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ENERGY INDUSTRY: REPORTS ABOUT MY DEATH HAVE BEEN GREATLY EXAGGERATED!

BLACKGOLD CAPITAL MANAGEMENT ®

Erik Dybesland
Managing Partner

Adam Flikerski
Managing Partner

Shalin Patel
Director of Research

Jim Rollyson
Senior Investment Analyst

Stephen Jones
Controller & Chief Compliance Officer

Office
BlackGold Capital Management LP
3231 Audley Street
Houston, Texas 77098
www.blackgoldcap.com

Table of Contents

About BlackGold

BlackGold Capital Management LP is a Houston-based alternative investments firm focused on asset heavy cash flowing investments in energy and other related industries. Founded in 2006 by Erik Dybesland and Adam Flikerski, BlackGold has made over $8 billion in energy investments since inception.

BlackGold Capital Management LP is an SEC registered investment advisor located in Houston, TX. Registration as an investment advisor does not imply any level of skill or training.

KKR & Co. LP, a global investment firm that manages investments across multiple asset classes, holds a 24.9% passive minority interest in BlackGold Capital Management LP.

Executive Summary

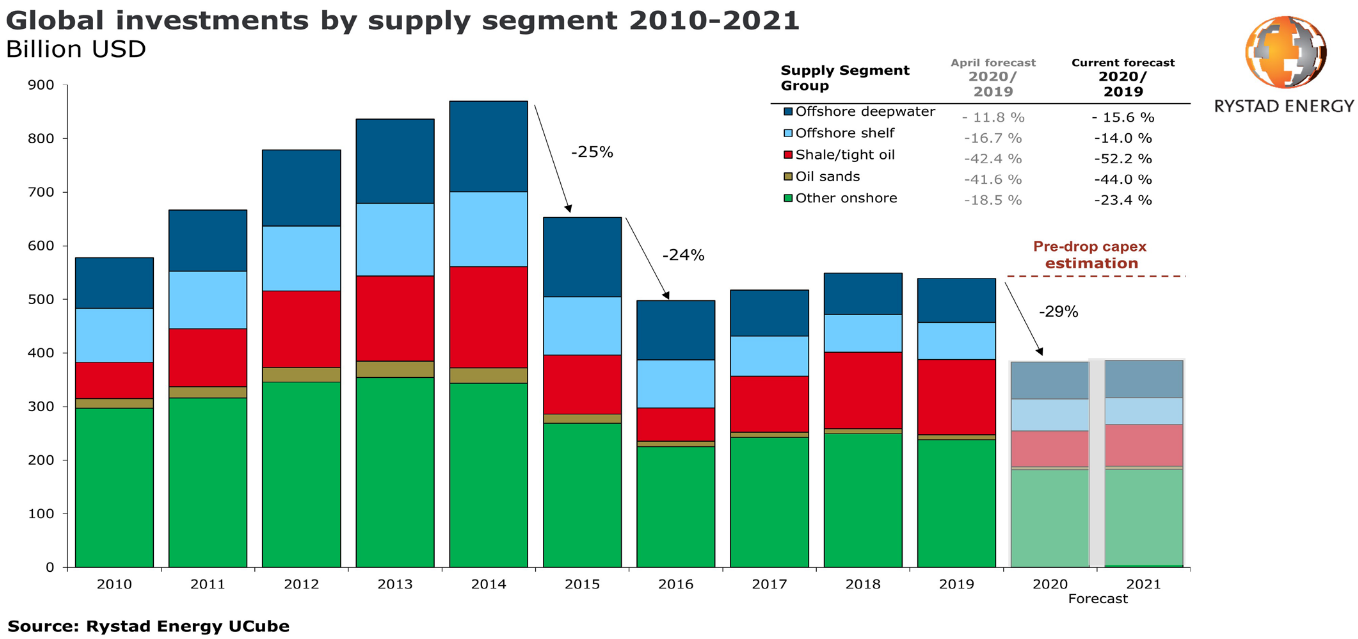
As we will detail later in this report, fossil fuels are far from dead and will continue to play an important role in global energy markets. That said, investing in fossil fuels will require increased focus on things that matter, and the tide isn't likely to lift all boats as it has in the past. Businesses that can still generate consistent cash flows under the new paradigm are increasingly important. Likewise, be prepared for changing trends over time. While commodity prices have clearly suffered following the pandemic outbreak, the sharp reduction in capital spending married with an eventual recovery in demand sets up for a bullish recovery over the next three to five years. Transition to increased renewable sources of energy to combat carbon emissions will continue to occur, but the path isn't set in stone and certainly isn't one size fits all. We don't believe the transition will cost-effectively work without the aid of fossil fuels – especially natural gas.

Cash flows matter! Through all the ups and downs that the energy sector and its investors have endured, companies with strong cash flow generating abilities, quality assets, and low leverage remain attractive investments. We believe those remaining investors that can fill the voids left in the energy capital markets going forward will be in a position to capture solid returns. Energy investing has become increasingly selective and we think the focus should remain on private markets and businesses such as: 1) pipelines/energy infrastructure that are essential to operations and not easily replicated, 2) quality minerals investments, with a focus on PDPs and cash flow visibility, 3) private credit or even structured equity that fills the void left by the departure of banks and other investors and allows for better structures and higher returns.

Be prepared for surprises! Unlike the period from 2001-2008 and again from 2009-2014, it's difficult to invest in energy with an "up and to the right" strategy where the tide will lift all boats. We clearly expect investors to have some sort of macro view, but one must make investments with strong consideration to downside risk. In other words, prepare for the unexpected. Remember after the November 2014 OPEC decision to keep pumping oil that ultimately took oil prices down below $30/bbl, while most E&P companies weren't running "doomsday scenarios" with anything below $50/bbl and were caught by surprise. Long range forecasts for commodity prices are often wrong. After the Asian contagion in the late 1990s, the super majors were planning on sub-$20/bbl oil as the new normal. Then after recovering from the 2008-2009 recession after oil prices rose back over $100/bbl (following the spike to $140/bbl in 2008), investors and energy companies alike thought $100/bbl oil was the new normal. Finally, after the 2015/2016 event and now especially after the impact of COVID on global economies, investors probably expect $40/bbl oil to be the new normal. It likely isn't, but we must invest as if it is.

The collapse in global upstream capital spending sets up for a bullish recovery as demand recovers over the next 3-5 years. Precisely timing a recovery is a difficult task, but given a long enough timeframe makes it somewhat more possible. Since the pandemic hit, not only has energy demand collapsed, but so too has upstream capex which over time will drive production lower. The folks at Rystad Energy project 2020 global capex to fall by nearly 30% to under $400 billion, [1] holding steady in 2021. This falls well below the International Energy Agency's

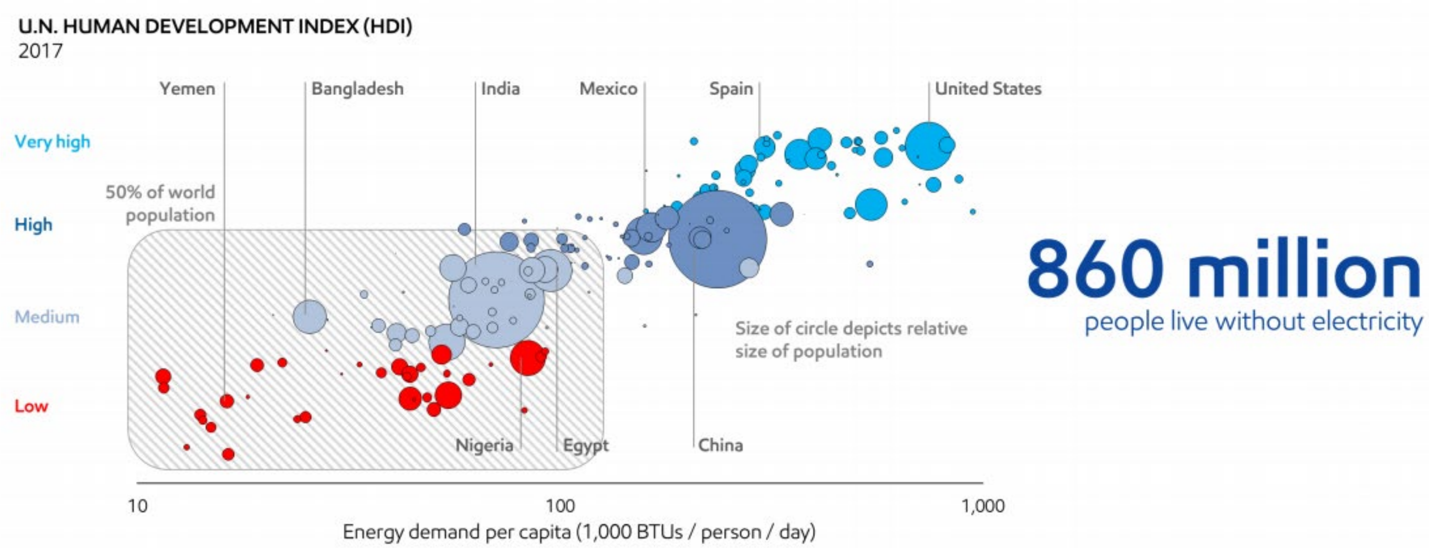
(IEA) estimated $1 trillion/year pace necessary to replace oil and natural production to depletion (for its 2040 target). This is likely to be especially acute in the short-cycle shale/tight oil arena that has been responsible for much of the production growth in recent years, as spending there is expected to fall by more than 50% in 2020. Thus, we expect that as demand returns and non-OPEC+ production falls, the set up for a recovery is present.



Energy transition will continue to occur and involves the use of fossil fuel energy. Despite the headlines of 100% of energy needs being met by renewable energy sources by (2030? 2040? 2050?), we do not think that is a reality based in science or economics. Clearly, the growth rate of renewable energy sources such as solar and wind will far exceed that of fossil fuels going forward and relative costs have improved dramatically, albeit working from a much smaller base. However, the notion of satisfying all the world's energy needs from such sources ignores the economic and scientific reality that costs would rise dramatically past a certain level of renewables contribution and the electricity grid is not designed to run off of just intermittent energy sources. As a result, we believe fossil fuels – most notably natural gas – will continue to be important to the future energy needs of the world. This especially rings true in as nearly 900 million people still don't have access to energy today and the world population is expected to grow by ~30% over the next three decades, with the middle class expected to double over the next decade. A focus on improving energy efficiencies within the fossil space will be equally important to hitting the climate sustainability goals over that timeframe.

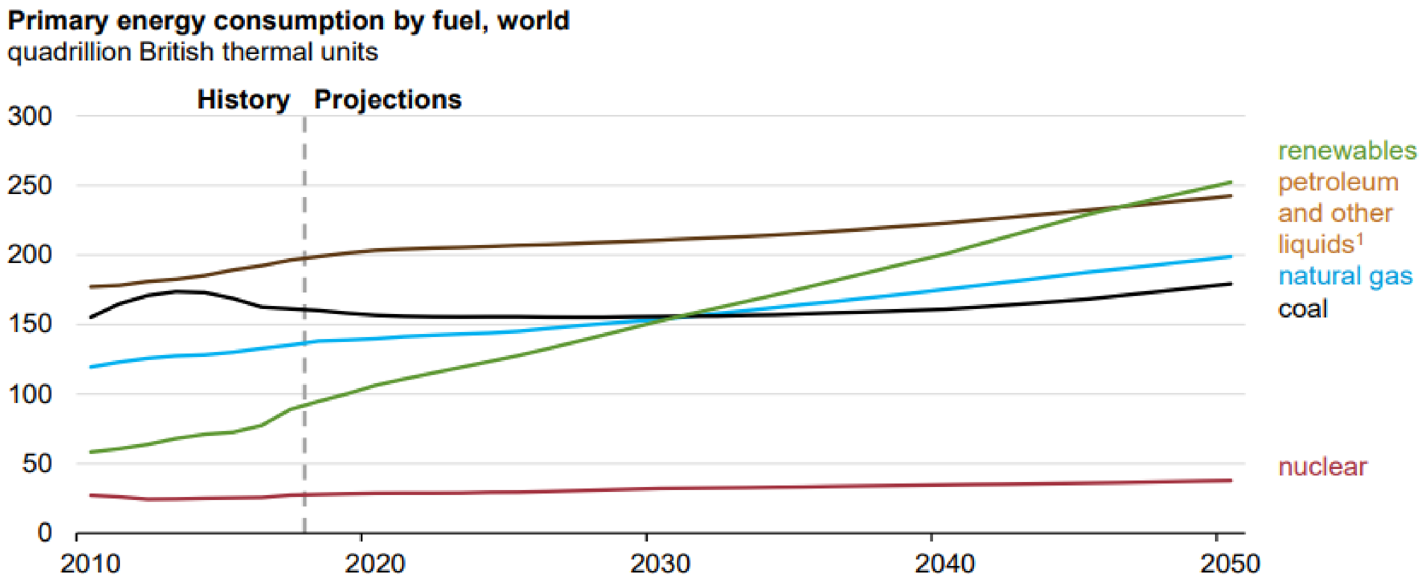
DON'T WRITE THAT EPITAPH, FOSSIL FUELS AREN'T DEAD

Despite rumors to the contrary, we believe fossil fuels will continue to play a material role in the global energy future. The underlying growth in global energy consumption revolves around people, standards of living, and economic activity that surrounds higher standards of living. Access to affordable energy is essential for progress. Half of the world's population live in countries that rank low to medium on the U.N.'s human development index. By 2050, the global population is expected to grow by ~30%, or two billion people to ~9.8 billion people. The middle class is expected to double from what it is today by 2030. There are more than 800 million people in the world that still don't have access to electricity. [2] These factors are expected to be the main drivers behind global energy consumption growth.



