
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

Sorting Out Long-term Thinking On Oil vs. Short-term Noise

“We have to stay on a capital diet”

BP plc (BP-NYSE) CEO Robert Dudley defined his industry’s mantra over two years ago as “lower for longer,” a reference to where oil prices would trade and why oil companies needed to downsize to survive this environment. At last week’s World Petroleum Congress in Istanbul, Turkey, Mr. Dudley may have coined the new industry mantra: “We have to stay on a capital diet.”

“What is more important than price assumptions is driving down our breakeven price each year and thus making our business more resilient for a range of prices”

In an interview with *Upstream*, Mr. Dudley explained how he and his management team were addressing the challenges of his mantras. First, with respect to “lower for longer,” he said, “we’re making our planning assumptions around a price of about \$50 at the end of this year and about \$50 to \$55 over the next couple of years.” He amplified his forecast saying, “What is more important than price assumptions is driving down our breakeven price each year and thus making our business more resilient for a range of prices.” This point is very important, as crude oil prices, which recently flirted with \$42 a barrel before rallying back above \$46, remain well below Mr. Dudley’s year-end and longer term price targets. The risk of oil prices failing to meet Mr. Dudley’s targets, or those of most oil price forecasters, was highlighted by a report from the commodities trading division of Goldman Sachs’ (GS-NYSE) in which it cut its 2017 oil price forecast, but more ominously suggested it was entirely possible for oil prices to fall back into the \$30s a barrel range.

“It isn’t that there’s too much oil in the world; there is too much money”

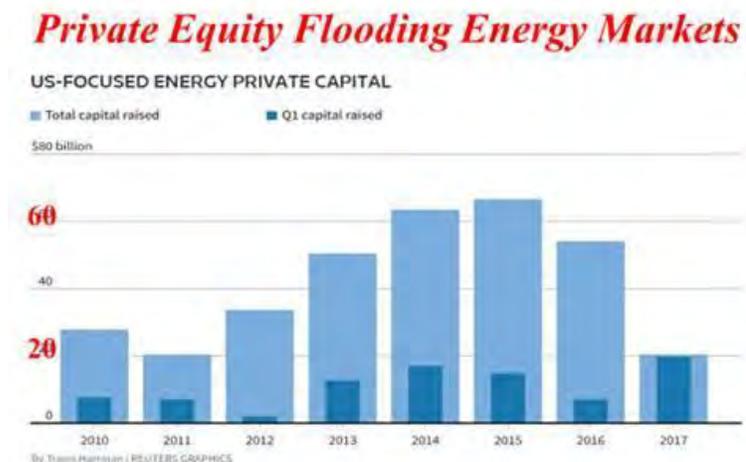
In talking about his firm’s latest oil price forecast report, Jeff Currie, global head of commodities research at Goldman, told the anchors on *CNBC*’s “Power Lunch” show that “it isn’t that there’s too much oil in the world; there is too much money.” He cited, as an example of this phenomenon, the recent discovery of a more than one billion barrel offshore Mexican oil field by a company backed by private equity. TALOS Energy, backed by energy-focused private equity

Amount of new capital raised by energy private equity firms was a record for the first quarter since 2010

firm Riverstone Capital, teamed up with Mexican private equity firm Sierra Oil & Gas and UK-listed Premier Oil (PMO, London) to win one of the first offshore tracts offered to private companies in 2015 by the Mexican government in its oil industry privatization effort, and now a huge discovery. This reflected just one private equity energy investment success that is reshaping the global oil business.

Exhibit 1 shows that total energy private equity fund-raising peaked in 2015. Due to the oil industry downturn, much of this money is still seeking investment opportunities. A substantial amount of private equity capital has targeted the shale sector because of its ability to quickly expand and contract in response to changes in near-term oil price expectations. As the chart's dark bars show, the amount of new capital raised by energy private equity firms set a record for the first quarter since 2010.

Exhibit 1. How Energy Private Equity Has Grown



Focus on startups, bankruptcy exits, Permian

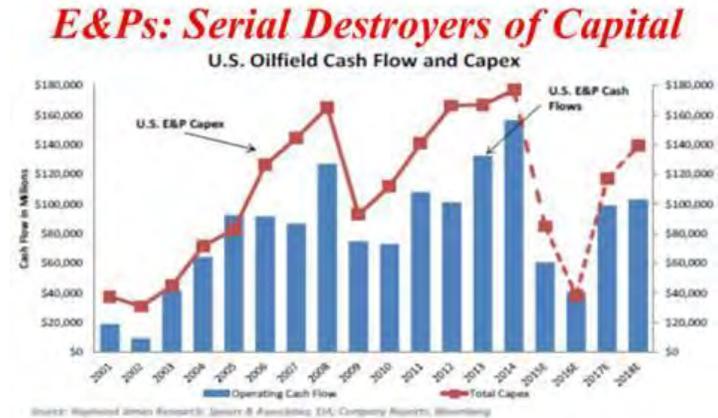
Source: James Halloran

Mr. Dudley is sensitive to improving financial returns and maintaining a conservative balance sheet

Having guided BP through a near-death experience following the Deepwater Horizon disaster in 2010, Mr. Dudley is sensitive to the need to improve financial returns while maintaining a conservative balance sheet. Given the industry's history of outspending its cash flow, the oil price downturn in 2014 decimated the heavily leveraged industry. Hundreds of energy companies have been forced to file for bankruptcy, including long-standing participants, causing them to shed hundreds of thousands of jobs. BP can't risk overspending.

The long-term nature of the oil and gas industry results from the long time-lag between finding and developing new supply sources. The global expansion of the oil and gas search has led to the discovery of significant resources, but often at escalating costs. Prior to 2015, these higher finding and development costs were matched by

Exhibit 2. E&P Industry’s History Of Outspending Cash Flow



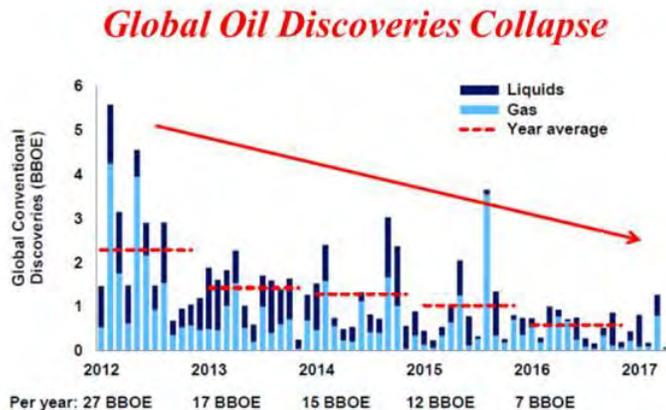
Incentivized by shale; enabled by cheap money
Justified by “sunk cost” accounting

Source: James Halloran

One casualty of the industry’s ongoing adjustment has been new oil and gas discoveries

extremely high oil prices. When prices fell, the industry was forced to quickly adjust its business model in hopes of preserving its companies. That is not easy to do, nor can it be done within a vacuum of the other pressures currently shaping the business, in particular, issues such as demand growth as well as the penetration of alternative fuel sources. One casualty of the industry’s ongoing adjustment has been new oil and gas discoveries, as the amount of money available for exploration has collapsed.

