and oil industries: starting right now, all marginal growth will swing away from ICE, and towards EV…the entire global auto industry is racing to produce a variety of EV for market, to capture the obvious: as the affordability window opens, they don't want to be left behind. Let's tip our cap to the auto industry, which usually moves slow: they are racing towards EV. This leads to a rather grim conclusion for the oil industry, however. Not only is it the most vulnerable industry as the EV era opens up, it is equally the least prepared."

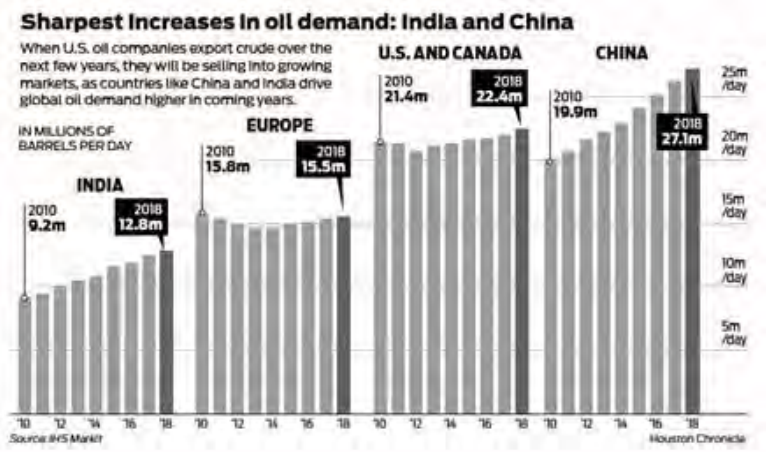
Mr. Macdonald believes these trends underlie the forecasts of the State of California and the Energy Information Administration (EIA) that road fuel use will peak in either 2018 or 2019

As he points out, the less than 2% decline in auto sales in 2017, coupled with the rise in EV sales, produced a slight decline in gasoline demand. Yes, increased fuel efficiency standards also played a role, but vehicle miles traveled were still rising for most of that year. Mr. Macdonald believes these trends underlie the forecasts of the State of California and the Energy Information Administration (EIA) that road fuel use will peak in either 2018 or 2019. As the U.S. is a good proxy for the developed world (OECD), he sees a similar tipping point in road fuel use. In his analysis, this leaves China,

Its push for EVs means that ICE vehicles, with their gasoline and diesel fuel needs, are likely to become a smaller portion of the nation's vehicle fleet

India and Southeast Asia to be considered. China is likely to set the pace, although it has an easier path to altering its fuel market because of significant government control of the economy. Its push for EVs means that ICE vehicles, with their gasoline and diesel fuel needs, are likely to become a smaller portion of the nation's vehicle fleet, with long-term ramifications for the global oil market. This disruption will upset those forecasts calling for these countries to drive oil demand growth.

Exhibit 2. How Much Oil Demand Needs China And India



Source: ***Houston Chronicle***

After admonishing the analysts to stop wasting their time trying to predict when EVs will take over the transportation market, he urges them to focus on identifying the tipping point when oil consumption growth falls to zero or becomes negative. As Mr. Macdonald states:

> "Oil dependency will indeed carry on for decades, in transportation by air, in material science and petrochemicals. But this dependency in no way protects oil's pricing power from the imminent loss of market share growth in global transportation."

Any force impacting oil's growth, or lack thereof, will reverberate throughout the industry, and those economies dependent on fossil fuels

It is important to remember that transportation's use of oil represents slightly over 50% of total global oil consumption. Any force impacting oil's growth, or lack thereof, will reverberate throughout the industry, and those economies dependent on fossil fuels. Assessing when the oil demand tipping point might be reached is a better use of one's time and effort, rather than speculating on the total takeover of the global transportation market by alternatives.

Demographics, Automation And Inequality, And Energy

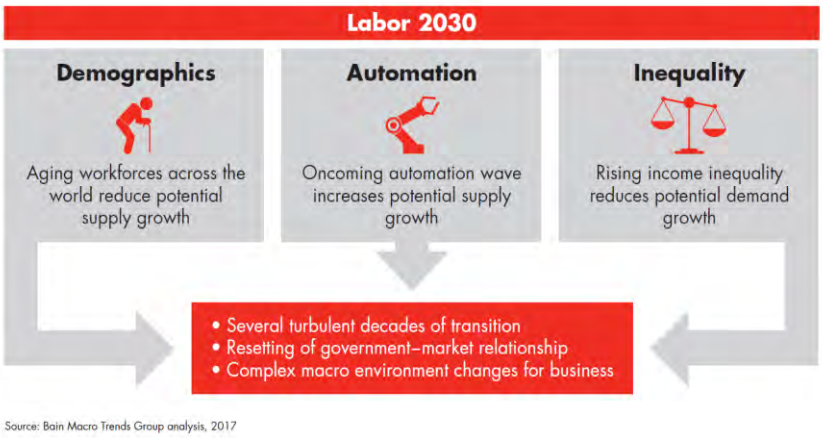
A recent research report by consultant Bain & Company, Inc., which was featured in a leading investment conference as the lead author presented the case, caught our attention for its discussion of broad

Seldom has someone linked demographics with automation and income inequality and shown how it could create a significant economic transformation

economic issues. While many people discuss how demographics will impact the future economic health of key countries around the world, seldom has someone linked demographics with automation and income inequality and shown how it could create a significant economic transformation. Karen Harris, managing director of Bain & Company's Macro Trends Group, led a team of researchers into the issue of job automation and its impact on the future of work. She recently spoke at investment advisor John Mauldin's Strategic Investment Conference, discussing the report and its conclusions.