Source: Exxon Mobil 2020 Analyst Day Presentation, The Brookings Institution – Global Economy & Development 2017

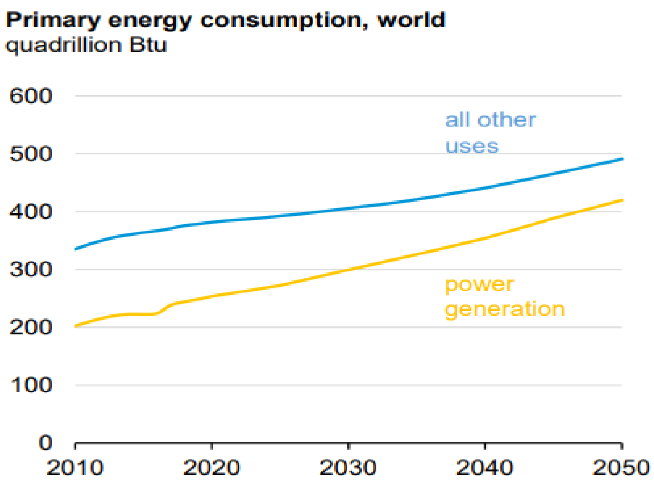
According to the most recent EIA International Energy Outlook, global energy consumption is expected to rise by nearly 50% by the year 2050 [3]. Although everyone on the planet knows by now that a focus on reducing hydrocarbon exposure to combat the perceived threat from global climate change is driving massive future growth in renewables, most projections also demonstrate that fossil fuels aren't going away anytime soon. While renewables do account for dominant share of growth, fossil fuels will likely continue to play a very significant role in the projected global energy mix over the next 30 years.

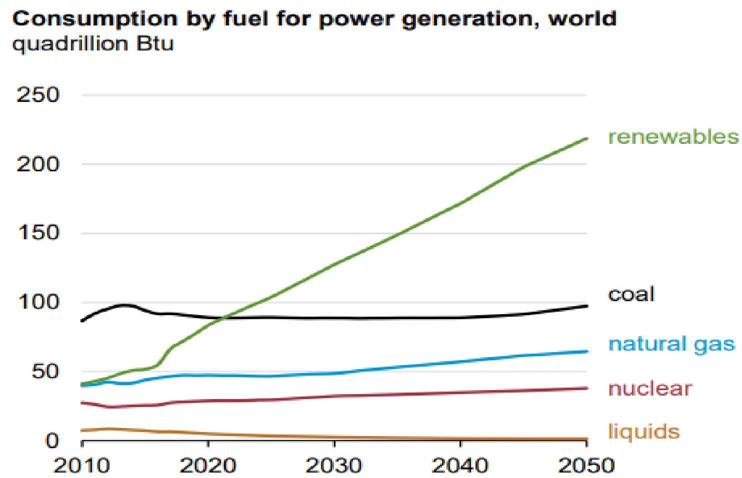


Note: 1 = Includes biofuels
Source: U.S. Energy Information Administration, International Energy Outlook 2019

In the EIA's International Energy Outlook reference case, renewables are projected to grow at a staggering rate of more than 150% between 2019 and 2050, at which point they are expected to represent nearly 28% of all energy sources. However, fossil fuels (including oil, natural gas and coal) are expected to grow by a collective 24.5% over the same timeframe, representing ~27%, ~22% and ~20% of global energy demand. **Collectively, hydrocarbons are expected to represent over two-thirds of all 2050 energy per EIA.**

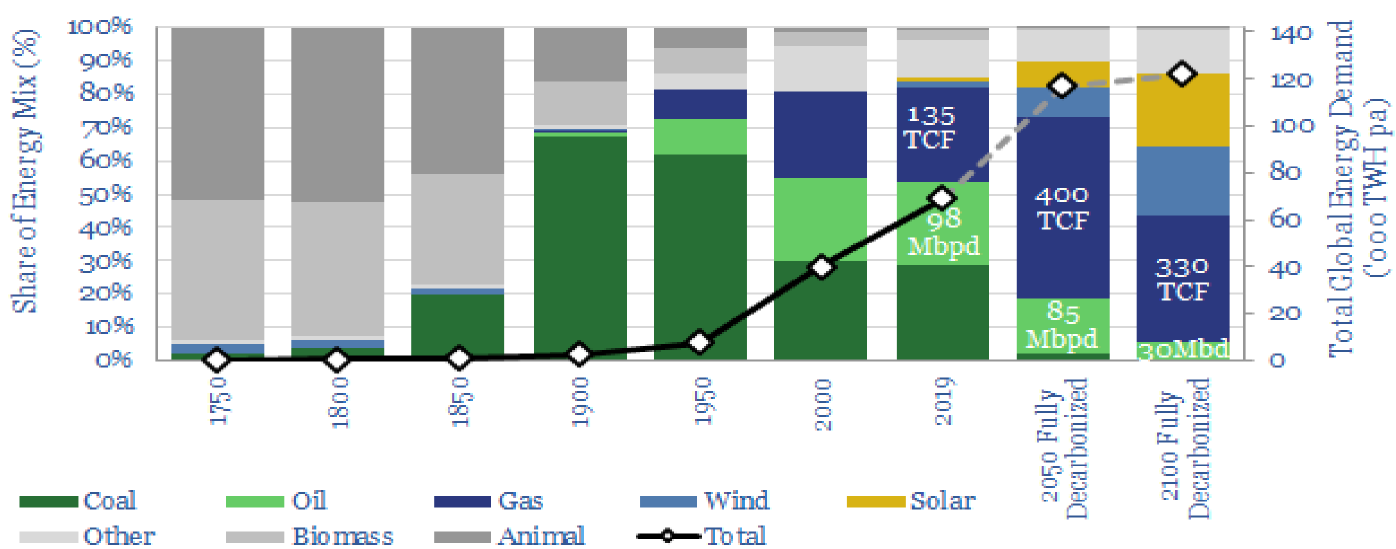
Global power generation is expected to represent the largest share of energy consumption growth (driven by China and India to a large extent), while all other uses are still expected to grow under the EIA's reference case. As it relates to power, you can see that renewables will be the driving force in growth while natural gas will see a meaningful increase in use for electric generation as well while oil/liquids are largely phased out for this category of demand. [3]





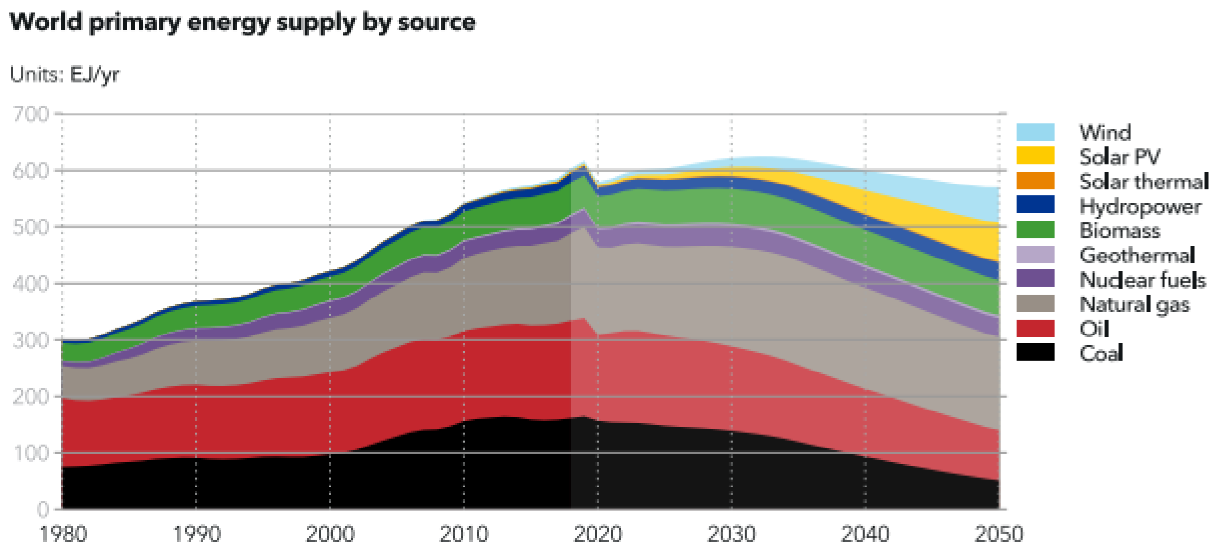
Source: U.S. Energy Information Administration, International Energy Outlook 2019

Under a more aggressive scenario put out by Thunder Said Energy, which estimates global energy consumption will rise 70% by 2050, its projected energy contribution mix in 2050 under a "decarbonized" scenario still shows global oil demand at 85MMBpd, relative to 98MMBpd in 2019. [4] While coal is largely phased out under this scenario, the global use of natural gas in 2050 nearly triples to 400 Tcf from 135 Tcf, accounting for a little over 50% of the total global energy mix. **Similar to the EIA forecast above, fossil fuels represent a combined +70% of the global energy mix, leaving renewables at around 30%.** Thus, fossil fuels should continue to be very relevant for investors.