Exhibit 3. Discoveries Followed Oil Prices Downward



Discoveries take 4-8 years to bring to market. Lower cash flow, siren of shale decimates discovery budgets

Source: James Halloran

A recent op-ed by Jeffrey Sonnenfeld, a professor of leadership practice at the Yale School of Management, in *The Wall Street*

The energy industry has become a target of activist investors interested in quick capital gains and caring less about the enterprise’s long-term viability

The IEA has sounded the alarm over sharply higher oil prices in the 2020-2022 time frame due to a lack of industry capital investment

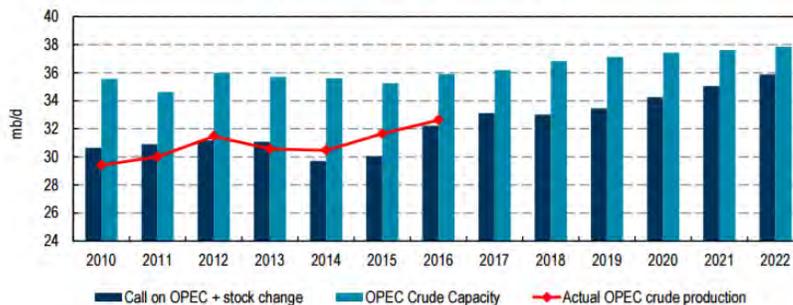
A possible relief valve might be the growth in U.S. shale output

Journal, focused on CEOs being ousted by their boards of directors for lack of near-term share price performance. His argument centered on the impact of short-term oriented activist investors on the ousting of many CEOs, either as a condition of settlement with companies or after securing seats on the board and then agitating internally for change. The energy industry has become a target of activist investors interested in quick capital gains and caring less about the enterprise’s long-term viability. Energy’s viability is finding and developing new supplies, something activists may hurt.

The latest topic of interest in the oil and gas business is the lack of new discoveries given the cutback in capital investment in keeping with Mr. Dudley’s “capital diet.” What does this mean for the industry’s future? The International Energy Agency (IEA) has sounded the alarm over sharply higher oil prices in the 2020-2022 time frame due to a lack of industry capital spending. With capital spending cut by 25% in 2015 and by another 26% in 2016, prospects are increasing for a growing gap in the future output trajectory for oil. Current expectations call for a modest increase in capital spending during 2017, but that increase could prove overly optimistic should oil prices fail to recover in the second half.

Exhibit 4. EIA Sees Tightening Oil Market And Higher Prices

Figure ES.1 Global oil market balance



Source: EIA

The IEA warned in its *Oil 2017* report of a possible imbalance between demand and supply growth, leading to the smallest global spare production capacity surplus in 14 years by 2022. That conclusion is based on demand growth for 2016-2022 of 7.3 million barrels per day (mmb/d), which exceeds the projected supply growth of under 6 mmb/d. A possible relief valve might be the growth in U.S. shale output. As Dr. Fatih Birol, the IEA’s executive director put it: “We are witnessing the start of a second wave of U.S. supply growth, and its size will depend on where prices go.” He went on to say, “But this is no time for complacency. We don’t see a peak in oil demand any time soon. And unless investments globally rebound sharply, a new period of price volatility looms on the horizon.”

The firm now sees oil prices exhibiting a U-shape cyclical pattern

The supply shortage view seems to be gaining traction among oil and gas industry professionals. Halliburton Company's (HAL-NYSE) Mark Richard, senior vice president of global business development and marketing, told the World Petroleum Congress that "You'll see some kind of spike in the price of oil, maybe somewhere around 2020, 2021." This fits with Bernstein Research's latest oil price downgrade. The firm now sees oil prices exhibiting a U-shape cyclical pattern: after having declined from over \$80 a barrel in 2014, they traded in the \$40s for 2015-2016, and will now be flat at \$50 for 2017-2018 before slowly climbing back to \$70 by 2021.

"We used to make money at \$40 oil, we used to make money at \$25 oil"

Reflecting the more pessimistic near-term view prevailing in the industry now, Dinesh Kumar Sarraf, chairman of India's Oil & Natural Gas Corp., suggested that companies must be prepared to live with a "lower forever oil price." Mr. Dudley reminded attendees that oil companies need to remain disciplined about spending and not count on higher oil prices to bail them out. As he put it, "The years of \$100 oil will turn out to be an aberration. We used to make money at \$40 oil, we used to make money at \$25 oil." Implicitly, he was asking why the industry can't make money at much lower than recent historical prices. But, he hedged his outlook by telling a dinner audience that "It's lower for longer, but not lower forever."

The price shock scenario could become a death knell for the industry

It is possible that everyone will prove right – depending on their time frame? However, the price shock scenario could become a death knell for the industry as sharply higher oil prices will incentivize governments and consumers to embrace electric vehicles and alternative mobility methods crimping transportation fuel demand. Producer animal spirits will drive an increase in supply. Those conflicting responses will ease the tight market, and may cap a rise in future oil prices. CEOs, thinking long-term about business opportunities, are shifting their companies' focus from crude oil to natural gas and renewables. We suggest investors focus on long-term trends working in the industry and ignore current oil price noise.

Did Auto Industry Ring Bell For Top In ICE Car Demand?

It places electrification at the core of its future business, but ultimately with a significant hedge in place

On Wall Street there is an expression: "They never ring the bell at market tops." It refers to the tendency for investors to be buying shares hand-over-fist as the market peaks and then ruing their losses after share prices fall. According to the mainstream media, the warning bell is now being rung for the global automobile industry. They cite the early July press release issued by Swedish auto maker Volvo, owned by China's Geely Holding Group, a multinational auto manufacturer, since 2010 when it purchased the company from Ford Motor Company (F-NYSE). The release announced that every new Volvo model launched from 2019 will have an electric motor, marking the historic end for cars that only have an internal combustion engine (ICE). It places electrification at the core of its future business, but ultimately with a significant hedge in place.

“Going Electric, Volvo Declares Gas Is the Past”

Based on the press release and additional comments from Volvo’s CEO Hakan Samuelsson, *The New York Times* headlined its front-page story as “Going Electric, Volvo Declares Gas Is the Past.” For much of the remainder of the Fourth of July week, the mainstream media was obsessed with predicting how Volvo’s action marks the beginning of the end for ICE cars. They declared it a clear victory for battery powered cars. The move was touted as support for those energy forecasters predicting peak oil demand soon, and eventual devastation for the petroleum industry.

It confuses electric with electrification, and assume they mean the same thing

Did the mainstream media get it right, or did they misread the Volvo press release? If the latter, maybe it was due to the media’s lack of understanding about the difference between “electric” and “electrification.” Maybe the media failed to do sufficient research as it confuses electric with electrification, and assume they mean the same thing. In reality, the two terms are materially different and will have significantly different impacts on the future of both the automobile and petroleum industries. The confusion may be explained partly by the reporters misreading the press release quotes of CEO Samuelsson. He said, “People increasingly demand electrified cars and we want to respond to our customers’ current and future needs. You can now pick and choose whichever electrified Volvo you wish.”

“‘Electrified’ cars simply have an electric motor somewhere in the drivetrain—and they don’t necessarily have plugs (although they may)”

What’s the difference between electric and electrification? As John Voelcker, writing in *Green Cars Report*, put it, “‘Electric’ cars are vehicles that plug into the electric grid to recharge batteries that provide the energy to run them. But ‘electrified’ cars simply have an electric motor somewhere in the drivetrain—and they don’t necessarily have plugs (although they may).” This distinction is critical. It differentiates between electric cars that are battery-only (Nissan Leaf, Tesla Model S and Chevy Bolt) or plug-in hybrid powered cars (Chevy Volt and Toyota Prius Prime) versus electrified cars, which include the previous kinds of electric cars plus conventional hybrid vehicles that have no plug and use electric motors to drive a mile or so on battery power and then assist the internal combustion engine, as well as mild hybrids, which employ enhanced “start-stop” technology.

Hybrids - both conventional and mild - represent the bulk of the global fleet’s electrified vehicles. A primary reason for that is because they are cheaper to build than electric cars with their large battery packs, plus they overcome consumer range anxiety.

The reality is that Volvo, in its press release, is promoting hybrid technology

The reality is that Volvo, in its press release, is promoting hybrid technology because it has declared that all its future models will provide some form of electrification option for its customers. In fact, Volvo stated in its press release that it “will introduce a portfolio of electrified cars across its model range, embracing fully electric cars, plug in hybrid cars and mild hybrid cars.” Volvo will build its battery powered cars starting in 2019 at a plant in China, targeting that

The company will ensure that all its existing ICE models will be able to incorporate “start-stop” technology

market. It plans to eventually build them in Europe and at its new plant under construction near Charlestown, South Carolina.