Exhibit 3. The Economic And Energy Disrupter Of The Future

The collision of demographics, automation and inequality is likely to create decades of disruption



Source: Bain & Company

As this collision occurs in the next decade, these forces will combine to create an economic climate with increased volatility and extremes

Ms. Harris and her team's research showed that the collision of demographics, automation and income inequality could become a greater disruptor than any other experienced in the past 60 years. As they see it, the impact of aging populations, coupled with businesses adopting new automation technologies that will help promote rising income inequality, will likely combine to create new business risks and opportunities. As this collision occurs in the next decade, these forces will combine to create an economic climate with increased volatility and extremes. But, these forces may also set off a decade-long investment boom, as companies race to buy and install new automated equipment, which may cause a jump in interest rates. The truly bad news from this analysis is that by the end of the 2020s, the authors believe automation may eliminate 20% to 25% of current U.S. jobs, an estimated 40 million jobs. These job losses will disproportionally impact middle- to low-income workers, which will reduce their spending, and thus, contribute to anemic demand growth in the 2030s and afterwards. To counter this anemic growth, monetary officials will be forced to drop interest rates back to near zero, but without a strong economic response, many societies may elect to redefine the role of government in the economy.

While this scenario may take a while to play out, the potential ramifications of it are significant. A critical conclusion of the report was: "The erosion of the middle class will have major ramifications for those selling big-ticket items, especially housing and autos. Consumers may tap their credit as they strive to maintain their standard of living." Consumers borrowing to support their lifestyle will add to the borrowing wave envisioned as manufacturers and service companies invest in new automated equipment to deal with the critical unskilled labor shortage. The Bain paper pointed to a recent working paper published by the Bank of England analyzing how quickly low interest rates can rise. The paper looked at 800 years of interest rate movements, which found that "upward adjustments after long periods of real rate stagnation averaged more than 315 basis points within two years of the trough of the cycle." The paper highlighted that the most recent interest rate trough in 1948 was followed by a rise of more than 200 basis points within two years. If the surge in investments and consumer borrowing happens, the global economy could be faced with a near doubling of current interest rates in 24-36 months – what a shock that will be.

The paper highlighted that the most recent interest rate trough in 1948 was followed by a rise of more than 200 basis points within two years

Even though educated and skilled workers will be prospering, they will not be able to sustain the economy's growth. That is only one aspect of the changing economy that will follow the collision of the three forces. The Bain authors state that leadership teams will be tested by the coming transformation. Automation will reshape national economies, throw labor markets into turmoil and change the rules of the game in many industries. Additionally, aging populations will strain social systems as they have never been before. This analysis raises numerous questions, but it offers hope that some segments of the population and new industries may flourish. But, other industries may be hurt. That was a point we were drawn to when reading the report.

Automation will reshape national economies, throw labor markets into turmoil and change the rules of the game in many industries

If big ticket purchases are to be impacted, one wonders what it means for the electric vehicle (EV) versus internal combustion engine (ICE) vehicle race, especially given EVs being significantly more expensive? If battery costs don't drop significantly soon, the higher cost of EVs may sway vehicle purchase decisions away from them, despite the leanings of governments. Will this result in efforts by environmentalists to convince governments to up the ante on EV subsidies? How will that work with governments being strained for tax revenues and facing escalating costs for retirement and health care for their aging populations?

If battery costs don't drop significantly soon, the higher cost of EVs may sway vehicle purchase decisions away from them, despite the leanings of governments

Taking another tack, expensive EVs may not be bought by individuals because they are too expensive, but rather they may be bought by ride-hailing services. Individuals may keep their old ICE cars and, at the same time, increase their use of ride-hailing services. This alternative scenario may mean a slower penetration rate for EVs and an extension of the Age of Petroleum. However, the loss of possibly 40 million jobs will have a significant impact on

energy demand, and importantly, on fuel poverty, or when the cost of energy consumes a noticeable percentage of a family's income. Determining that percentage is arbitrary but estimates run from 5% to as much as 20% of family incomes. Many analysts define fuel poverty as starting at 10% of family income.

Rest assured that if anything close to the scenario outlined by Bain occurs, including its variations in the pace of the collision, energy demand will be impacted

Attempting to quantify the impact of the Bain thesis on future energy demand is virtually impossible to do. That said, we felt that the possible impacts needed to be outlined as the Bain report, which addresses major economic and stock market issues, is receiving increased media attention. The *Economist* wrote a brief article on the report, with the focus on the impact of automation on interest rates. Expect more articles, including detailed newsletter issues from Mr. Mauldin and some of the investment professionals who were in attendance at the Strategic Investment Conference, about the report, but we doubt anyone will focus on the potential energy impact. Rest assured that if anything close to the scenario outlined by Bain occurs, including its variations in the pace of the collision, energy demand will be impacted. By how much and when are unknown, but with time and further analysis, we may be able to offer a guestimate. Stay tuned.