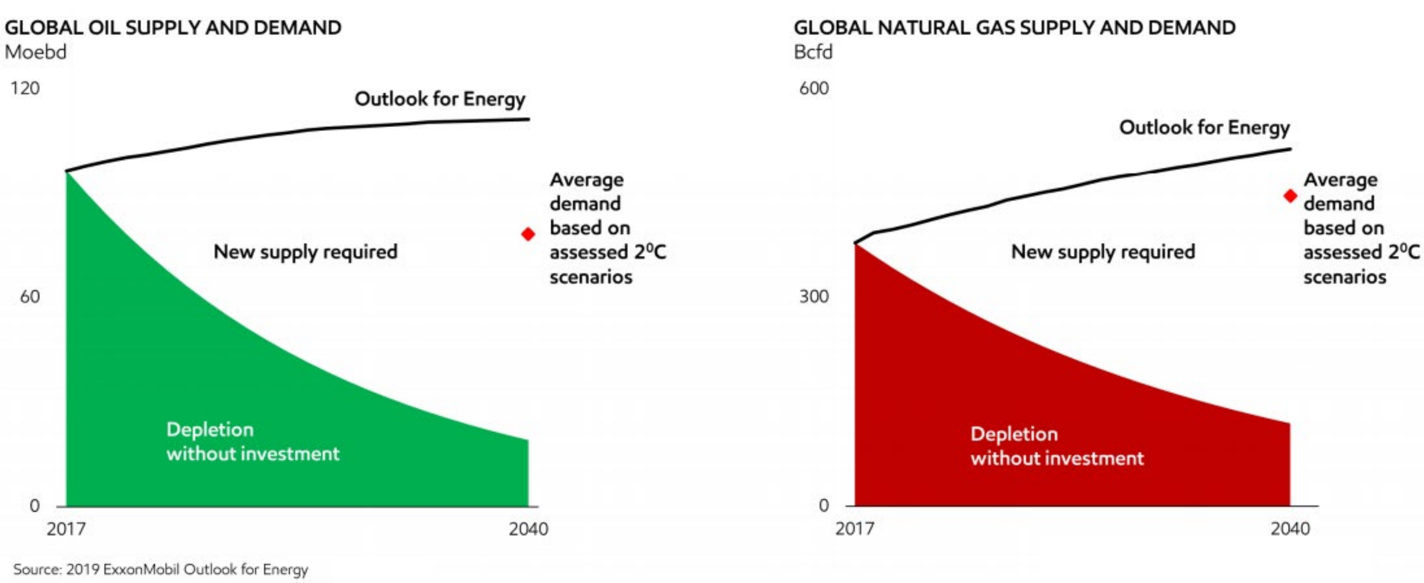
Source: Thunder Said Energy projections

A forecast by DNV GL, which is European based and strongly promotes energy transition and decarbonization, suggests global energy demand may be nearing a peak with a very slight decline between now and 2050. Even under this pessimistic outlook that includes renewables (including wind, solar, biomass, geothermal and hydro) growing to nearly 44% of global energy supply, **hydrocarbons still account for half of total world energy supply in 2050.** [5]



Source: DNV GL

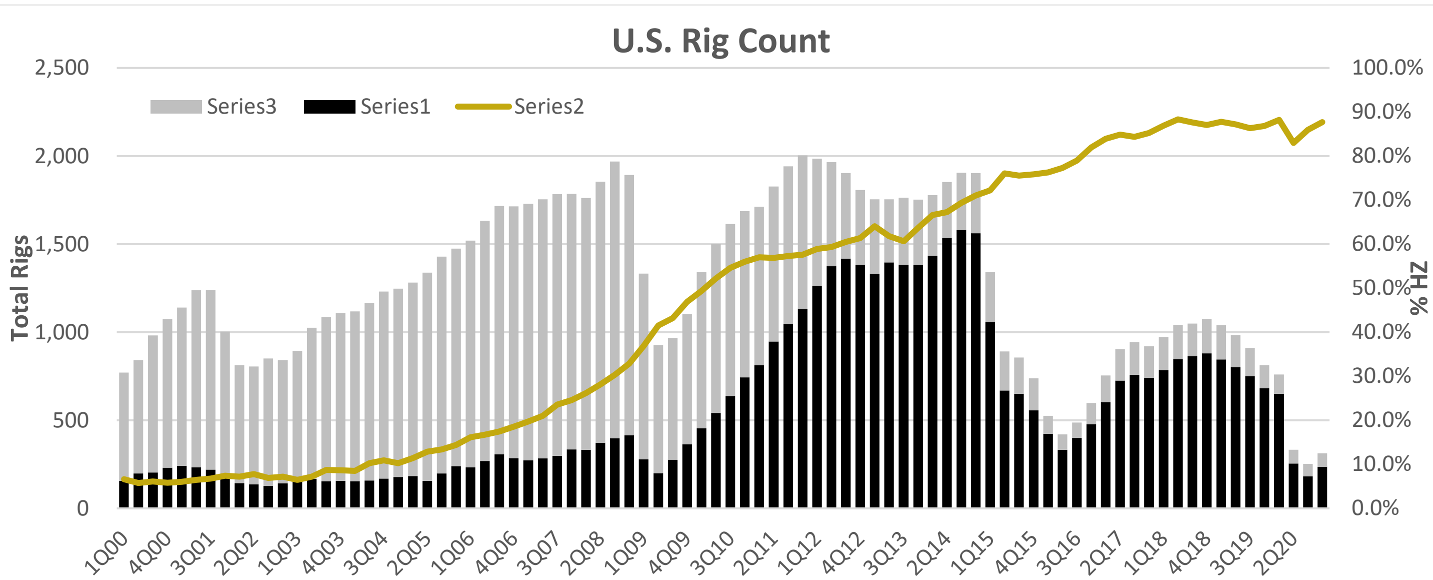
Almost regardless of which level of growth or decline one foresees for global crude oil and natural gas demand, trillions of dollars in capital investment will be necessary over a 30-year timeframe towards significant new supplies across a wide range of possible demand scenarios due to inherent depletion rates. The IEA estimates in excess of $20 trillion would need to be spent for oil and gas development to offset depletion by 2040. On average, that equates to $1 trillion per year over the next 20 years, relative to Rystad's current 2020 and 2021 global capex forecast of less than $400 billion. The 2020 Exxon Mobil investor day presentation demonstrates the gap that new investment must fill for oil & natural gas production to offset depletion in order to meet future demand. [2]



ENERGY INVESTING HAS FACED A CHALLENGING PERIOD

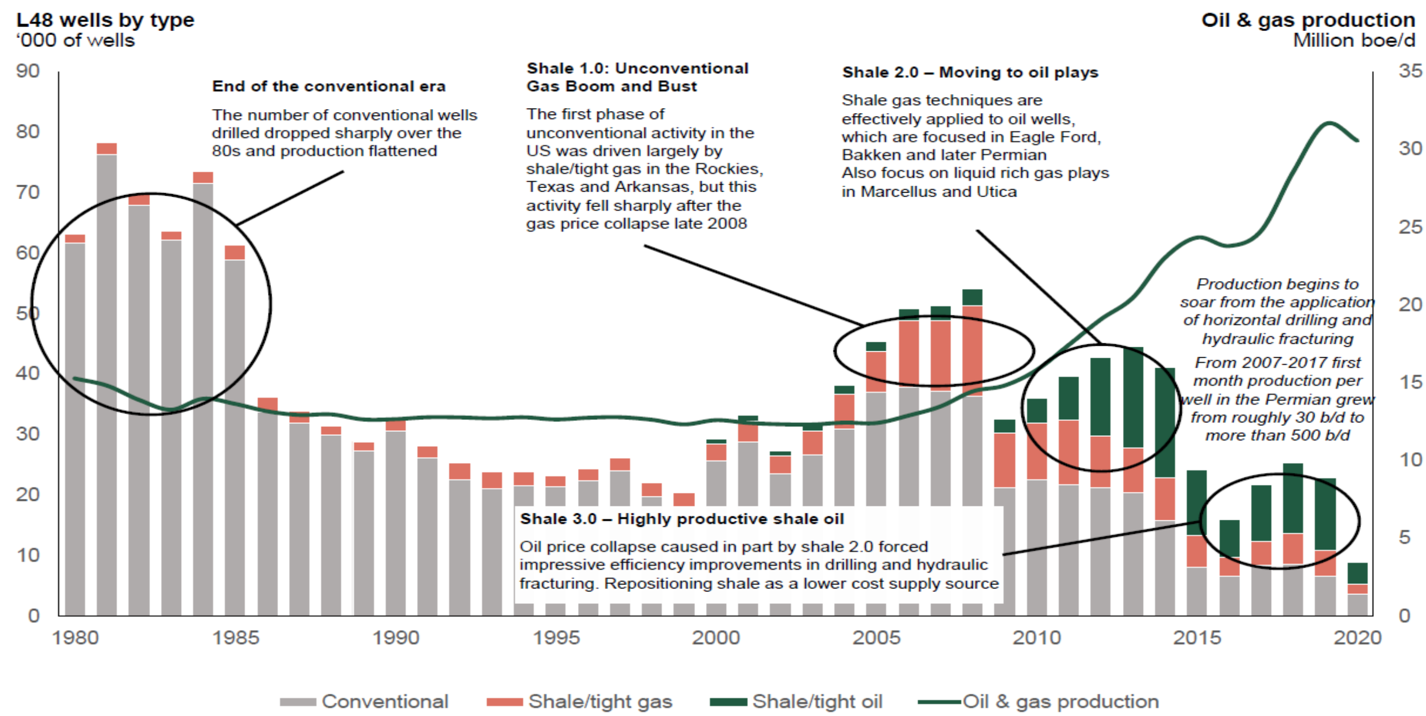
Rise of unconventional resources (horizontal development) leading to short cycle production. Over the past several years, traditional oil and gas markets have been plagued by several downcycles caused in part by the short-cycle nature of U.S. onshore unconventional production. The adoption of modern completion techniques (increasingly longer horizontal lateral lengths, higher proppant/water loadings, tighter staging and well spacing and enhanced efficiencies and pad drilling) have driven the unconventional basins ability to bring on production more rapidly. When paired with supply growth elsewhere and a multitude of demand factors, the oil and gas industry has experienced multiple recent up/down cycles.

One way to visualize the above context is to look at the graph below, which depicts U.S. drilling activity (total U.S. rigs in black and grey bars) relative to the percentage of rigs that are drilling for horizontal targets (gold line). There are a few trends to notice: 1) The combined rig count had a fairly sustainable rise between the recovery from the 2001 recession and the 2008/2009 recession, and again from the 2009 recovery until late 2014, 2) natural gas accounted for the lion's share of drilling activity through 2008, before drilling/completion techniques learned there were then increasingly applied to oil basins as oil became the more attractive target, and 3) The percentage of rigs drilling horizontally rose from under 10% from 2000-2004, through steady increases thereafter until eclipsing 65% in 2014 and reaching ~90%. [6]



Source: Baker Hughes

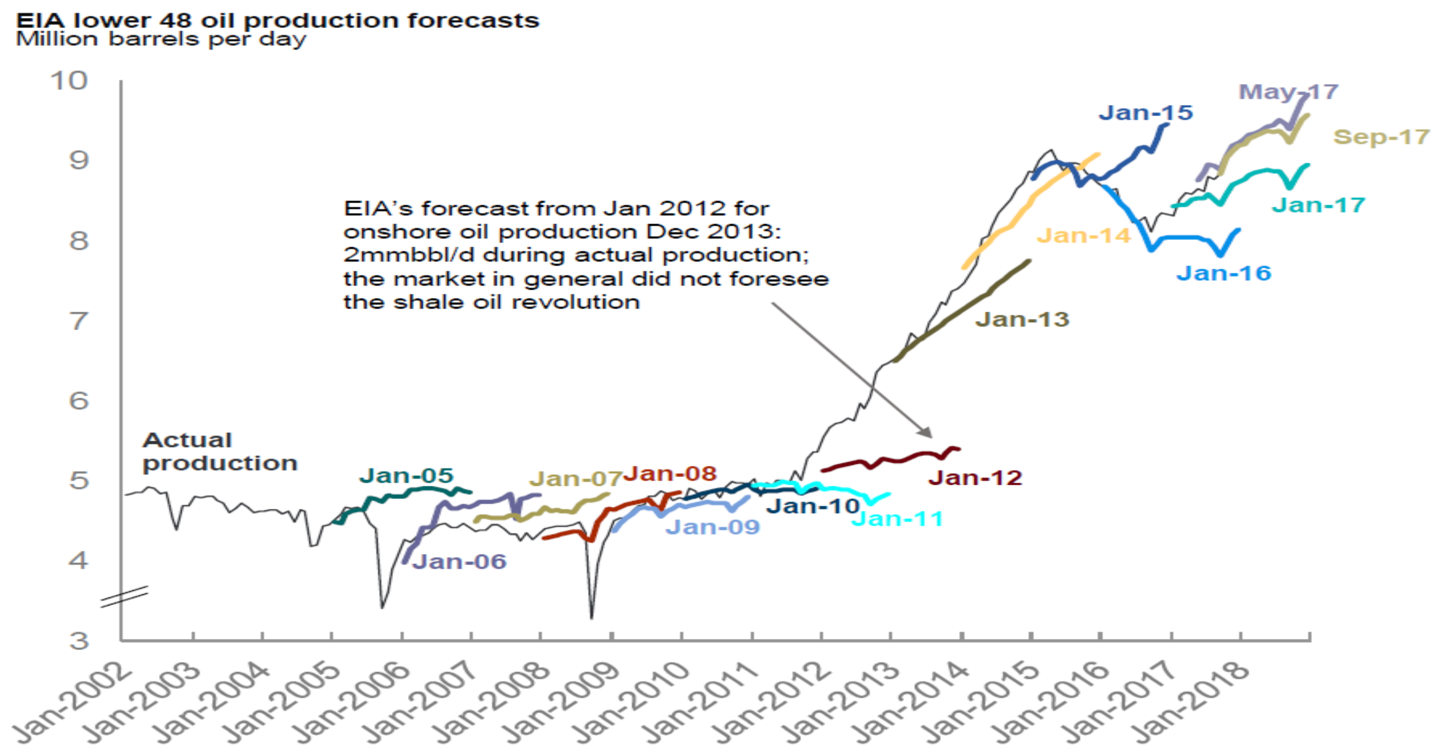
A longer look back at the transition from conventional into unconventional U.S. plays is highlighted in the next graph, which depicts Lower 48 wells by type (conventional, shale/tight gas and shale/tight oil) against oil & gas production in MMBoe/d. [7] As you can see, for two decades the well count was primarily driven by conventional activity, which took a notable step down in the mid-1980s and yet oil and natural gas production was held relatively flat through that period. Starting in the early-mid 2000s, unconventional gas became the target (as noted both by the sharp increase in unconventional gas wells and the increase in rigs drilling for gas on the prior chart). Once that ramp up in gas-directed, unconventional activity caused a sharp rise in natural gas production, which then led to sharply lower prices, the new prize became unconventional oil targets in the late 2000s. From there you can see the rise in the number of unconventional oil wells below, which corresponds to the ramp up in oil-directed rigs on the prior chart.