Professional auto forecasters predict that the largest share of Volvo’s output will be 48-volt mild hybrids (without a plug) because the company will ensure that all its existing ICE models will be able to incorporate “start-stop” technology. As Mark Twain commented on the predictions of his death, the prediction of the death of ICE cars and the petroleum industry “was an exaggeration.”

Tesla Stumbles: Is It An EV Issue Or Something Else?

Tesla reported its second quarter shipments at the end of June and the results were not as robust as many investors were hoping

After spending three months as the most valuable auto manufacturer on the planet, Tesla Inc.’s (TSLA-Nasdaq) share price fell due to perceived problems with its business model. Tesla reported its second quarter shipments at the end of June and the results were not as robust as many investors had hoped. Results were at the low end of the range management had guided analysts to earlier. As the quarter ended, Tesla CEO Elon Musk tweeted details about the timing of production and delivery for the Model 3 units, the company’s electric vehicle (EV) targeting the mass market.

Many investors who examined the company’s results were pleased with Tesla’s progress in meeting its target production range. Others were dissatisfied by the battery production problems cited for deliveries failing to meet the upper end of the second quarter output target range, an issue reportedly corrected in June. As the output controversy swirled, the share price plummeted. The market sentiment quickly shifted to whether Tesla should be valued as an auto manufacturer or as a technology company?

In the background is the issue of Tesla facing increased competition in its auto business, meaning it may no longer be the stock market darling it has been

How you classify Tesla shapes the issues investors consider most important in valuing the company. An auto manufacturer’s value rises and falls on output targets - either met or not. Technology company valuations are more sensitive to the business opportunities being exploited by a company and conceptually how these are likely to create new demand. Given Tesla’s multiple business lines – leading edge EVs, auto financing, solar roof tiles, battery storage projects, and tunnel boring – more investors lump the company in with technology companies, meaning investors focus on the “dream” rather than the results. As the technology sector is currently undergoing a market correction, many investors are chalking up Tesla’s recent stock price decline to market rotation rather than the company’s car output issues. But, in the background is the issue of Tesla facing increased competition in its auto business, meaning it may no longer be the stock market darling it has been.

A recent analysis by *The Wall Street Journal* shows the impact of EV subsidies on demand. In February, the Hong Kong government announced the ending of tax subsidies for EVs effective April 1st. While Tesla doesn’t break out its sales by country, car registration

The ending of the tax subsidy raised the effective price of a Tesla Model S four-door car to around \$130,000 from its subsidized price of less than \$75,000

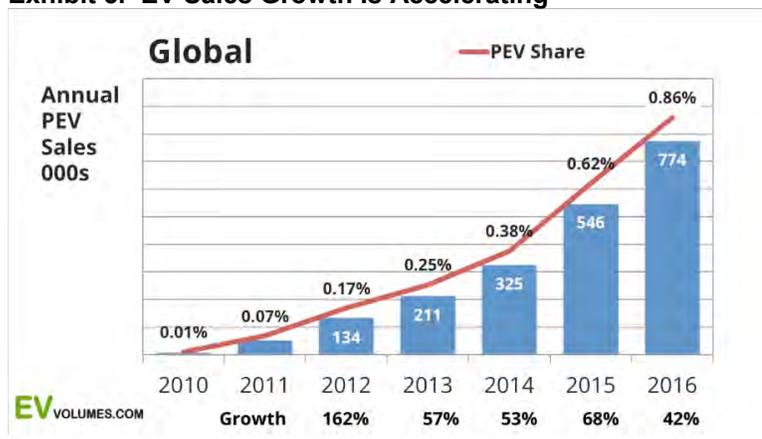
data is available from government sources. For 2017's first quarter, Tesla registered 3,700 vehicles in Hong Kong, including 2,939 cars in March, alone. That volume compares to the 1,506 Teslas registered for the entire second half of 2016. According to the *WSJ*, the ending of the tax subsidy raised the effective price of a Tesla Model S four-door car to around \$130,000 from its subsidized price of less than \$75,000, and making it nearly twice as expensive as a Mercedes Benz. Ouch! No wonder not a single Tesla was registered during April. The suspension of EV tax subsidies lasts through March 2018, but the government has said it will review the policy before then.

That raises the question as to what happens to Tesla's Model 3 backlog when price-sensitive EV buyers, who have ordered the car, realize it may be delivered without the tax subsidy

Tesla, which produced 25,000 Model S and Model X vehicles in the first quarter, only shipped 22,000 in the second. Questions abound now as to whether the company met its 1Q2017 production target by pulling forward nearly 3,000 vehicle sales in Hong Kong as a result of the impending end to EV tax subsidies. The sales pulled forward may have contributed to Tesla missing its second quarter output target. Of course, if Tesla is a tech company and not an auto manufacturer, these production/sales misses shouldn't be a major issue, as the EV business retains a cult following.

As a manufacturer of a niche automobile attempting to grow into a mainstream competitor, it is important to note that Tesla's U.S. tax subsidies apply for the first 200,000 vehicles produced, which will likely be exceeded sometime in 2018. That raises the question as to what happens to Tesla's Model 3 backlog when price-sensitive EV buyers, who have ordered the car, realize it may be delivered without the tax subsidy. We won't know the possible impact on Tesla's future sales until the tax subsidy ending is announced. However, the history of every secession of EV tax subsidies has seen an immediate and sharp fall in sales, such as in Hong Kong. This episode highlights how widespread EV tax subsidies are partly (maybe largely) responsible for the surge in global EV sales.

Exhibit 5. EV Sales Growth Is Accelerating



Eight out of 10 cars sold in 2030 would have a plug

In 2016, the global motor vehicle population of cars and trucks was estimated at 1.4 billion, but just 2 million of them are EVs, or a 0.0014% market share

BP frames its forecast slightly differently, but arrives at a similar conclusion regarding oil's use – it will not be impacted significantly

Meaning another 900 million ICE cars added to the current estimate of 900 million cars on the world's roads today

Global EV sales have more than tripled since 2013, and if last year's 42% growth rate continues, it means eight out of 10 cars sold in 2030 would have a plug. That growth pattern is described as an S-curve, which begins with very sharp growth for a while before eventually flattening and then possibly declining. As inconceivable as that scenario may seem, it is not impossible to imagine. The probability of the S-curve dominating the EV industry growth, however, remains in question.

In 2016, there were an estimated 773,600 EVs sold worldwide out of 90 million total light-duty vehicle sales, which grew 2%. While the global EV picture shows only a 0.86% market share for new car sales last year, in certain markets it was substantially greater. Norway had a 24% EV market share in 2016, while the Netherlands' share was 5% and Sweden's was 3.2%. Despite these notable country performances, the impact on the global vehicle population is barely noticeable. In 2016, the global motor vehicle population of cars and trucks was estimated at 1.4 billion, but just 2 million of them are EVs, or a 0.0014% market share.

Exhibit 6. Monthly EV Sales Suggest S-curve Growth



Source: *EVvolumes.com*

The monthly EV sales gains in 2016 appear to support the S-curve growth model, despite the doubts of energy forecasters such as OPEC, BP plc (BP-NYSE) and Exxon Mobil Corp. (XOM-NYSE). ExxonMobil sees EVs growing slowly to about 10% of U.S. auto sales, but it sees something very different for hybrid vehicles – those possessing both an electric motor and an internal combustion engine. According to ExxonMobil's latest forecast, The Outlook for Energy- A View to 2040, the company writes that “Sales of new hybrids are expected to jump from about 2 percent of new-car sales in 2014 to more than 40 percent by 2040, when one in four cars in the world will be a hybrid. Average fuel economy will rise from 25 to about 45 miles per gallon.” BP frames its forecast slightly differently, but arrives at a similar conclusion regarding oil's use – it will not be impacted significantly.