The Global Oil Market And The Shale Oil Challenge

People often forget, or possibly don't understand, that all crude oils are not created equally

The shale oil revolution has upended the global oil market in many ways. U.S. crude oil is now being exported after having been restricted for 40 years. However, the public, oil speculators, and possibly even some oil professionals, may be misinterpreting exactly how this oil flow is or will impact the global oil market. People often forget, or possibly don't understand, that all crude oils are not created equally. The light oil produced from U.S. shale formations is not of the same composition as most of the conventional oil produced in the United States, which means what petroleum products, and how much, can be extracted from a barrel of each crude oil will differ significantly. Light crude oil is certainly not the equal of heavy oils produced here and elsewhere.

If the gravity rating is greater than 10 degrees, it is light and will float on water

The American Petroleum Institute gravity measure is a a degree system that measures how heavy or light a petroleum liquid is compared to water. If the gravity rating is greater than 10 degrees, it is light and will float on water. If it is less than 10 degrees, it is heavy and sinks. The gravity ratings of most of the petroleum liquids falls between 10 and 70 degrees.

The importance of the gravity ratings is that it can be a measure of the product yield – lighter crude oils generally will produce more light products such as gasoline. Low gravity ratings usually are associated with heavy refined products such as residual oil or distillates, such as heating oil and diesel fuel. This is an important concept for the oil business, as crude oil has little value in its raw state, thereby it needs to be refined into products with different

qualities that make it useful when burned for powering different equipment – cars, trucks, jet planes, home heating systems.

Exhibit 4. Petroleum Dominates World's Export Market

Source: ***VisualCapitalist.com***

For the United States, our largest export is refined petroleum products, which is an important consideration when considering shale's impact on the global oil market

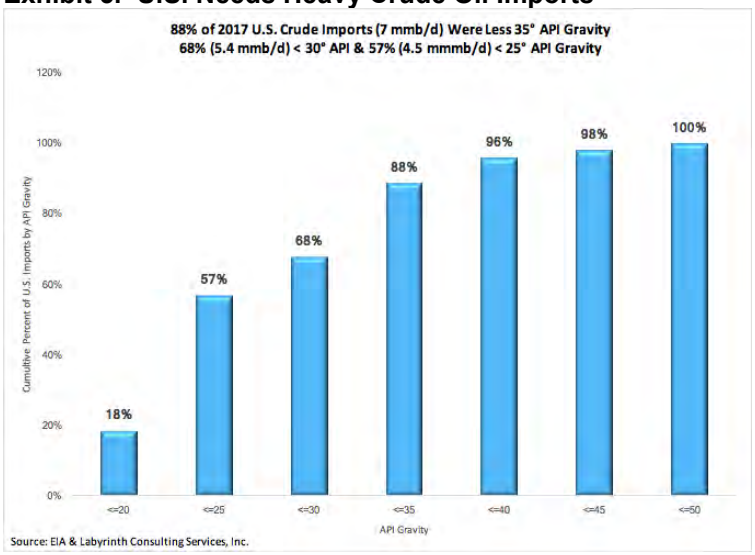
The global map of the world that shows each country's largest export highlighted this significance of petroleum for the world's economy. We were struck when we saw the map at how much of the earth's surface is colored yellow, signifying that crude oil or refined petroleum products is the largest export from those countries. For the United States, our largest export is refined petroleum products, which is an important consideration when considering shale's impact on the global oil market.

88% of 2017's average daily U.S. oil imports was crude oil with gravity ratings of 35o or less, and more than half of it was had a gravity rating of 25o or under

For those who assume that all oil is equal, their focus on the potential growth of U.S. shale oil production volumes, and how much may be exported may lead to an incorrect conclusion about the evolution of the global oil market. One reason so much of this light oil being exported is that the U.S. has too much supply to efficiently refine given the way our domestic refineries are set up. At the same time that we are exporting light oil, we are importing heavier crude oils to feed our domestic refineries. As the chart prepared by Art Berman, based on data from the Energy Information Administration (EIA), shows, 88% of 2017's average daily U.S. oil imports was crude oil with gravity ratings of 35^{o} or less, and more than half of it had a gravity rating of under 25^{o}. This data demonstrates the imbalance in the mix of domestic crude oil production between light and heavy oil.

Just as the debate about whether the surge in U.S. light oil production and its growing export volumes would overwhelm the world's oil market, along comes Exxon Mobil Corp. (XOM-NYSE) announcing a light oil refinery expansion program. ExxonMobil said it is going ahead with a multi-billion-dollar expansion of its Gulf

Exhibit 5. U.S. Needs Heavy Crude Oil Imports



Source: EIA, Art Berman

Coast refining capacity that would double its light oil refining capability. While the expansion will not be complete until the next decade, it fits with another strategic undertaking of ExxonMobil. The company recently announced plans to expand its crude oil production by 25%, or one million barrels a day, by 2025, including a five-fold increase in its Permian Basin output, which will likely be light oil. Based on its huge upstream spending plans, expanding its downstream refining capacity to handle the additional future light oil output makes sense.