Source: Rystad energy

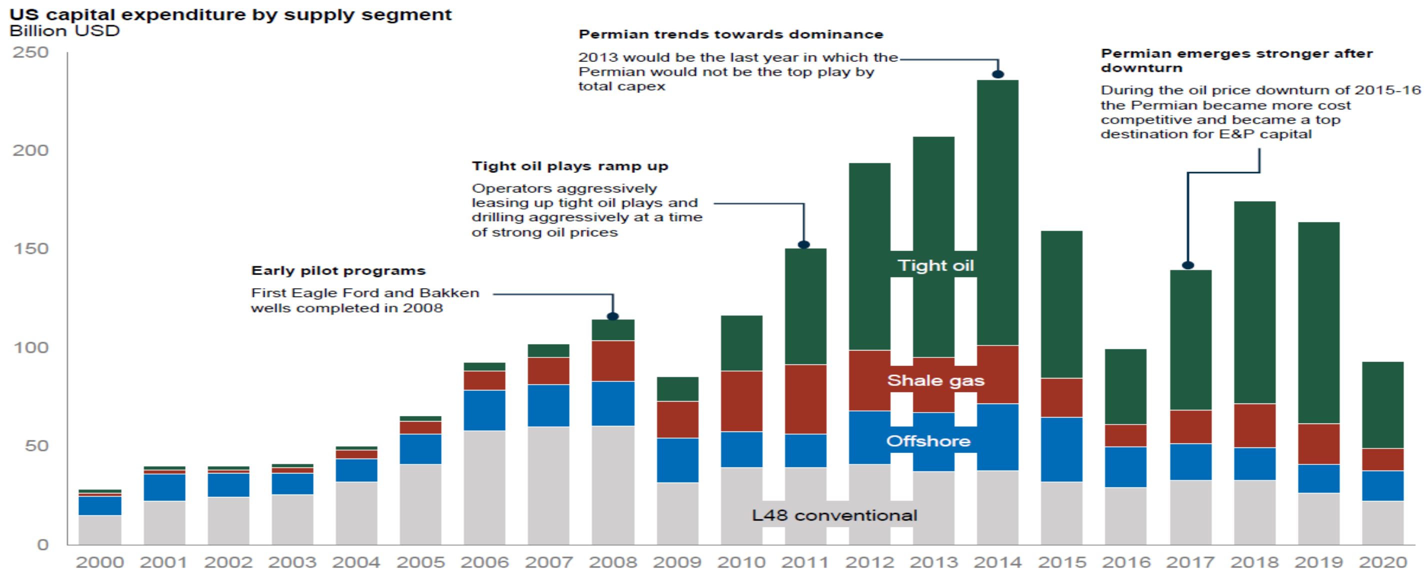
This shift towards unconventional oil basins, combined with continued improvements in drilling and completion efficiencies (and increased use of pad development) led to a very rapid rise in U.S. oil production (as well as associated gas from several oil basins). Specifically, U.S. Lower 48 oil production doubled from a trough around 4.0MMbpd in 2006-2008. and in a matter of just six years, exited 2014 at nearly 9.0MMbpd. Following the 2015/2016 downcycle that briefly led to lower production, the industry refocused on oil basins over the next three years and drove L48 oil production up +50% to over 12.0MMBpd until the impacts from COVID-19 crushed demand, causing crude oil prices to come crashing down and sending cash flows and subsequently activity to multi-decade lows in recent months. Current U.S. crude oil production is just over 10.4 MMbpd (as of October 2020).

Clearly, this growth in unconventional oil production has been staggering. To put it into context, consider the following graph that depicts actual oil production volumes relative to various historical EIA forecast production volumes through 2018. [7] As you can see, production growth has far exceeded EIA estimates since the transition by the industry to focus on unconventional oil plays.



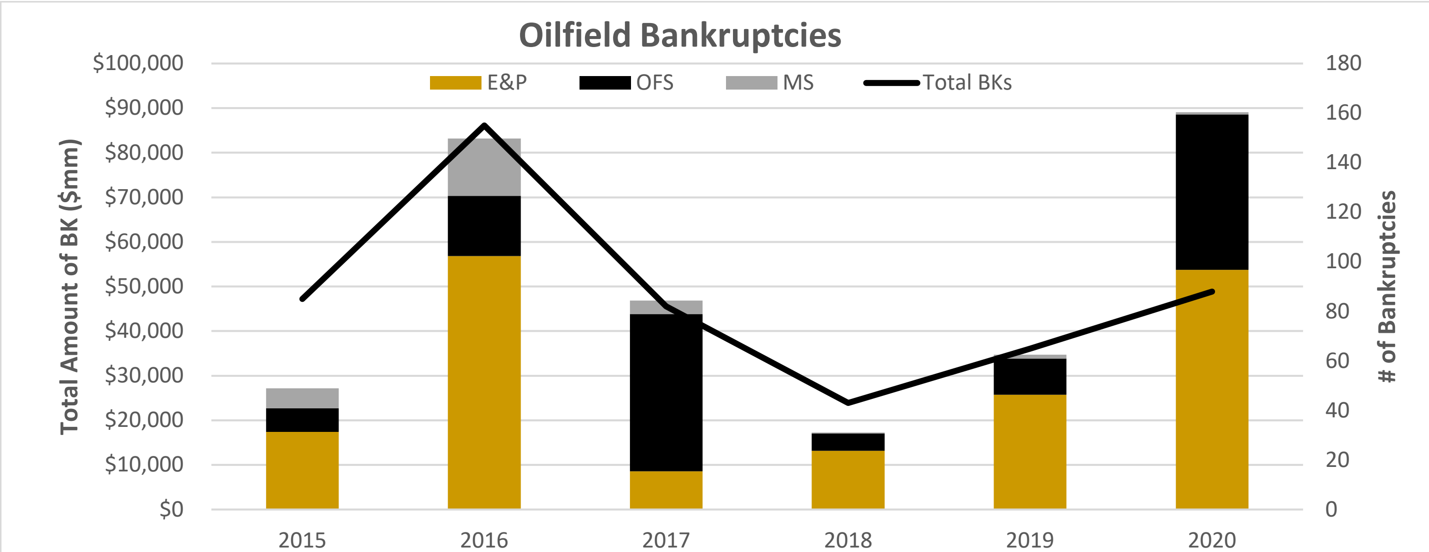
Source: EIA, Rystad

Rapid unconventional production growth came at a massive cost. The sharp growth in short-cycle unconventional oil production noted above happened at a much greater expense than historical conventional resources and even unconventional gas did. Consider the following graph from Rystad that highlights the amount of capital spent each year for the four main oil and gas supply sources: 1) conventional (grey), 2) offshore (blue), 3) unconventional gas (red), and 4) unconventional oil (green). [7] In order to achieve the previously noted doubling of production between the 2006-2008 timeframe and the end of 2014, annual capex more than doubled (from ~$100bn to almost $250bn), with unconventional oil capex growing from $5-$15bn to +$135bn over the same timeframe. Even after the 2015/2016 crash, unconventional oil capex has generally ranged in the $75-$100bn range, prior to the 2020 COVID-induced crash. This also occurred at a time where efficiencies continued to improve almost across the board, and oilfield services costs remained at depressed levels relative to the heyday of the pre-2015 period. **In short, in order to achieve the sharp increase in production, it took massive amounts of capital.**



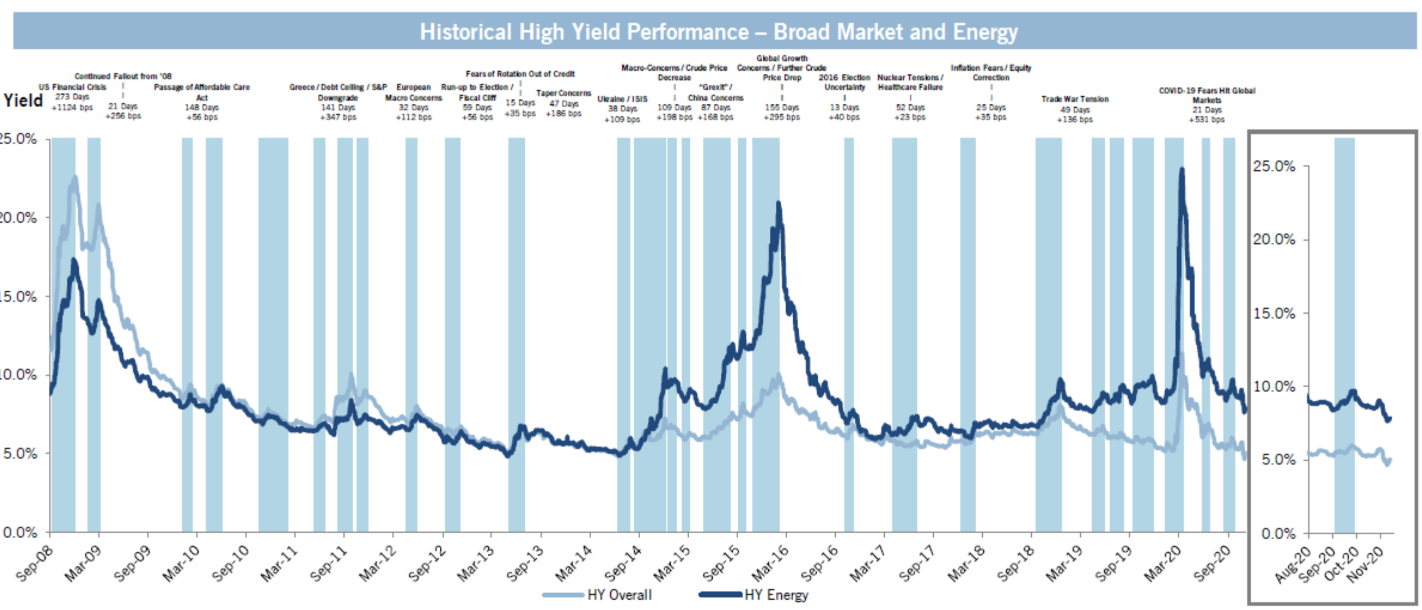
Source: Rystad

Increasing number of bankruptcies brought on by overleveraged balance sheets heading into downcycles. The increased volatility of oil and natural gas prices, production, and cash flows over the past few years has induced an increasing amount of stress on the energy industry. This has been exacerbated by overleveraged balance sheets during a period of cheap credit coming out of the 2008/2009 credit crisis paired with the massive capex noted in the prior section. The result has been a sharp increase in bankruptcies across the oil patch – especially for E&P and oilfield service companies. From 2015 through 3Q20, there have been 518 bankruptcies, nearly split between E&P companies and oilfield service companies, which combined account for ~94% of all bankruptcies. [8] In dollar terms, the total amount of debt that has been restructured over the same timeframe is nearly $300 billion. Approximately 46% of that amount was secured debt, while 54% was unsecured debt. Also, ~59% of the restructured capital was E&P companies, versus ~34% oilfield service companies and the remainder from midstream.