BP's Energy Outlook 2035 forecasts that over the next two decades, EVs will grow from around 1.2 million vehicles today to around 70 million in 2035, about a 58-fold increase. Meanwhile, the world's global car fleet will double, meaning another 900 million ICE cars added to the current estimate of 900 million cars on the world's roads today. Promoters of EVs would argue that the BP estimate,

Since 2010, lithium-ion battery pack prices have declined by two-thirds to around \$300 per kilowatt-hour

Major hurdles include the limited range of EVs and their long charging times

NEF suggests EVs may have a difficult time making inroads in dense urban areas, which may slow EV growth after 2040

and those of other energy companies, are way too conservative. A new study issued by Bloomberg New Energy Finance (NEF) suggests that EVs will become price competitive with ICE vehicles even without government subsidies between 2025 and 2030. At that point, NEF sees a “real shift” occurring that will create an explosion in EV sales.

Colin McKerracher, the head of advanced transport analysis at NEF, told *The New York Times*, “Our forecast doesn’t hinge on countries adopting stringent new fuel standards or climate policies. It’s an economic analysis, looking at what happens when the upfront cost of electric vehicles reaches parity [with internal combustion engine vehicles].” NEF sees it happening as a result of a continuation of the decline in the cost of EV batteries. Since 2010, lithium-ion battery pack prices have declined by two-thirds to around \$300 per kilowatt-hour (kWh). GM has said that the cost of the battery for its new Chevy Bolt EV was down to about \$145/kWh. NEF projects that battery costs will fall to \$73/kWh by 2030, without any significant technological breakthroughs. The cost reduction is driven by larger battery manufacturing plants and optimizing the battery pack design.

Interestingly, the *NYT* article presented an extensive number of challenges for the NEF forecast. For example, it quoted other auto experts suggesting that falling battery costs are not the only factor that will determine whether EVs gain a significant share of the global fleet. Major hurdles include the limited range of EVs and their long charging times. As EVs begin using larger batteries and are able to go further on a single charge, the range issue will disappear, however, changing the psychology surrounding EVs may take much longer. A reader suggested that EV owners should invest their waiting time meeting very interesting people as their cars charge. Maybe this can become a new social event – elitist as it may seem.

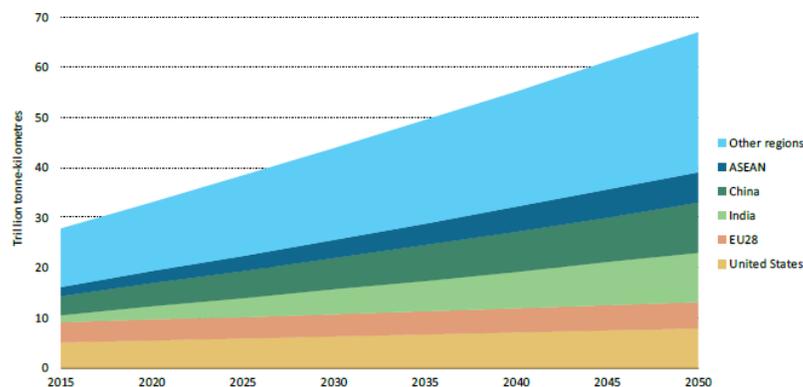
The charging infrastructure issue is a significant hurdle to overcome – the number of locations, their accessibility, and the time necessary for charging. While companies are working to reduce the charging time, it still takes considerably longer than the time for filling up an ICE car. Building out the charging infrastructure will take time and substantial investment, so this hurdle will not disappear quickly. Many people charge their EVs at home overnight, but that is not an option for city dwellers who must park their vehicles on city streets. As a result, NEF suggests EVs may have a difficult time making inroads in dense urban areas, which may slow EV growth after 2040. That is an interesting conclusion since EVs are offered as a key component of the mobility revolution futurists see impacting the automobile industry. If overcoming the EV charging issues cannot be achieved, the mobility revolution will need to be driven primarily by commercial fleets that can arrange for facilities for mass charging of vehicles.

“Oil consumption by road freight overtakes fuel demand from passenger cars around 2030”

The *NYT* made two points in concluding its article, one of which echoed BP’s forecast. The *NYT* pointed out that even with a greater number of EVs, the world would still have more traditional vehicles, just as BP pointed out. The second point was that EVs and improved batteries will have little impact on heavy-duty trucking and aviation, meaning that petroleum consumption in these sectors will likely grow. The International Energy Agency in a recent study, [The Future of Trucks – Implications for energy and the environment](#) showed the significance of the heavy-duty truck sector on global fuel use. According to the report, “Much of the growth in road freight energy demand to 2050 in the Reference Scenario is satisfied by oil products. The road freight sector’s weight on future oil demand growth is significant; it accounts for 40% of total global oil demand growth (across all sectors) to 2050. Oil consumption by road freight overtakes fuel demand from passenger cars around 2030. Much of the growth in road freight oil demand is from emerging and developing countries, in particular in Asia: at 4.5 million barrels per day (mb/d), growth from road freight vehicles in Asia alone is responsible for 90% of the freight transport sector’s global oil demand growth.”

Exhibit 7. Freight Growth In All Areas Except Europe

Figure 27 • Road freight activity by region in the Reference Scenario, 2015-50.



Note: ASEAN = Association of Southeast Asian Nations; EU28 = European Union.
 Source: IEA (2017a), Mobility Model, June 2017 version, database and simulation model, www.iea.org/etp/etamodel/transport/.

Source: IEA

All geographic regions show growth, with the possible exception of the European Union countries

With trucking demand growing, transportation fuel use will grow, although gasoline use by cars may suffer from the growth of EVs. This may force refineries to need to be revamped to increase truck fuel output. Examining Exhibit 8 (next page) from the IEA report, all geographic regions show growth, with the possible exception of the European Union countries. That is not surprising given the countries’ population density, lack of population growth, aging populations, and increased push to eliminate CO2 emissions. These forces are likely to force the distribution business to adjust its business model, potentially stifling oil use in Europe.

Exhibit 8. Road Freight Growth Drives Truck Fuel Demand

Figure 29 • Energy demand growth from road freight vehicles by region in the Reference Scenario, 2015-50



Source: IEA (2017a), Mobility Model, June 2017 version, database and simulation model, www.iea.org/etsi/etnomodel/etnomodel/

Source: IEA

NEF projects that EVs will make up 54% of new light-duty sales globally by 2040

The NEF study, which is similar to several others that assume a highly aggressive acceptance of EVs, projects that EVs will make up 54% of new light-duty sales globally by 2040. By the time that happens, according to NEF, the global petroleum market will have surrendered about eight million barrels a day of gasoline demand, which is a considerably greater impact than EVs have in BP's forecast, which sees a three million barrels a day impact by 2035.

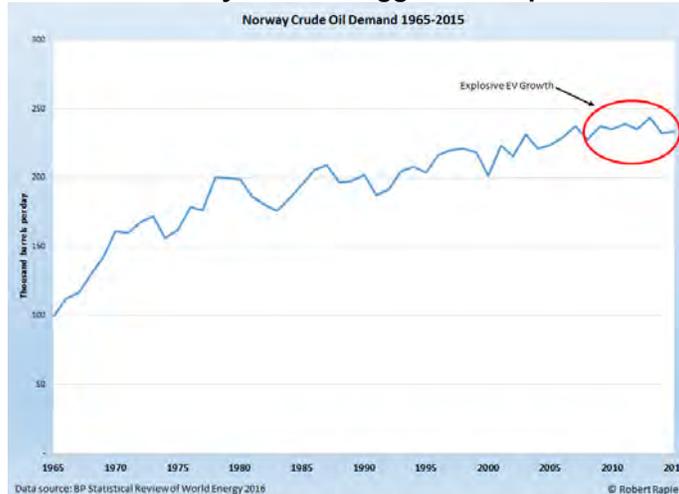
Critics of these studies point to the recent history of oil consumption in Norway, one of the leading EV success stories

Critics of EV studies such as NEF's point to the recent history of oil consumption in Norway, one of the leading EV success stories. Very generous tax subsidies coupled with significant operational favoritism – free tolls and parking as well as access to high occupancy travel lanes – have spurred EV sales. At the end of 2016, the country had slightly over 135,000 EVs registered out of a total fleet of roughly 2.7 million vehicles, representing about a 5% market share. This has happened at the same time oil use has been essentially flat or has risen slightly since 2011. Oil use climbed in both 2015 and 2016 based on the latest energy data from BP, years when EV sales in Norway soared.