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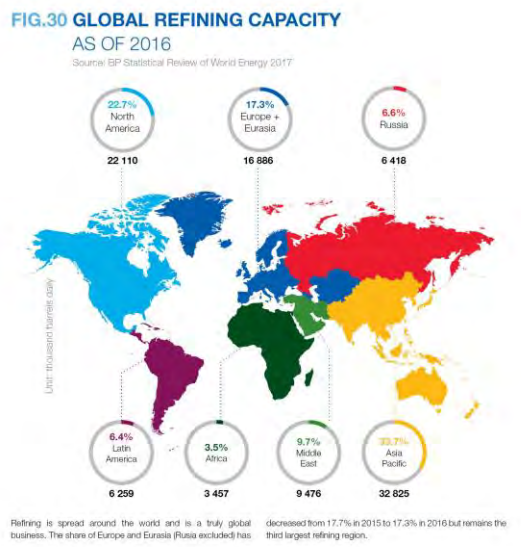
As shale oil output grows, other changes are underway in the fuels market

The International Energy Agency (IEA) projects that U.S. oil production will reach 12.1 million barrels a day by 2023, a two-million-barrel a day increase over current output, with nearly half coming from additional shale wells. As shale oil output grows, other changes are underway in the fuels market. Diesel fuel is under assault globally due to its greater air quality pollution, which was highlighted by the recent emissions' testing scandal in Europe and the United States. In the EU, governments and cities are aggressively moving to ban diesel cars from their streets, and eventually to ban all internal combustion engine (ICE) vehicles.

The lighter oil is better suited for producing gasoline

Diesel fuel is a middle distillate, which is easier to refine from heavier crude oils, although some diesel can be refined from light oil. The lighter oil is better suited for producing gasoline. When we look at the global distribution of refining capacity, North America has the second largest amount behind Southeast Asia, with Europe in third place. Capacity is one thing, but the output of the European refineries is another consideration, and an important one, given changes underway in the European fuels market.

Exhibit 6. Europe Is Third Largest Refining Center

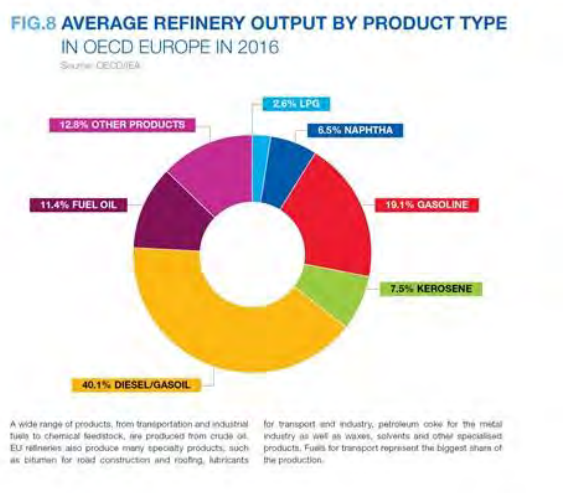


Source: Fuels Europe

Most European countries have favorable tax treatment for diesel/gasoil

As we see in the chart showing the average refinery output by product type in Europe in 2016, diesel/gasoil production represents over twice the output of gasoline. Since most European countries have favorable tax treatment for diesel/gasoil, this has become the predominant fuel for vehicles, which explains the refining

Exhibit 7. Diesel Dominates Refinery Output

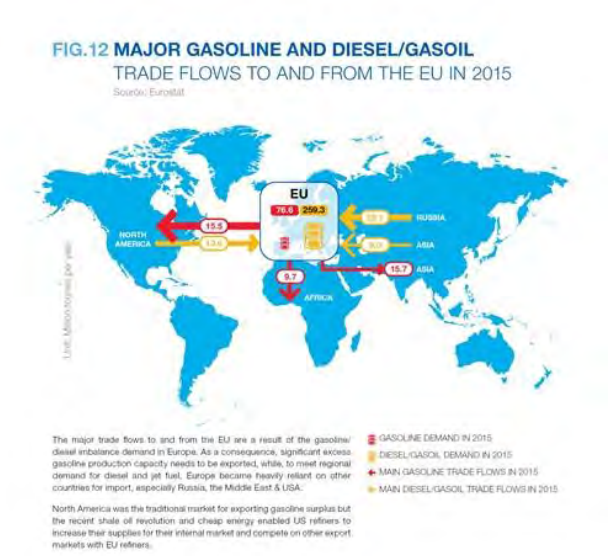


Source: Fuels Europe

Europe ships surplus gasoline to the U.S. in exchange for our surplus diesel fuel

configuration. Despite the high diesel/gasoil output, Europe is short of diesel supply, therefore, Europe and the U.S. have a strong bilateral fuel trade. Europe ships surplus gasoline to the U.S. in exchange for our surplus diesel fuel. That trade relationship is shown in Exhibit 8.

Exhibit 8. Diesel/Gasoline Trade Flows



Source: Fuels Europe

The three largest European vehicle fuel markets are Germany, France and the United Kingdom. As we see in Exhibit 9 on the next page, France has the highest ratio of diesel fuel demand to gasoline at nearly four-to-one. In Germany and the UK, the diesel to gasoline ratios are closer to two-to-one.