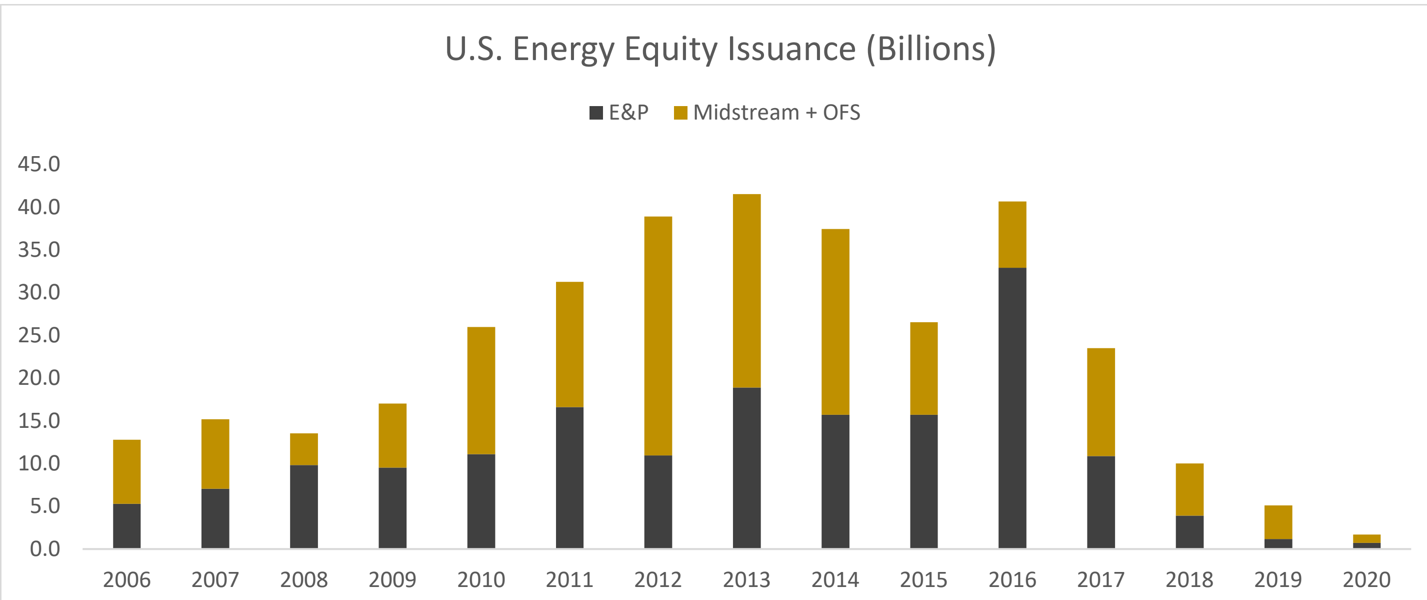
Source: Haynes and Boone

Historical energy credit yields have widened over the past few years. The dark blue line in the following graph represents the High Yield Energy index, while the light blue line represents the overall High Yield Index – both in terms of yield. [9] Since the gradual recovery from the 2008/2009 credit crisis that saw yields blow out, the Energy High Yield Index has endured two sharp widening periods that coincide with distress in the oil patch tied to weak commodity prices – in 2015/2016 and again in 2020 following the impacts of COVID-19. The net effect of these record high yields has been that credit markets have largely been closed to lesser quality issuers for much of the past five to six years, except for select periods of time. Only quality issuers have truly been able to achieve attractive debt financing/refinancing rates throughout most of this period.



Source: BlackGold, Jefferies

This also comes at a time when the equity markets have also been largely closed, especially over the past three years. Simply stated, investors have grown increasingly weary of traditional oil and gas equities amid these volatile macro conditions, overleveraged balance sheet and as noted earlier, the ability to rapidly grow production for what have been questionable returns. Furthermore, the public push towards an eventual energy transition has been the icing on the cake. As a result, the departure of investors away from energy towards sectors that have thrived have continued to push valuations lower and lower, which combined with the rising number of bankruptcies noted earlier, have resulted in very little new equity issuance since 2017 as seen in the following graph. [10]

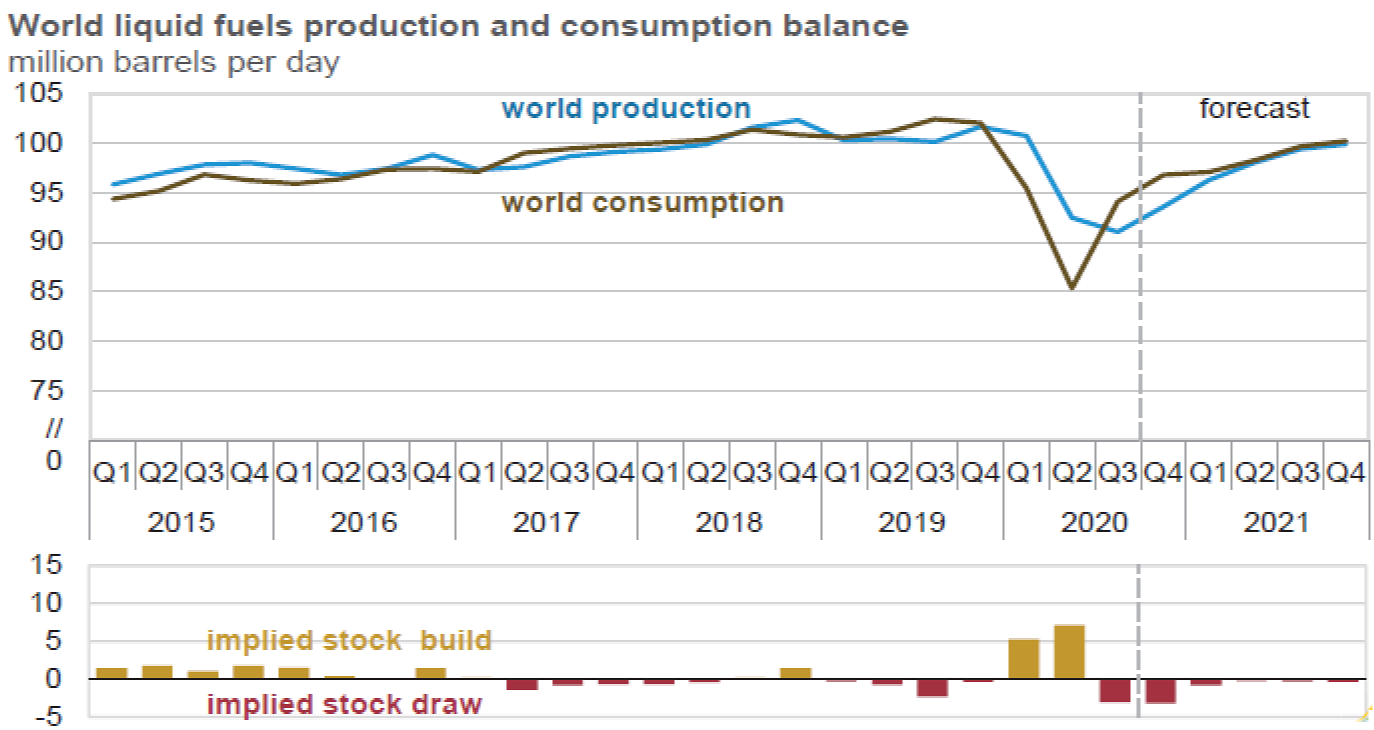


Source: BlackGold, Bloomberg

Bond defaults have delivered sharper losses in recent wave of bankruptcies. A recent article from Bloomberg highlighted the fact that under the surging bankruptcies from the economic fallout from the pandemic, recoveries through restructurings are sharply lower than they were historically. Instead of recouping ~40 cents for each dollar invested – which has been the norm for many years – unsecured creditors now face the prospect of recovering just a few cents, if that. This phenomenon has taken hold across many industries but is noted as being especially acute in the retail and energy industries. The overleveraged balance sheets we noted earlier, heading into this sharp downturn has been the major culprit. Increased use of cheap, secured debt in recent times has been one of the largest factors weighing on recoveries for unsecured bond holders. It's not just unsecured debt seeing lower recoveries either. According to Barclays, loan investors could face losses of 40 to 45 cents on the dollar, compared with historical averages of 30 to 35 cents. Cheap (low rates) and easy (covenant lite) credit has been a large contributor to the current problem. **Eventually, we suspect those days are gone and future lending**

will involve higher rates and much tighter structures to account for the new reality, which should help put a lid on large production increases.

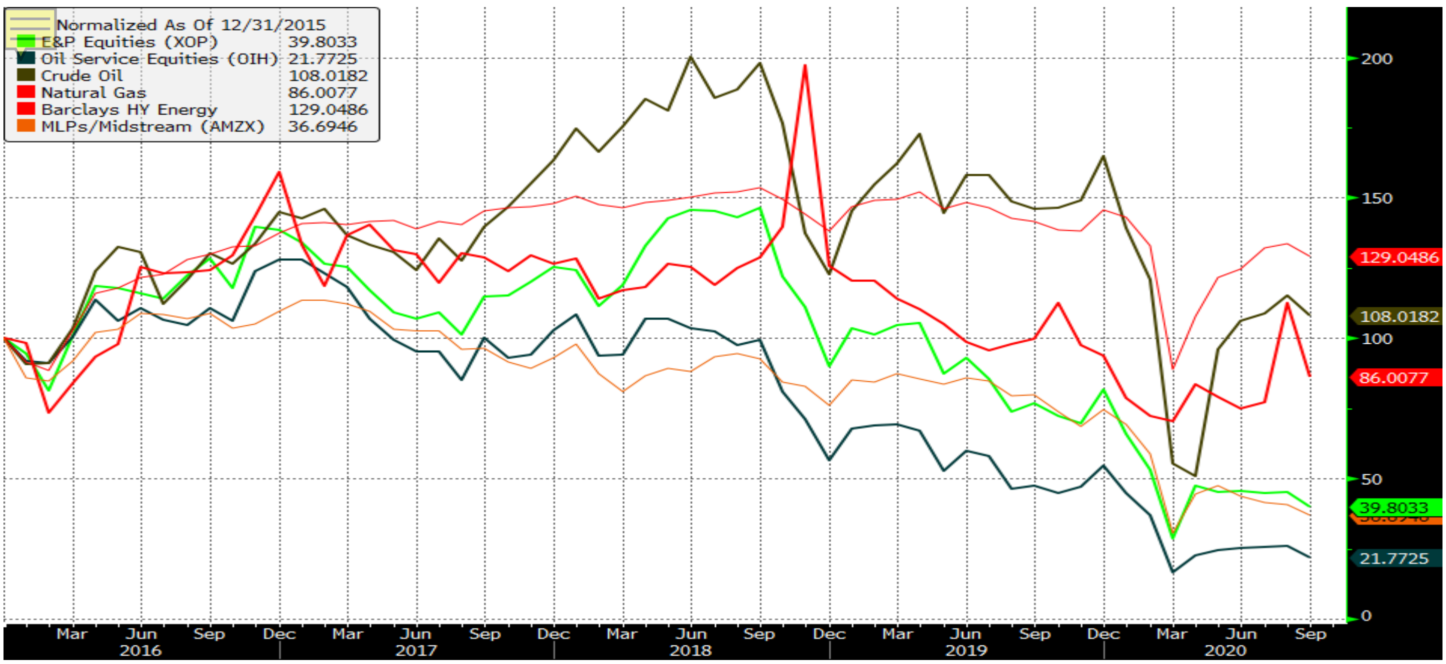
COVID-19 has exacerbated recent cyclical events We have already referenced the impacts of the COVID-19 pandemic on the oil and natural gas markets. But to put things into perspective, consider the following graph from the EIA that depicts global oil consumption falling nearly 17% from around 102MMBpd in late 2019, to a 2Q20 low of just ~85MMBpd, before slowly starting to recover as economies have gradually been reopening in phases. [11] According to the EIA, global demand isn't expected to fully recover through 2021, given that some of the shifts will likely be more permanent from the fallout of the pandemic. Overall, the EIA projects global oil demand to have fallen by ~8.6% in 2020, making it the largest single year decline in recorded history back to at least 1965. They do project, however, a recovery of nearly 6% in 2021 as economies start to recover from the effects of COVID-19 and reopen on a more complete/sustainable basis.