A large number of EVs represent second, third or fourth cars owned by Norwegian families

How is it possible for one of the leading countries embracing EVs to have higher gasoline consumption? From our investigation, it might be happening due to a large number of EVs representing second, third or fourth cars owned by Norwegian families. It is possible that many commuting trips utilize EVs for their fuel-efficiency as well as free highway tolls, quicker access into city centers and free parking benefits. Many Norwegian families may be using their larger, gasoline or diesel powered cars for their longer trips due to the hassle of charging EVs and their limited range. An examination

Exhibit 9. Norway Oil Use Suggest No Impact From EVs



Source: *The Energy Letter*

While the Norway’s data suggests that tax subsidies have distorted the economics of EVs, the fact that a large percentage of them are secondary family vehicles supports the view that these vehicles remain a niche market

of BP’s data on oil consumption in other EV-popular countries – Sweden, Denmark, and the UK – show a similar oil use trend. Finland’s oil use is nearly flat over the last five years, as was oil demand in the Netherlands, although it experienced a sharp yearly increase last year. While Norway’s data suggests that tax subsidies have distorted the economics of EVs, the fact that a large percentage of them are secondary family vehicles supports the view that these vehicles remain a niche product. Norwegian auto experts suggest that the transition from early EV adopters to them becoming mainstream is a hurdle that may take considerably more time to achieve than forecasters assume. The oil consumption data of other countries would seem, at least superficially, to support that view.

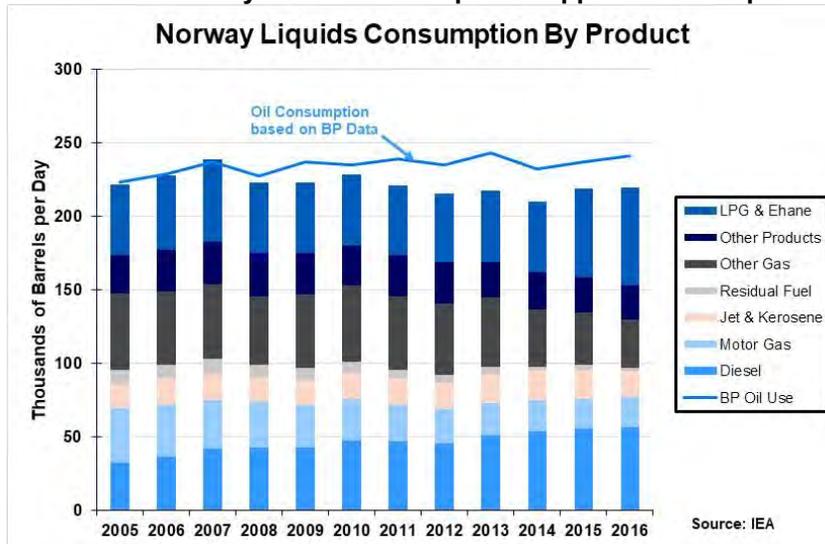
Gasoline consumption in Norway actually fell by 20% since 2011

Unfortunately, a deeper dive into the Norwegian oil consumption data shows a very different story that actually supports the impact of EV penetration on gasoline consumption. Exhibit 10 (next page) shows the components of Norway’s liquids consumption, which is compared against the BP oil use data. The growth in liquids used has largely been centered in LPG and ethane, as well as diesel. Gasoline consumption in Norway actually fell by 20% between 2011 and 2016, while LPG grew nearly 40% and diesel increased by 20%.

These cars begin life with a CO2 legacy of 5.3 metric tons (MT) and 17.5 MT

An aspect of EVs now receiving increased attention is the legacy carbon emissions from their manufacture, in particular the production of the battery. In the last *Musings*, we commented on a recent study in Sweden that concluded that the CO2 legacy for EVs was between 150-200 kilos (330-440 pounds) of carbon emissions per kilowatt-hour (kWh) of battery storage capacity. Using the mid-point of that emissions range and the typical battery size of a Nissan Leaf (30 kWh) and a Tesla Model S (100 kWh), these cars begin life with a CO2 legacy of 5.3 metric tons (MT) and 17.5 MT, respectively. Applying the carbon intensity of gasoline (8,777 grams

Exhibit 10. Norway's Fuel Consumption Supports EV's Impact



Source: BP, IEA, Nordea, PPHB

The Leaf's CO2 legacy would need 1.1 years of driving an ICE to neutralize the emissions legacy, while it takes 3.7 years to offset the legacy of a Model S

of carbon per gallon), the fuel efficiency of an average car (21.6 miles per gallon), along with the typical number of miles driven annually (11,400 miles), all measurements used by the Environmental Protection Agency, the average car generates 4.7 MT of CO2 emissions per year. Thus, the Leaf's CO2 legacy would need 1.1 years of driving an ICE to neutralize its emissions legacy, while it takes 3.7 years to offset the legacy of a Model S.

A report with great impact on the global climate change effort was recently published. It focused on the EV emissions legacy versus ICE cars in China. A team of five scientists with the State Key Laboratory of Automotive Safety and Energy at Tsinghua University in Beijing published the paper in May in the journal *Applied Energy*. In the introduction to the report, the authors point to China's efforts to stop carbon emissions growth before 2030 and then hopefully bring emissions down relative to 2005. The authors wrote about the challenge facing the government's effort to limit CO2 emissions: "The development of BEV's [battery electric vehicles] has been prioritized to help achieve the target and BEV production has already become one of the major concerns."

"Nobody has anticipated the rapid growth of electric drive vehicles in China, the country with [a] relatively weak manufacturing base and coal based energy structure"

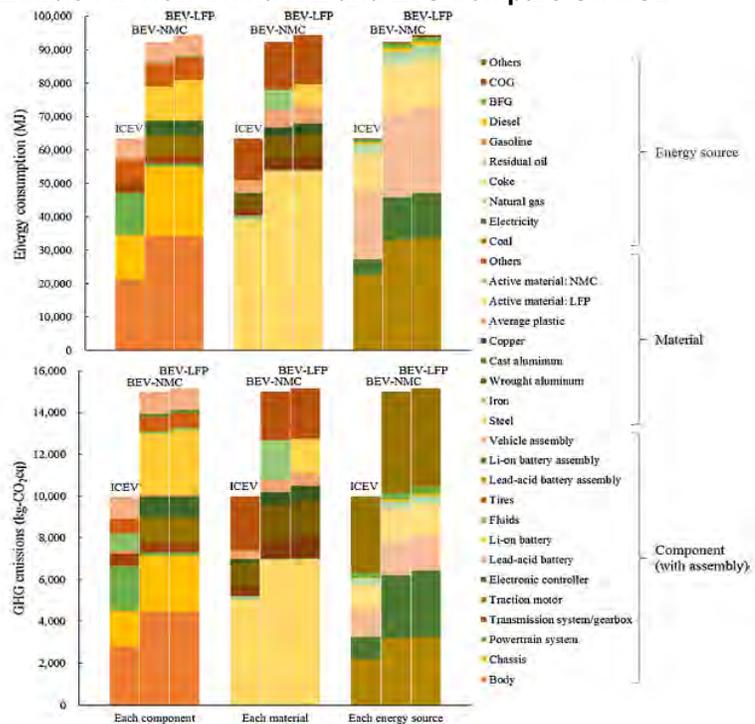
The authors went on to state: "Since nobody has anticipated the rapid growth of electric drive vehicles in China, the country with [a] relatively weak manufacturing base and coal based energy structure, most of the former studies were based on the manufacturing process in developed countries and paid little attention to China's case." As the world's largest EV market, understanding the carbon emissions associated with manufacturing EVs in China it is necessary to understand the country's power industry fuel mix on CO2. It is notable that in the Swedish study, the

An EV employing either of the two popular battery technologies creates either 15,005 or 15,174 kilos of CO2 compared to an ICE car that creates only 9,985 kilos of carbon emissions, or 50% to 52% greater emissions

authors recognized the impact of the fuel powering the nation's electricity generation where the plants are located. The Swedish study referenced that most EV emission studies assumed that electricity came from a system powered 50%-75% by fossil fuels. In 2015, Sweden generated 66% of its power from renewable resources and is aggressively pushing to further decarbonize its power industry. As a result, the Swedish CO2 study modified its higher emissions estimates.