The German Supreme Court recently ruled that cities in that country can ban diesel cars from their centers

In terms of total fuel consumption in Europe, Germany leads by consuming approximately 42.5 million tons per year (mmt/y), while France with 41 mmt/year is second. The UK comes in third with 38 mmt/y of total fuel sales, with Italy at 30 mmt/y in fourth place. Importantly, the German Supreme Court recently ruled that cities in that country can ban diesel cars from their centers. Germany and France have also indicated that they plan to ban ICE vehicles from various cities, and eventually from the entire country in 2030-2040. This reality is becoming a significant challenge facing European auto manufacturers.

According to media reports from the recent Geneva auto show, auto executives remarked that they are grappling with the issue of whether to re-engineer existing vehicles at huge costs or restrict the sales of some of their most profitable models to meet changing market demands. Depending on their choice, they will either face

It is hard to see how diesel vehicles will experience a renaissance anytime soon

the risk of hundreds of millions of euro fines, or possibly sharply lower profits. Some executives are hoping that the latest Euro 6 type of diesel vehicles may be rehabilitated, which will improve their fortunes. Based on the legal developments, and the anger of locals at the diesel emissions scandal, it is hard to see how diesel vehicles will experience a renaissance anytime soon.

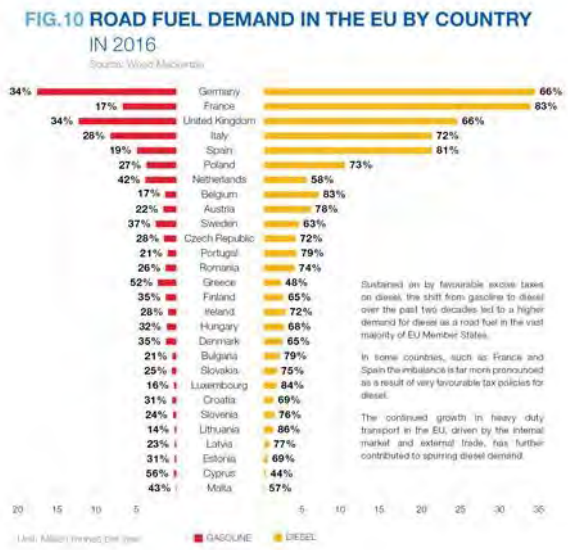
In 2017, the 406,000 hybrid units sold represented 41% of Toyota's total European vehicle sales

Contrasting with the dilemma facing the European auto manufacturers, Toyota Motors (TM-NYSE) announced that due to strong customer demand on the continent for its hybrid versions of its core models, it will phase out diesel engines from all its passenger cars in 2018. In 2017, the 406,000 hybrid units sold represented 41% of Toyota's total European vehicle sales, up from 38% in 2016. In contrast, Toyota's diesel cars represented less than 10% of its sales in 2017. Toyota will continue to offer diesel engines in commercial vehicles to meet customer needs.

Beginning in 2020, shipping vessels will not be allowed to burn fuel with a sulfur content higher than 0.5%, down from 3.5%, currently

In another global fuel market that will marks a shift in favor of more light oil is shipping. Beginning in 2020, shipping vessels will not be allowed to burn fuel with a sulfur content higher than 0.5%, down from 3.5%, currently. The change, engineered by the International Maritime Organization, is among the most significant changes made in decades for the global shipping business. As a result, petroleum executives and traders anticipate increased volatility in the fuels market as refiners begin to process more light crude oil in advance of the implementation of these new rules designed to end the use of high-sulfur fuel oil.

Exhibit 9. Four Countries Dominate Fuel Market

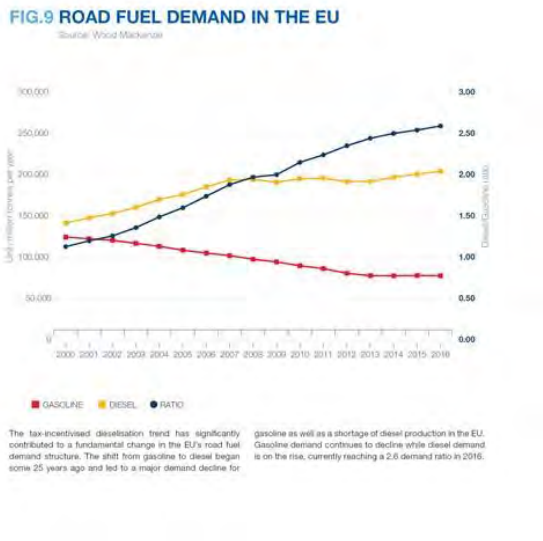


Source: Fuels Europe

We expect to see forecasts reflect more meaningful trend changes for diesel and gasoline use in the future

The record of EU fuel consumption for road traffic since the turn of the century shows a steady growth in diesel fuel use, albeit slowing in recent years. At the same time, there has been a steady decline, again with recent stabilization, in the use of gasoline. Given the diesel emissions scandal and the regulatory moves against diesel cars initially, and then against ICE vehicles, we expect to see forecasts reflect more meaningful trend changes for diesel and gasoline use in the future.