Source: U.S. Energy Information Administration, Short-Term Energy Outlook, November 2020

Making things much worse for the oil and gas industry was the fact that global oil supply was in the midst of growing and as one might expect, did not correct as swiftly or as sharply as the decline in demand. As a result, global oil inventories ballooned until the combination of recovering oil demand, shut in U.S. production, and OPEC production cuts acted to start slowly reigning in the inflated inventories. It will likely take a bit of time to get the situation rectified. However, as previously noted, we believe the near-term damage has been done. Companies that were already under pressure have faced a generational event that caused oil prices to briefly go negative for the first time in history, activity levels to decline to levels not seen in decades, and industry capex levels to decline to levels not seen for multiple decades. **As we'll discuss later, the pending underinvestment will likely lead to supply challenges for a while.**

Energy sector benchmark performance has been challenging. The result from the different macro and micro factors noted above has been poor performance for just about every energy benchmark over the past five years. Only crude oil and the Barclays High Yield Energy Index have managed slight gains relative to 1Q16, which marked the prior low point in crude oil prices prior to 2020. [10] As a result of increasing defaults, there remains a current lack of appetite for anything energy from both public and private markets.

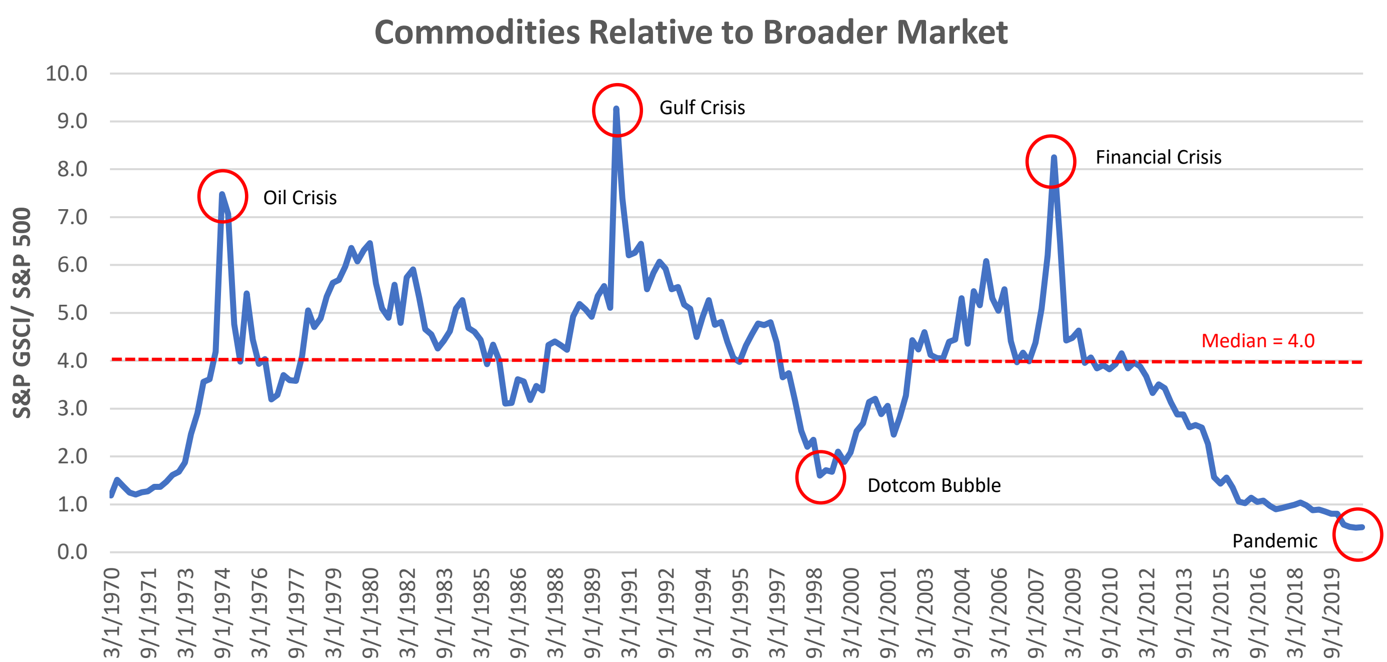


Source: BlackGold, Bloomberg

Adding to this lack of enthusiasm has been poor energy private equity (PE) and public equity performance for nearly a decade, with investors now focused on ROIC and capital efficiencies forcing energy companies to improve balance sheets. This calls into quest the historical E&P operator model. In total, the North American energy sector has nearly $1 trillion in debt outstanding. The collective result of the above can be seen in the fact that energy's representation in the S&P 500 is at a multi-decade low as shown below. [10]

Source: Bloomberg

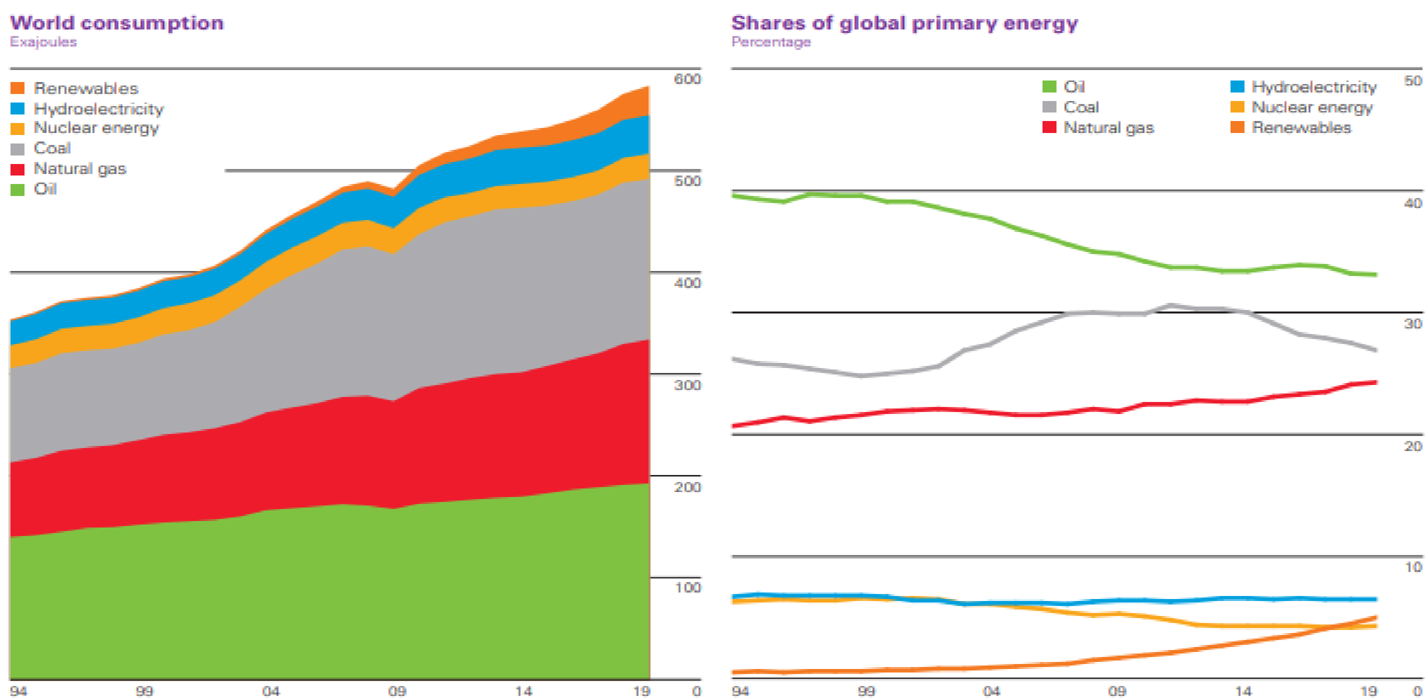
Similarly, the following graph provides some context as to how the market currently views commodities in general. Commodities have been on a steady downtrend since the financial crisis in 2009, exacerbated by the OPEC decision + oil supply growth in 2014-2016, and most recently by the pandemic. As a result, commodities currently represent the lowest value relative to the broader market in at least six decades, which would seem to indicate strong relative value. [10]



Source: Bloomberg

CRUDE OIL OUTLOOK

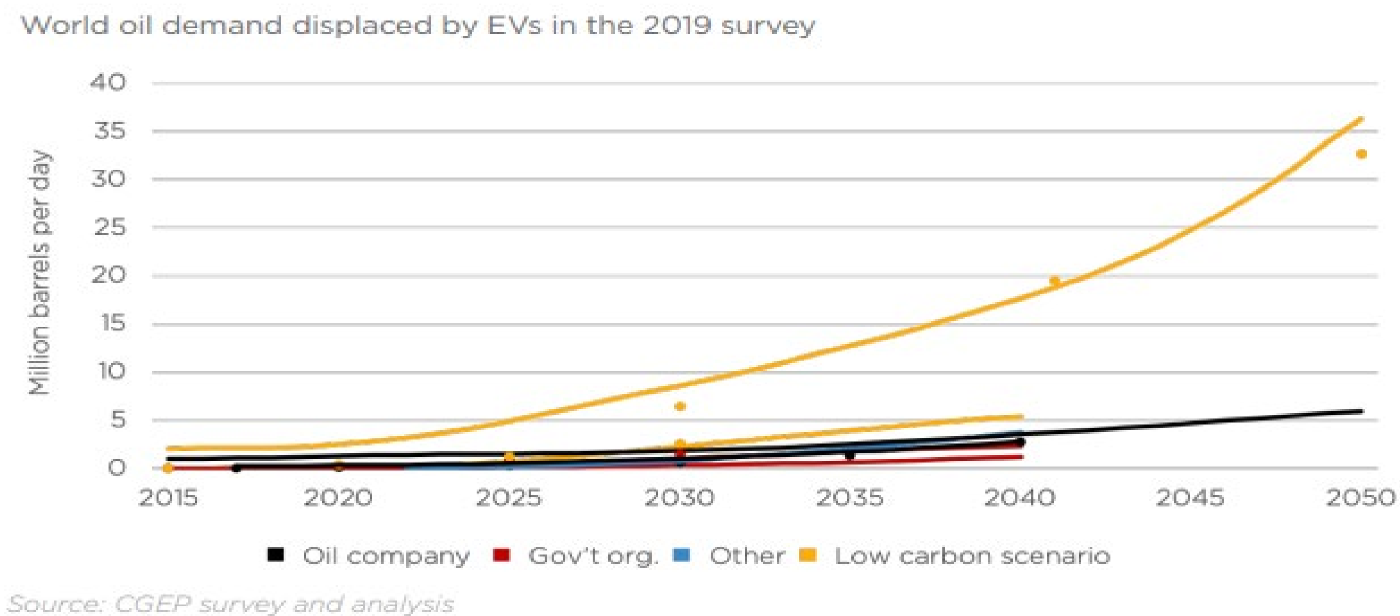
Long-term oil demand impacted by alternatives, but still vital. Despite expectations that hydrocarbons will become obsolete in the near future, we believe oil will remain a relevant investment for the duration of our investing careers. Oil demand growth will primarily bedriven by commercial transportation and chemical feedstock, while the adoption of EVs will take a bite out of passenger vehicle demand for oil. Still, long range forecasts for oil demand range from modest growth over the next 30 years, to modest declines. **Additionally, when market pundits talk about declining global crude oil demand (present tense), they often reference its share of global consumption rather than absolute declines.** The following graphic from BP's Statistical Review of World Energy highlights the underlying absolute growth in global oil demand over the past two decades (the green portion of the left hand graph), while oil's share of global energy demand has steadily declined from ~40% in the mid-late 1990s to 33% in 2019 (as shown in green on the right). [12]