The China study completed an extensive step-by-step analysis of the pollution created in manufacturing each component of an EV. The study also performed a series of sensitivity analyses on the conclusions. The study found that an EV employing either of the two popular battery technologies creates either 15,005 or 15,174 kilos (33,011-33,383 pounds) of CO2 compared to an ICE car that creates only 9,985 kilos (21,967 pound) of carbon emissions, or 50% to 52% greater emissions. The authors also made the point that "Li-ion batteries in the BEV cause huge amounts of additional energy consumption and GHG emissions." They also observed that "the energy consumption and GHG emissions of several other components of a BEV are also larger than those of an ICE due to the larger weight." As shown in Exhibit 11, the energy use and GHG emissions for ICE vehicles is well below those for EVs for each component, each material and each energy source involved in the cars' manufacture. (ICE is the far left column in each graph.)

Exhibit 11. How China ICE and EVs Compare On CO2

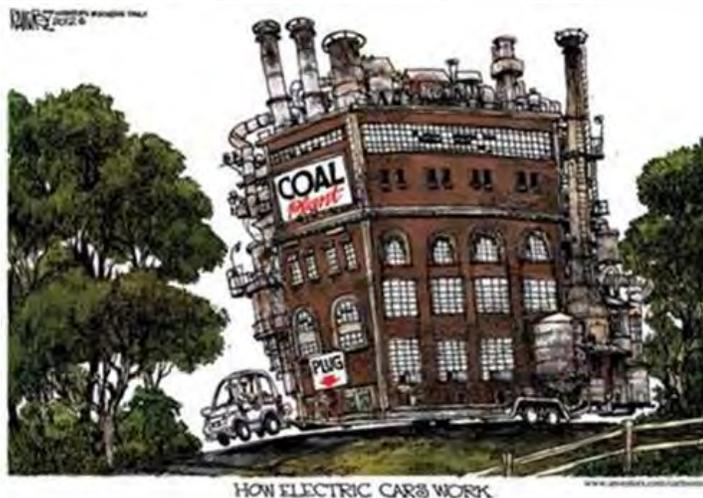


Source: *Applied Energy*

China will not be able to dramatically overhaul its electric power industry anytime soon to make it more environmentally friendly

The China study highlights that the government's push to promote EVs may actually create a greater hurdle for it achieving its goal of restricting CO2 growth. Equally important is understanding that China will not be able to dramatically overhaul its electric power industry anytime soon to make it more environmentally friendly. As China migrates its power industry to renewables and natural gas, CO2 emissions growth should slow, but that still does not eliminate the CO2 legacy of lithium-ion batteries as shown by both the Swedish and Chinese studies. EVs are not as clean as their promoters would like us to believe.

Exhibit 12. How EVs Are Powered Determine Their Cleanliness



Source: Allen Brooks

Despite NEF's optimistic outlook for EVs, the *NYT* article's conclusion clearly summed up the reality: "...it is too soon to write an obituary for the internal combustion engine." We agree.

Northeast Natural Gas Market Continues To Battle To Grow

It now struggles with rapidly growing natural gas production at the same time neighboring New England residents suffer from the highest electricity prices nationwide

The Northeast quadrant of the country was the birthplace of the U.S. oil and gas industry. It now struggles with rapidly growing natural gas output, while neighboring New England residents suffer from the highest electricity prices nationwide. This dilemma was highlighted by two recent events - the release of the latest monthly Energy Information Administration (EIA) report for crude oil and natural gas production based on the department's Form 914 survey of state energy agencies and producers, and the announcement of the delay in the Northeast Access pipeline expansion by the Algonquin Gas Transmission subsidiary of Enbridge Inc. (ENB-NYSE).

The growing gas supply in the Middle Atlantic region is represented by successful exploitation of the Marcellus and Utica shale formations underlying the states of Ohio, Pennsylvania, New York

Exhibit 13. New England Has High Priced Electricity



Source: EIA, PPHB

Northeast drillers focused on these old producing states for their potential resources close to large energy consuming markets

and West Virginia by E&P companies. These formations were the location of early natural gas production, but the output declined over the years. The shale potential was acknowledged, but not exploited due to its drilling challenges. The successful marriage of horizontal drilling and massive hydraulic fracturing technologies, which revived natural gas output from the Barnett Basin in Texas in the early years of this century, changed the equation. As those technologies improved, and demonstrated that they were capable of helping extract higher gas volumes than from conventional wells, Northeast drillers focused on these old producing states for their potential resources close to large energy consuming markets. The expectation became that developing these gas resources would yield higher wellhead prices due to avoiding substantial transmission charges. Unfortunately that hasn't happened.

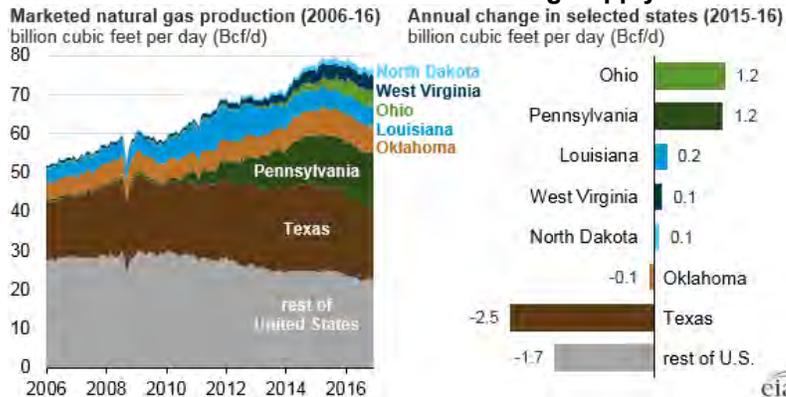
Significant growth in output experienced by Ohio, Pennsylvania and West Virginia since 2012

The latest EIA monthly gas report for April 2017 showed that Ohio, Pennsylvania and West Virginia, the primary producers of Marcellus and Utica natural gas, experienced month-over-month output gains of 3.2%, 0.4% and 0.6%, respectively. More impressive was the year-over-year production increases of 10.2%, 4.0% and 11.0%, respectively. As shown in Exhibit 14 (next page), the history of U.S. natural gas production by state show the significant growth in output experienced by Ohio, Pennsylvania and West Virginia since 2012.

None of what has happened in this region has been what was envisioned when the drilling boom began a half-dozen years ago

In recent times, natural gas prices in this region have been under pressure due to a lack of pipeline capacity to move the output to markets. The reversal of pipelines, allowing natural gas to flow west as well as east, has helped, but a substantial volume of Marcellus and Utica gas supply has been exported to Eastern Canada to meet its growing needs as Western Canadian gas supplies have been limited in growth. None of what has happened in this region has been what was envisioned when the drilling boom began a half-dozen years ago. Increased natural gas consumption in the

Exhibit 14. Marcellus Basin States Showing Supply Growth



Source: EIA

Northeast, particularly for gas-fired electricity generation, has happened, but most of the demand growth has been met by increased expensive liquefied natural gas (LNG). New England electricity consumers have not benefited from low U.S. natural gas prices, and especially not from the depressed wellhead prices experienced by Marcellus producers.