Exhibit 10. Europe's Diesel And Gasoline Trends



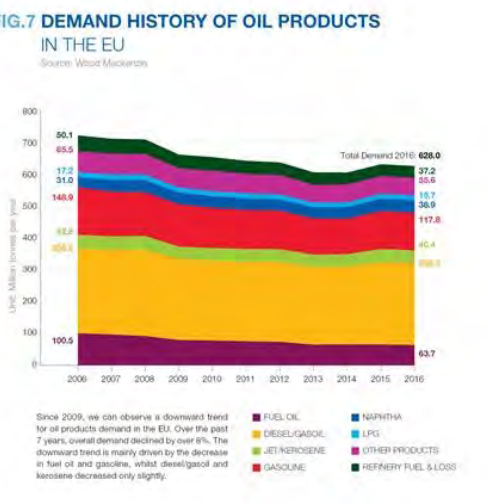
Source: Fuels Europe

One wonders whether the fear about rapid light oil output growth, driven by American shale production, is unfounded as global fuels markets trend toward lighter fuels. This likely means refineries will need to reconfigure their operations to be able to process more light crude oil, but with declining demand for diesel and high sulfur fuel oil for shipping, this shift would have happened anyway.

It is important to understand that the global trend to a decarbonized economy means that the crude oil needed in refineries needs to become lighter

We are not making light of the issue of more light crude oil. On the other hand, it is important to understand that the global trend to a decarbonized economy means that the crude oil needed in refineries needs to become lighter. That trend contrasts with the historical trend that saw heavier and more sour crude oil dominate the refining input mix. The biggest impact will be the need for refiners to invest in upgrading their facilities to process additional light oil in order to produce the desired refined product output. We see ExxonMobil's announcement as an example of investment steps other refiners will be announcing in the coming years.

Exhibit 11. Europe's Oil Use In Decline



Source: Fuels Europe

The biggest concern is that policy planners will equate light oil with conventional oil when figuring out how to deal with the shale oil output growth

While there is reason to be worried about the growth of light oil from the shale plays, hysteria about its future is likely overdone. Refiners will adapt, but importantly, there are significant shifts underway within the transportation fuel markets that need to be considered when plotting the future use of light oil. The biggest concern is that policy planners will equate light oil with conventional oil when figuring out how to deal with the shale oil output growth. Mistaking the trends could lead to incorrect policy and regulatory moves that would disrupt the market's natural process in improving the domestic oil and gas business.

Autonomous Cars Or Autonomous Skies?

The biggest concern is that policy planners will equate light oil with conventional oil when figuring out how to deal with the shale oil output growth

The global vehicle market has been laser focused on the progress of autonomous vehicles and their early stage testing. Their potential impact on road transportation fuel markets is enormous. They may offer transportation options to segments of the population currently unable to move around on their own, or totally dependent on others that results in restricted mobility, which could boost the number of trips and miles traveled. On the other hand, we are learning that autonomous vehicles are leading to increased urban congestion, the exact opposite of what was initially projected. When married with ride-hailing services, autonomous vehicles might reduce the ownership rate of vehicles, and miles traveled as fewer extraneous trips are taken.

While the focus of autonomous vehicles has been on passenger cars, many experts believe autonomous transportation's initial

Highway driving is much easier to map and handle using autonomous driving technology

success will be in over-the-road truck traffic. A substantial volume of truck traffic is moving from one transit hub to another, i.e., warehouse to warehouse. Because most of the movement is done on interstate highways, the thought is that human drivers could move the trucks from the warehouse to the highway entrance, they could then be organized into caravans and then driven autonomously to the highway exit point closest to the final destination point, at which time another human driver would take them on the final leg of the journey. Highway driving is much easier to map and handle using autonomous driving technology. The more taxing initial and final legs of the journey would be conducted by human drivers. This scenario would minimize the over-the-road trucking industry driver shortage, in that drivers would only be needed for local work so they could remain at home rather than having to drive long distances and remain away from home and their families for long stretches of time. This re-orientation of the work might improve the attractiveness of truck driving as an occupation.

Many companies are pushing to develop self-flying taxis – the modern version of the Jetson's flying car

Another area where autonomous vehicles may prove successful earlier than on the highways is in the skies. Many companies are pushing to develop self-flying taxis – the modern version of the Jetson's flying car. A full-fledged testing of such a concept is just beginning over the South Island of New Zealand. It was recently announced that an agreement has been reached between a company, Kitty Hawk, personally financed by Larry Page, the co-founder of Google and now the chief executive of Google's parent, Alphabet (GOOG-Nasdaq), and the prime minister of New Zealand, Jacinda Ardern, to test the autonomous car/plane, dubbed Cora, as part of an official certification process. New Zealand has a less restrictive flight certification process than in the United States where the Federal Aviation Authority (FAA) regulates who and what can fly in U.S. airspace.

Exhibit 12. The Kitty Hawk Flying Car Concept

Source: Kitty Hawk

Cora, the experimental flying car, has a wingspan of 12 feet, and is equipped with a dozen rotors, all powered by batteries. It can fly roughly 62 miles and carry two passengers.