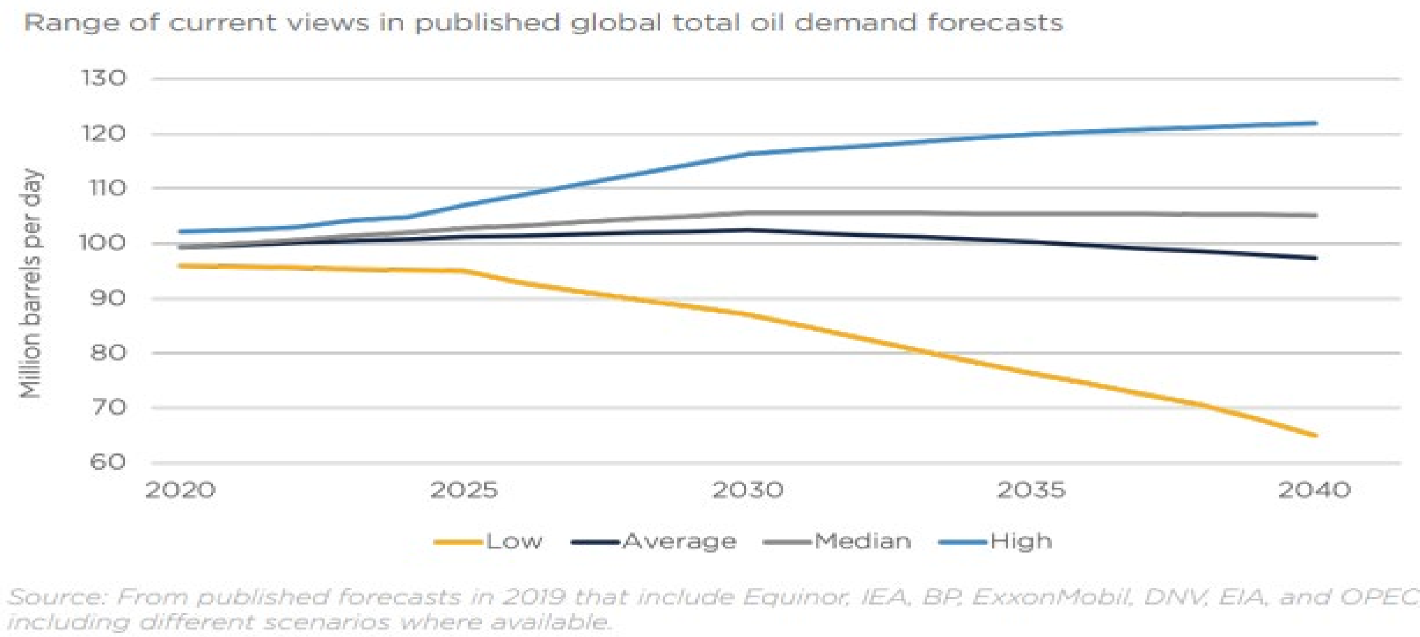
Source: BP Statistical Review of World Energy 2020

Impact of electric cars on gasoline/diesel demand. There are numerous estimates out there regarding the impact that electric vehicles (EVs) will have on gasoline and/or diesel demand, making it somewhat challenging to get a precise picture of future long-range demand.

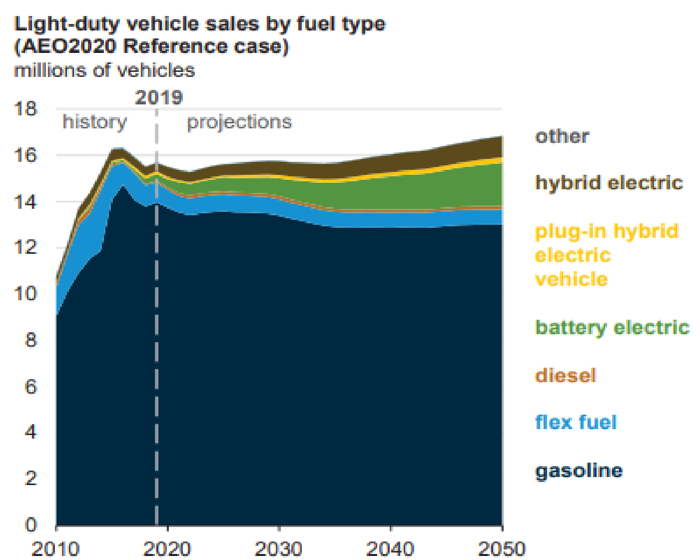
The following graph produced by Columbia University's Center for Global Energy Policy, represents various forecasts for the impact on how much global oil demand is projected to be displaced by EVs. [13] It was calculated by subtracting forecasts with EVs from what the forecasters said their forecasts would have been without EVs. By 2040, most forecasts only project around a 5MMBpd impact to demand. Extended out to 2050, there is a wider range that incorporates a more traditional EV adoption rate forecast and low carbon scenario – of less than 10MMBpd up to +35MMBpd. We suspect the right answer is likely somewhere in between.

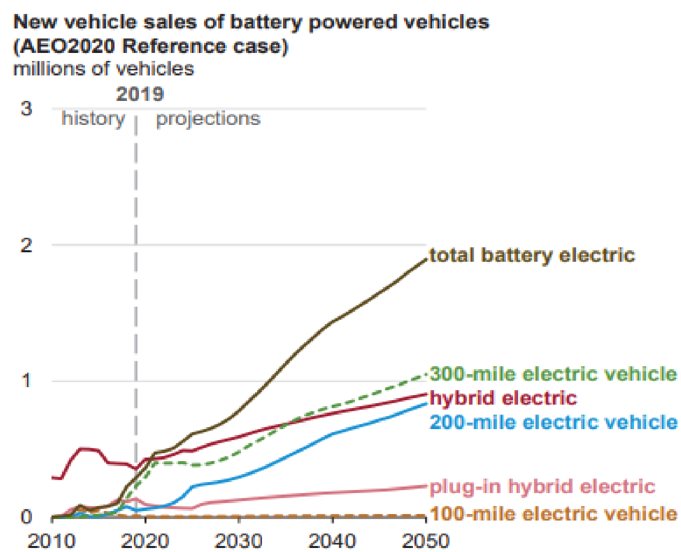


We also want to point out that, while the adoption of EVs will clearly be a negative for passenger vehicle oil demand, it does not necessarily speak to the other demand factors. Per the same Columbia University report, oil demand growth is expected in the truck, aviation, marine, and petrochemical sectors. The following graph that comes from the same report shows the published forecasts for global oil demand growth for all sectors and products. The average of the various forecasts shows growth over the 2020-2030 period, and modest declines thereafter. [13] Note that this report was published towards the end of 2019, so it excludes the impacts from COVID-19. How public policy proceeds over time will likely be the largest driver of oil demand as it relates to the average forecast and low carbon forecast. Even under the low demand case, investment will likely be required to replace production against inherent declines in existing production.



As a point of reference, the two charts below provide a sense of what the overall passenger vehicle fleet mix looks like, juxtaposed against projected sales of new EVs/hybrids over the next 30 years for the United States. **Despite a sharp projected increase in EV and hybrid sales, ICE-driven cars are still expected to account for most of the passenger vehicle fleet, even through 2050.** [14] Although certain regions outside the U.S. may see a faster adoption of EVs and turnover of the comparably smaller vehicle fleet mix, the point stands that oil consumption from passenger vehicles isn't going away any time soon.