Almost 50% of electricity was powered by natural gas, followed by nuclear at 31%, renewables at 9.7%, hydroelectric at 7.1%, and coal's 2.4% share

In 2016, according to ISO New England, the nonprofit corporation responsible for electricity pricing and supply in the region, almost 50% of electricity was powered by natural gas, followed by nuclear at 31%, renewables at 9.7%, hydroelectric at 7.1%, and coal's 2.4% share. The most recent monthly fuel mix data was roughly similar to the annual data, but with natural gas down to 45% and renewables up to 11%. Within the renewables category, 7% of the total came from wood, refuse and landfill gas. Wind accounted for 3%, helped by the start-up of the Block Island offshore wind farm, while 1% came from solar resources. Coal units generated 0.8% of the region's power, while oil-fired resources produced under 0.1%. The May ISO New England fuel mix report also showed the region receiving net imports of 1,328 gigawatt hours of electricity from neighboring regions, over 14% of total power consumed.

Exhibit 15. NE Generating Capacity At Risk Of Closing

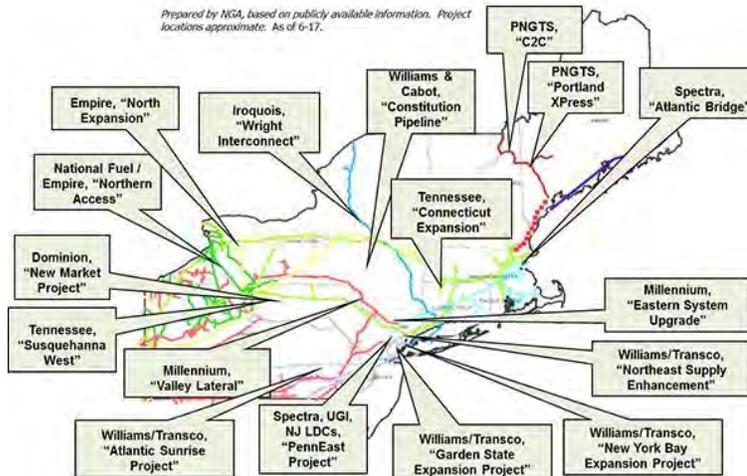


Source: ISO New England

By 2025, it expects gas fired capacity will account for 56% of output

According to ISO New England, the region's gas-fired electricity capacity has grown from 18% in 2000 to 45% now. By 2025, it expects gas-fired capacity will account for 56% of output given older nuclear and oil- and coal-fired power station retirements. While a number of gas pipeline projects are being considered, several major ones have recently been canceled or delayed, largely due to protests by local activists adopting the anti-fracturing mantra of environmentalists.

Exhibit 16. Optimism For Adding More Gas Supply To Region Proposed Pipeline Projects



Source: Northeast Gas Alliance

One major gas project canceled was Kinder Morgan’s (KMI-NYSE) Northeast Energy Direct, which failed to gain sufficient commitments from large customers needed to support the \$3.3 billion for New York and Massachusetts pipelines. The project would have shipped 1.3 billion cubic feet per day (bcf/d) of natural gas.

The latest New England project to be suspended is Algonquin’s Northeast Access pipeline expansion

The latest New England project to be suspended is Algonquin’s Northeast Access pipeline expansion. Enbridge, the parent company, announced on June 29th that it was suspending federal permitting for the \$3.2 billion upgrade project that would have delivered an additional 1 bcf/d of gas to serve around 60% of the New England electricity capacity.

Exhibit 17. The Planned Algonquin Pipeline Expansion



Source: ISO New England

They are forced to rely on short-term supplies, principally LNG, or restarting old coal- or oil-fired power plants

Both the Northeast Access and Northeast Energy Direct pipeline projects were targeted for being on stream for the winter of 2018-2019. Winter is a key time for natural gas supply due to cold temperatures forcing New England electricity providers to push out more power for home heating. To generate that increased power, since electricity utilities cannot enter long-term supply contracts, they are forced to rely on short-term supplies, principally LNG, or restarting old coal- or oil-fired power plants. The company managements behind the suspended pipeline projects employed estimates of the financial savings consumers would gain from the pipelines being in service to try to gain public support. According to Enbridge, “New England commercial and residential consumers during years with normal to severe winters” would save an estimated \$1 billion to \$2.5 billion in their power bills if the Algonquin expansion had been in place.

A recent article asked whether New Englanders are really that opposed to new pipelines. A survey conducted by the Consumer Energy Alliance (CEA) was cited as evidence that the opposition was not that strong. The survey was conducted of 500 voters in

"In reality, it's a small but very influential set of opposition voices that are setting and determining the economic future and trajectory for an entire state and region"

Connecticut, Massachusetts, New Hampshire and New York. More than 90% of respondents are positive regarding the importance of affordable and reliable energy and the necessity of having these supplies. However, only 58% approve of expanding or adding new pipelines. According to Brydon Ross, CEA's vice president for state affairs in comments to *Rigzone*, "In reality, it's a small but very influential set of opposition voices that are setting and determining the economic future and trajectory for an entire state and region." He went on to say, "At the end of the day, the polls are confirming what we all intuitively know – we need this critical infrastructure and the public not only wants it maintained but expanded." He believes this opposition can be overcome with increased education.

Mr. Ross commented on how the protest scene has changed and why increased communications is important. "The rise of the professional protester has really changed things across society. It is important for the industry and public officials to make sure there is readily available and fully transparent information about energy, energy products and the important roles they play in our lives each and every day," he said.

After more than a year of battling, the power plant's owner last week announced its delay until at least June 1, 2020

That's good advice, but the view of the energy business is extremely distorted in the Northeast. For example, in Rhode Island, not only has there been strong opposition to the Algonquin expansion, but there has also been a pitched battle underway over a proposed 900-megawatt natural gas-fired power plant targeted to be built in Burrillville, in the northeast corner of the state, by Invenergy. Burrillville also is the site of an Algonquin pipeline compressor station that is scheduled for expansion. Residents who have lived alongside the compressor for decades suddenly complained about its noise. After more than a year of battling, the power plant's owner last week announced its delay until at least June 1, 2020. The project had originally expected to be delivering power starting in 2019. At a power auction earlier this year, it received interest for only half the output, raising questions as to whether all the power will be needed as soon as 2019. It will be needed later, though.

Natural gas producers have drilled 397 shale in the first half of 2017, more than twice the number drilled in last year's period

Higher natural gas prices during the first half of this year has prompted increased drilling in the Marcellus and Utica formations. Natural gas producers have drilled 397 shale wells in the first half of 2017, more than twice the number drilled in last year's period. There are about 20 more drilling rigs working now. The opening of new pipelines such as Rover, Mariner 2, Atlantic Sunrise and PennEast has improved takeaway capacity from the region, further incentivizing producers to drill. Their enthusiasm for the formation helped drive the recently announced acquisition of Rice Energy Inc. (RICE-NYSE) by EQT Corp. (EQT-NYSE) for \$6.7 billion, a healthy premium. Hopefully, the Northeast gets its act together to expand gas pipeline capacity into the region soon before all the supply sources are locked up.

Enjoying A Laugh At The Expense Of Climate Change

What the report didn't say, in a break with its prior two reports, was that humans are primarily responsible for the emissions increase

No, it has nothing to do with the huge iceberg that broke off of Antarctica that glacier experts say is nature's traditional "housekeeping" and not related to climate change. Neither is it based on the latest Annual Greenhouse Gas Index published by the National Oceanic and Atmospheric Administration (NOAA). The index showed global GHG emissions increasing by 40% between 1990 and 2016. What the report didn't say, in a break with its prior two reports, was that humans are primarily responsible for the emissions increase. No, what we're talking about was a rerun of the snookering of a climate official by a Congressman last year.