The prime minister is enthusiastic about the Kitty Hawk plane because it is fully-electric, which means no carbon emissions

The reason New Zealand is supporting this effort is the country's clean energy goal. As Ms. Ardern was quoted telling *The New York Times*, "We've got an ambitious target in New Zealand of being net carbon zero by 2050." The prime minister is enthusiastic about the Kitty Hawk plane because it is fully-electric, which means no carbon emissions. Will flying people from one site to another, rather than driving them be the answer to global climate change? Some people believe so, which probably explains the rush by companies and start-ups to develop flying taxis.

An attraction for seeking certification in New Zealand relates to the fact that the country has long been viewed as having a thoughtful and safety-conscious regulatory regime. The thought is that whatever rules New Zealand establishes may become the template for other nations, including the United States.

Bell is also working with Uber Elevate, a division of Uber, to establish a flying taxi service in the Los Angeles region within two years

At the Consumer Electronics Show last January, Bell Helicopters unveiled its own version of a flying car that it is planning to introduce as a taxi service between the Texas cities of Dallas and Frisco, which it expects will be operating by 2023. Bell is also working with Uber Elevate, a division of Uber, to establish a flying taxi service in the Los Angeles region within two years. Uber has teamed up with the National Aeronautical and Space Authority (NASA) in the joint venture. The fuel source for powering these flying taxis remains a mystery.

The FAA allows test flights of autonomous vehicles, but there is no path to certification and commercial operation

For anyone attempting to move around Los Angeles and its immediate surroundings, dealing with huge traffic jams is normal, so having an alternative method of travel may prove attractive. The unknown question is whether the proposed service will receive FAA approval, and, if it does, what form (restrictions) the approval might take. At the moment, the FAA allows test flights of autonomous vehicles, but there is no path to certification and commercial operation. An issue for autonomous flying cars will be developing "sense and avoid" systems to prevent mid-air collisions. This technology does not exist, yet, but NASA is working on it.

Exhibit 13. The Bell Helicopter Flying Taxi Body

Source: Bell Helicopter

Last November, Boeing (BA-NYSE) acquired Aurora Flight Services, while Airbus SE (EADSY-Nasdaq) made an investment in late February in Blade, an aviation start-up in New York. Dubai formed a partnership with a Chinese company, EHang, to develop a flying car. And, there is Uber's Elevate division. Other companies involved in flying car initiatives include Workhorse, an American maker of electric vehicles; Joby Aviation, a California company backed by JetBlue Airways Corp. (JBLU-Nasdaq) and Toyota Motor Company (TM-NYSE); AeroMobil, a Slovakian company; and Lilium, a German firm working on an air taxi that utilizes jet-style electric thrusters.

Although the TF-X is several years away from test flights, according to Terrafugia, it will be able to operate autonomously with four people on board, covering a range of 500 miles at a cruising speed of 200 miles per hour

One of the most advanced flying cars is the TF-X, developed by Terrafugia, a Massachusetts-based company. The TF-X is a plug-in hybrid that can drive but can also take off and land vertically, like a helicopter. Although the TF-X is several years away from test flights, according to Terrafugia, it will be able to operate autonomously with four people on board, covering a range of 500 miles at a cruising speed of 200 miles per hour. In 2017, Terrafugia was acquired by the Chinese automobile manufacturing company Geely, who also owns Volvo. Geely Automobile Holdings Ltd. (GELYF-Nasdaq) is actively involved in developing electric vehicles in China, and through its Volvo subsidiary, in Europe, so becoming involved in flying cars as a new technology makes sense strategically for the company.

In the 1920s, Henry Ford began tinkering with the idea of making cars fly

While we are years away from a Jetson's style world of flying cars, the pace of development of this technology may be about to accelerate if the New Zealand tests prove successful. The Uber and Bell Helicopter timeframes, if realized, are also close enough for people to have to consider the potential impacts on transportation and fuel use. In the 1920s, Henry Ford began tinkering with the idea of making cars fly. "You may smile," he said. "But it will come." Maybe it will arrive - just 100 years later.

The Greening Of The Electric Vehicle Fleet Helps Its Future

The average EV, on a sales-weighted basis, has the equivalent of the carbon emissions of an internal combustion engine vehicle with an 80 mile per gallon rating

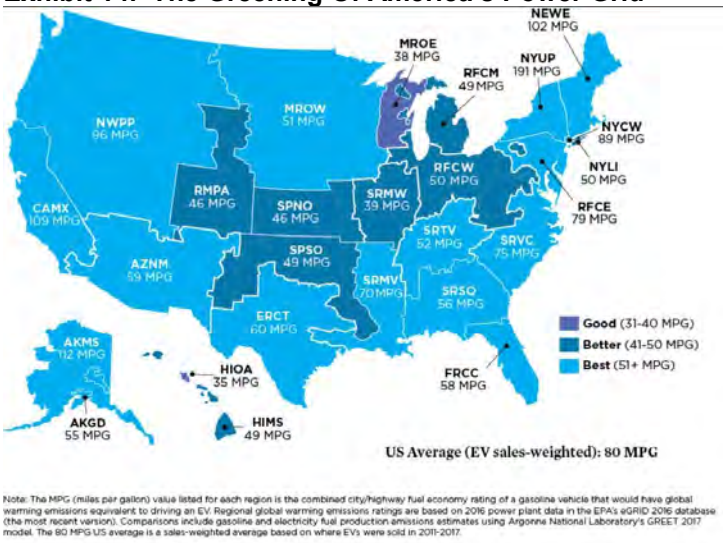
The Union of Concerned Scientists, an active environmental group of academic scientists, has been tracking the carbon emissions of the electrical grid in the United States since 2013, with the aim of determining the cleanliness of our electric power. From that analysis, the scientists have been able to assess the carbon emissions of electric vehicles (EV) based on how clean or dirty the power is in states or regions of the county. The latest report was just released and shows that the average EV, on a sales-weighted basis, has the equivalent of the carbon emissions of an internal combustion engine (ICE) vehicle with an 80 mile per gallon (mpg) rating from the Environmental Protection Agency (EPA).