At a September 21, 2016, hearing before the House Natural Resources Committee, California Rep. Tom McClintock (R) asked then-President Barack Obama's top climate adviser Christy Goldfuss, Managing Director of the Council on Environmental Quality in The White House about an *Associated Press* article quoting from a government report printed in *The Washington Post*.

Rep. McClintock read from the article:

"The Arctic ocean is warming up, icebergs are growing scarcer and in some places the seals are finding the water too hot, according to a report to the Commerce Department yesterday from Consulafft, at Bergen, Norway.

"Reports from fishermen, seal hunters and explorers all point to a radical change in climate conditions and hitherto unheard-of temperatures in the Arctic zone"

"Reports from fishermen, seal hunters and explorers all point to a radical change in climate conditions and hitherto unheard-of temperatures in the Arctic zone. Exploration expeditions report that scarcely any ice has been met as far north as 81 degrees 29 minutes. Soundings to a depth of 3,100 meters showed the gulf stream still very warm. Great masses of ice have been replaced by moraines of earth and stones, the report continued, while at many points well known glaciers have entirely disappeared.

"Very few seals and no white fish are found in the eastern Arctic, while vast shoals of herring and smelts which have never before ventured so far north, are being encountered in the old seal fishing grounds."

Ms. Goldfuss confessed she had not seen the article

Ms. Goldfuss confessed she had not seen the article or read the government report. That wasn't surprising since she hadn't been born, yet. The article was published on November 2, 1922.

The article was based on an August 1922 report by George Ifft, American consul in Bergen, Norway, and sent to the U.S. State Department, which was subsequently published in *Monthly Weather Review* that November. In his report, Mr. Ifft cited information from an expedition led by Dr. Adolf Hoel, lecturer on geology at the University of Cristiania, sponsored by the Norwegian Department of

Commerce, to Spitzbergen and Bear Island to assess coal mines there. Dr. Hoel observed that there was “so little ice as has ever been noted” in the Arctic.

Mr. Ifft reported on comments from Captain Martin Ingebrigtsen, who said that the Arctic “of that region is not recognizable as the same region of 1868 to 1917.” He had been sailing the eastern Arctic for 54 years and commented that he had noted warming in 1918 and every year since. Mr. Ifft also referred to the very warm weather experienced in the Arctic region of Norway where “Many old landmarks are so changed as to be unrecognizable.” He also mentioned that “At many points where glaciers formerly extended far into the sea they have entirely disappeared.”

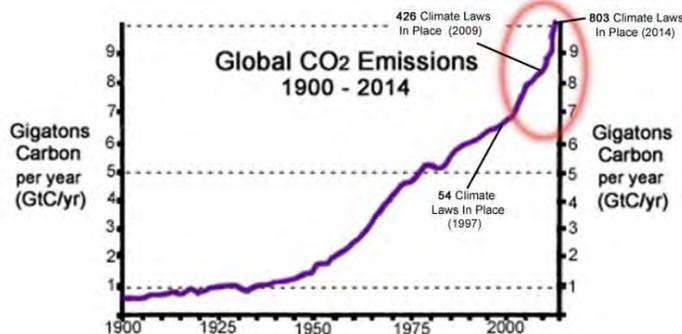
This was the furthest north “modern oceanographic apparatus” had been taken, meaning there are no scientific records from anywhere else in Arctic waters

Environmentalists criticized the use of the newspaper article to reflect the current warming in the Arctic. They said the readings were from an area outside of the Arctic and are not reflective of the current weather there. What they failed to do was read the entire article in *Monthly Weather Review*, (Page 25) which states that this was the furthest north “modern oceanographic apparatus” had been taken, meaning there are no scientific records from anywhere else in Arctic waters at that time, or earlier. They also ignored Mr. Ifft’s discussion of the Norwegian captain’s observations as well as his own observations about Norway’s warm Arctic weather.

CO2 atmospheric concentrations to have risen from 1,160 to 9,777 metric tons

We continue to be struck by the realization that every time we are told about how extreme today’s weather is, it is compared to similar past events, often within our memory, but usually only slightly worse. We’ve been alive long enough for CO2 atmospheric concentrations to have risen from 1,160 to 9,777 metric tons per year, according to data through 2013 from the Carbon Dioxide Information Analysis Center at Oak Ridge National Laboratory, yet weather events aren’t much worse.

Exhibit 18. CO2 Rise Hasn’t Boosted Bad Weather



Source: notrickszone.com

Maybe the latest NOAA GHG emissions report is a step away from the mass hysteria that has driven the global debate in recent years. Is a more balanced discussion in our future?

NOVEMBER, 1922. MONTHLY WEATHER REVIEW.

THE CHANGING ARCTIC.

By GEORGE NICOLAS IFFT.

[Under date of October 10, 1922, the American consul at Bergen, Norway, submitted the following report to the State Department, Washington, D. C.]

The Arctic seems to be warming up. Reports from fishermen, seal hunters, and explorers who sail the seas about Spitzbergen and the eastern Arctic, all point to a radical change in climatic conditions, and hitherto unheard-of high temperatures in that part of the earth's surface.

In August, 1922, the Norwegian Department of Commerce sent an expedition to Spitzbergen and Bear Island under the leadership of Dr. Adolf Hoel, lecturer on geology at the University of Christiania. Its purpose was to survey and chart the lands adjacent to the Norwegian mines on those islands, take soundings of the adjacent waters, and make other oceanographic investigations.

Dr. Hoel, who has just returned, reports the location of hitherto unknown coal deposits on the eastern shores of Advent Bay—deposits of vast extent and superior quality. This is regarded as of first importance, as so far most of the coal mined by the Norwegian companies on those islands has not been of the best quality.

* R. L. Holmes: Quart. Journ. Royal Meteorol. Soc., January, 1905.

The oceanographic observations have, however, been even more interesting. Ice conditions were exceptional. In fact, so little ice has never before been noted. The expedition all but established a record, sailing as far north as 81° 29' in ice-free water. This is the farthest north ever reached with modern oceanographic apparatus.

The character of the waters of the great polar basin has heretofore been practically unknown. Dr. Hoel reports that he made a section of the Gulf Stream at 81° north latitude and took soundings to a depth of 3,100 meters. These show the Gulf Stream very warm, and it could be traced as a surface current till beyond the 81st parallel. The warmth of the waters makes it probable that the favorable ice conditions will continue for some time.

Later a section was taken of the Gulf Stream off Bear Island and off the Isfjord, as well as a section of the cold current that comes down along the west coast of Spitzbergen off the south cape.

In connection with Dr. Hoel's report, it is of interest to note the unusually warm summer in Arctic Norway and the observations of Capt. Martin Ingebrigtsen, who has sailed the eastern Arctic for 54 years past. He says that he first noted warmer conditions in 1918, that since that time it has steadily gotten warmer, and that to-day the Arctic of that region is not recognizable as the same region of 1868 to 1917.

Many old landmarks are so changed as to be unrecognizable. Where formerly great masses of ice were found, there are now often moraines, accumulations of earth and stones. At many points where glaciers formerly extended far into the sea they have entirely disappeared.

The change in temperature, says Captain Ingebrigtsen, has also brought about great change in the flora and fauna of the Arctic. This summer he sought for white fish in Spitzbergen waters. Formerly great shoals of them were found there. This year he saw none, although he visited all the old fishing grounds.

There were few seal in Spitzbergen waters this year, the catch being far under the average. This, however, did not surprise the captain. He pointed out that formerly the waters about Spitzbergen held an even summer temperature of about 3° Celsius; this year recorded temperatures up to 15°, and last winter the ocean did not freeze over even on the north coast of Spitzbergen.

With the disappearance of white fish and seal has come other life in these waters. This year herring in great shoals were found along the west coast of Spitzbergen, all the way from the fry to the veritable great herring. Shoals of smelt were also met with.

Source: NY Library Archives

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