As the map shows, various regions and states receive good, better and best mpg ratings, which are a combination of the city and highway fuel efficiency ratings delivered by the EPA. Because of the

California's rating is 109 mpg

sales weighting, the U.S. average is heavily impacted by the large number of vehicles in California and that state's very clean power grid. As a result, California's rating is 109 mpg. Texas doesn't fare too poorly as most of the state has a 60-mpg rating. A portion of the state achieves a 70-mpg rating.

Exhibit 14. The Greening Of America's Power Grid

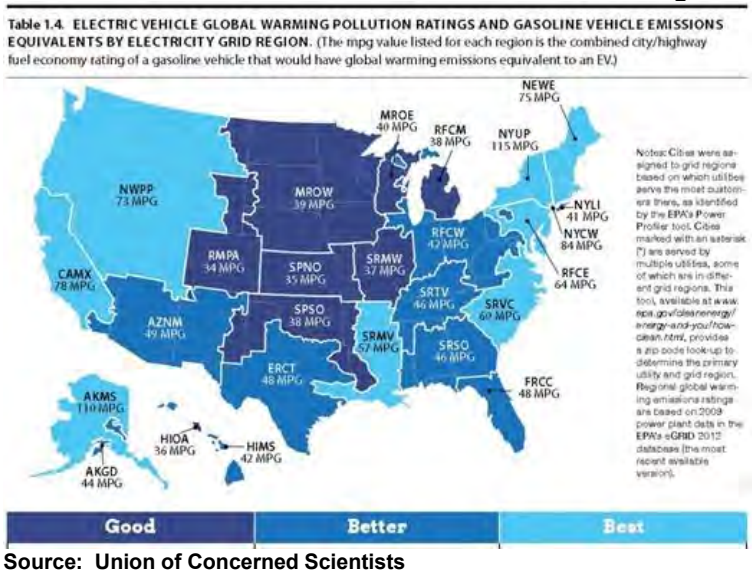


Note: The MPG (miles per gallon) value listed for each region is the combined city/highway fuel economy rating of a gasoline vehicle that would have global warming emissions equivalent to driving an EV. Regional global warming emissions ratings are based on 2016 power plant data in the EPA's eGRID 2016 database (the most recent version). Comparisons include gasoline and electricity fuel production emissions estimates using Argonne National Laboratory's GREET 2017 model. The 80 MPG US average is a sales-weighted average based on where EVs were sold in 2011-2017.

Source: Union of Concerned Scientists

Since the scientist group has been tracking this wells-to-wheels emissions measurement, the U.S. average has improved, but they didn't report the national average. Instead, the scientists focused more on the performance of EVs and the cleanliness of the power in

Exhibit 15. How Less Clean Power Was Five Years Ago



Source: Union of Concerned Scientists

individual regions or states. However, if we look at several areas as reported for 2013 compared to 2018, we see California increasing from 78 to 109 mpg, while the main part of Texas increased from 48 to 60 mpg. Very impressive is the performance of the New England states where the improvement went from 75 to 102 mpg, and upstate New York, which increased from 115 to 191 mpg.

The overall U.S. electricity grid has reduced its total carbon emissions in the five-year span of 2013-2018

The most noticeable difference in the maps of areas ranked by the good, better or best ratings, is how much the 2013 good area has shrunk by 2018. In other words, the overall U.S. electricity grid has reduced its total carbon emissions in the five-year span of 2013-2018. That improvement has come as more coal-fired generating plants have shut down and been replaced by either natural gas-fired or renewable energy sources. Each coal-plant closure leads to reduced pollution in the region or state, and nationally, too. These improvements will begin to have a greater impact as more EVs are registered in other areas.

The low mileage rating for EVs in this area suggests that the challenge of promoting EVs in this highly congested urban region has a long way to go

One comparison that struck us was that of New York Long Island, which has only increased from 41 to 50 mpg. While a greater than 20% increase should be applauded, it is notable that the goal of EVs is to improve the environment of urban areas that are choked with traffic congestion. The low mileage rating for EVs in this area suggests that the challenge of promoting EVs in this highly congested urban region has a long way to go. Is this an infrastructure issue, or an acceptance issue? Most likely it is due to an inadequate charging network, which needs to expand substantially if more EVs are to be on the roads in and around New York City. Maybe New York Governor Cuomo will include mandates for EVs in his effort to make his state look more like California.

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