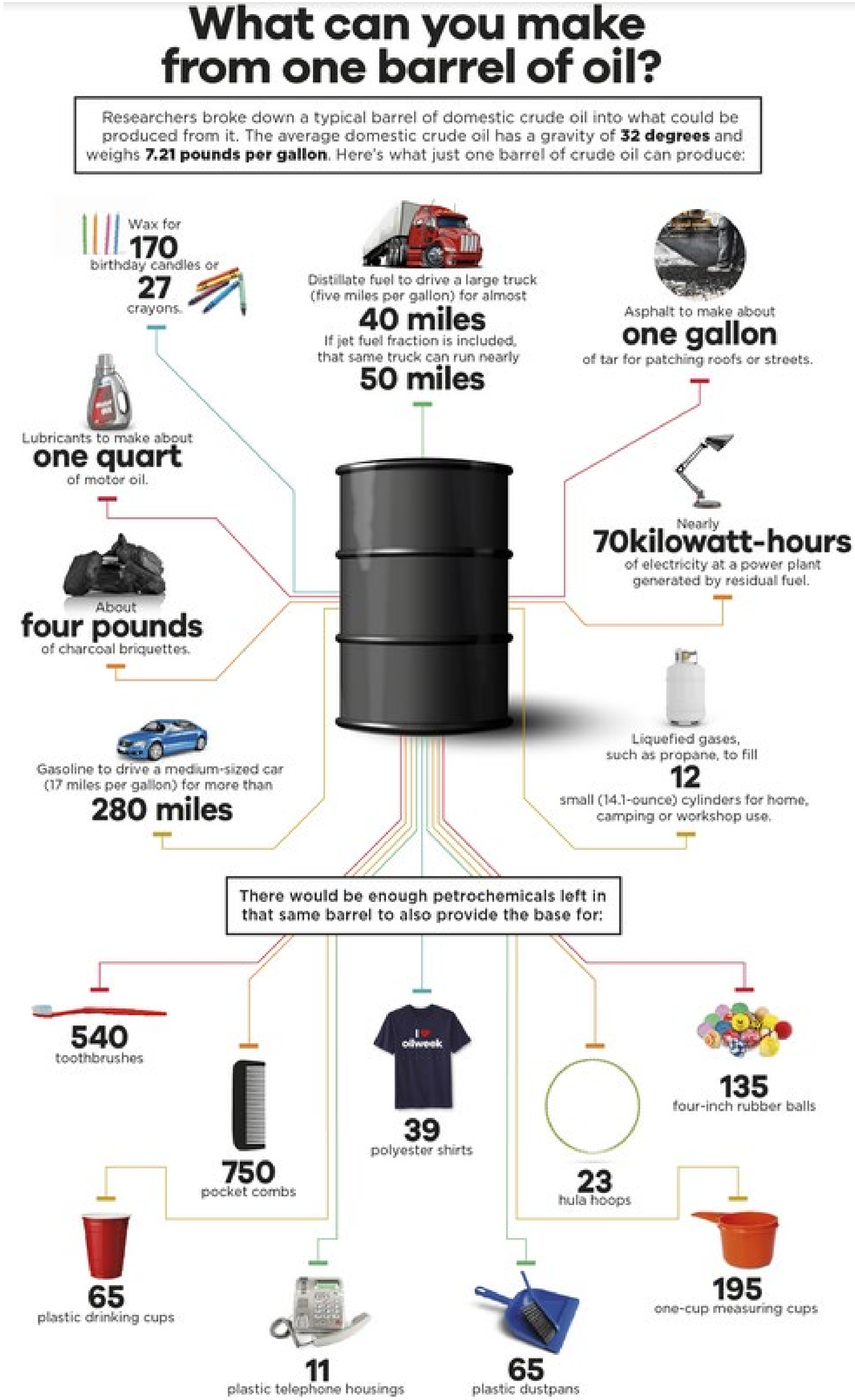




Source: EIA Annual Energy Outlook 2020

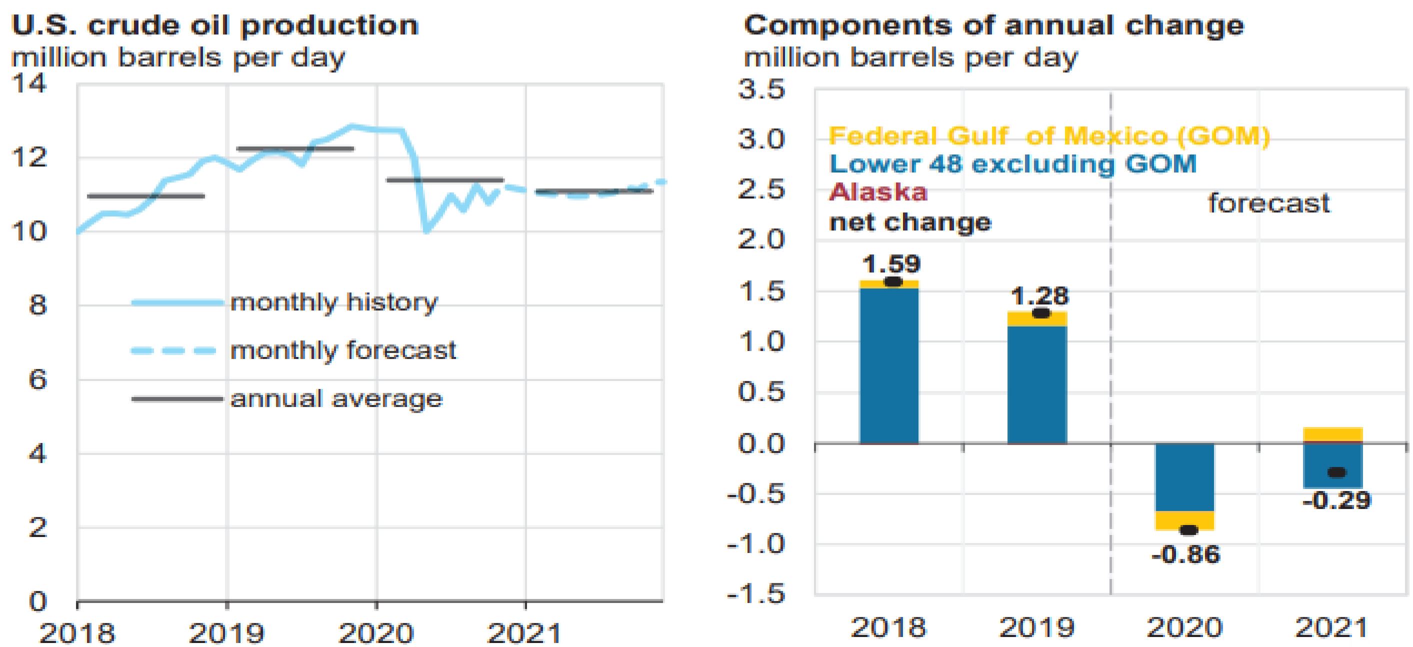
Other demand factors. The market has remained laser focused on all the publicity that public policy makers have given against hydrocarbons, and for oil that has largely been replacing internal combustion engine vehicles with EVs – the demand impact of which we spoke about in the prior section. **However, passenger vehicles only account for approximately 25% of total global oil demand. Moreover, a typical 42-gallon barrel of oil creates nearly 20 gallons of gasoline and 4 gallons of jet fuel, with the remainder being used to make a multitude of over 6,000 products.**

All plastic is made from petroleum and plastic is used almost everywhere: in cars, houses, toys, computers and clothing. Asphalt used in road construction is a petroleum product as is the synthetic rubber in tires. Paraffin wax comes from petroleum, as do fertilizer, pesticides, herbicides, detergents, phonograph records, photographic film, furniture, packaging materials, surfboards, paints, and artificial fibers used in clothing, upholstery, and carpet backing. The following illustration gives you an idea of the many uses of one barrel of oil. [15] **One thing is clear, it would be an enormous task to replace the consumption of crude oil completely within our lifetimes. Policy makers and the general public seem to have overlooked the broad impact that "getting rid" of oil would have on society.**



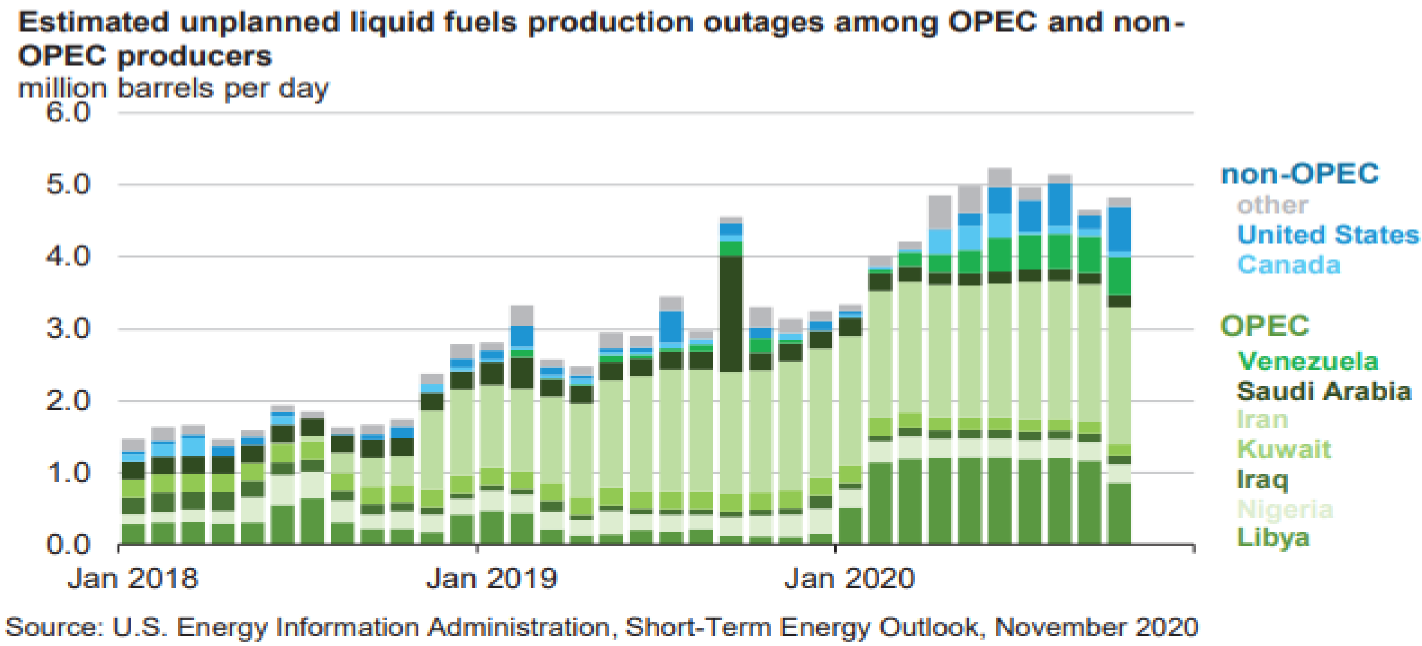
Source: JWN Energy

Near-term oil supply driven by OPEC+ unwinding of cuts and the impact of lower worldwide activity. U.S. crude oil production is expected to have fallen by approximately ~0.9 MMBpd in 2020 to average ~11.4 MMbpd, according to the EIA. [11] From peak production levels in 2019 (November), production has declined by ~16% or over 2 MMBpd. The EIA also projects a 0.3 MMBpd decline in 2021 for average production levels to ~11.1 MMBpd. The steep decline in U.S. drilling activity resulting from the collapse in oil demand, oil prices, and producer capital budgets are the primary factors driving the decline. As you can also see below, the 2020 production forecast was influenced by the temporary oil production shut-ins caused by the extremely low (even briefly negative) oil prices brought on by the abrupt demand loss.



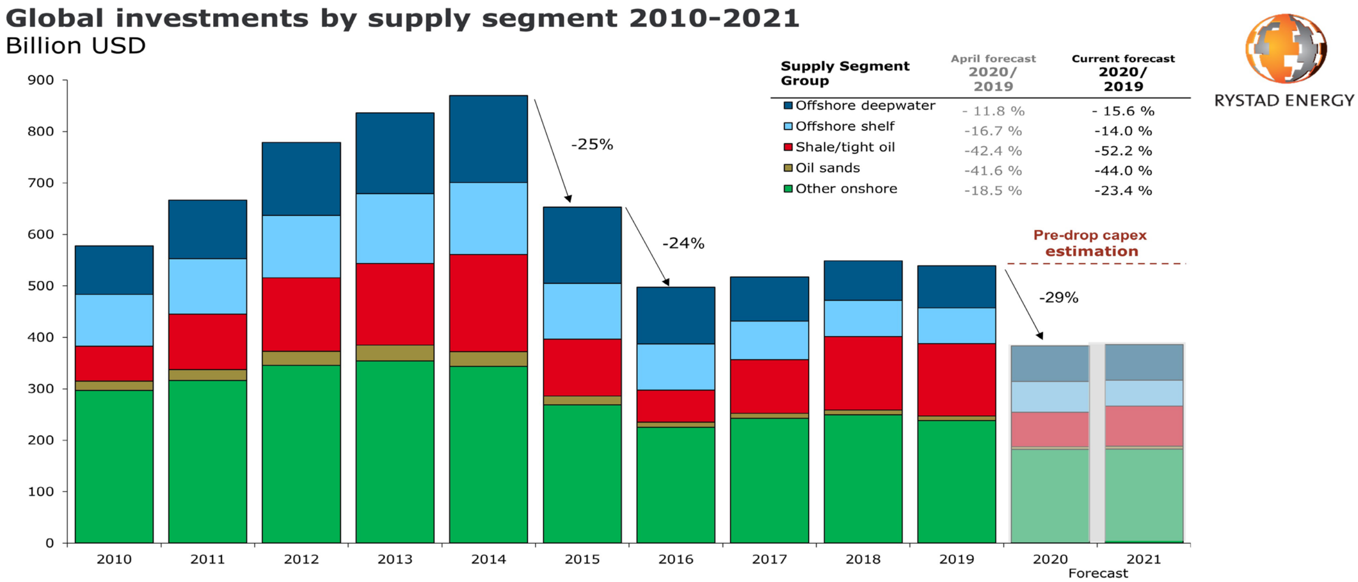
Source: U.S. Energy Information Administration, Short-Term Energy Outlook, November 2020

On a global scale, OPEC nations, as well as Russia, continue to cooperate to keep supply out of the market in order to offset the sharp decline in demand. This has also been aided by internal battles within Libya that has kept production below 200 MBpd for most of 2020, after surging to over 1 MMBpd for most of 2019. Likewise, political-driven economic struggles in Venezuela have caused its production to fall below 400 MBpd in 2019, from over 1 MMBpd in early 2019 and over 2 MMBpd just four years ago. Unlike Libya, that trend appears unlikely to reverse in any meaningful way in the near future.



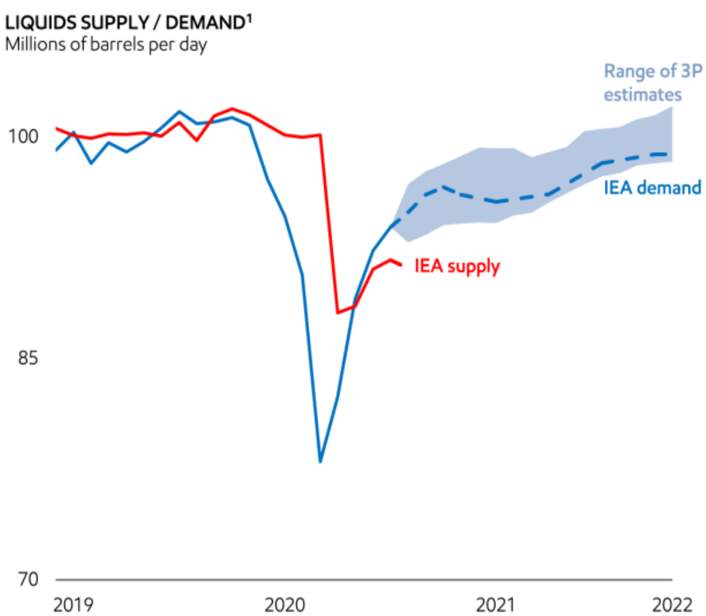
For the near-term, OPEC+ continues to discuss further extending planned production cuts, pending the recovery in demand (current talk is by three to six months). Notwithstanding the outlook for higher production from Libya, the group is still curbing oil production by ~7.7 MMBpd, down from ~9.7 MMBpd, with another planned step up in supply of 2 MMBpd expected in January 2021. Over time, one would presume that the cuts will dwindle lower and should crude oil prices trend higher, we would expect increased OPEC cheating relative to official quotas. The above EIA chart shows the contribution mix of key global oil producers. [11]

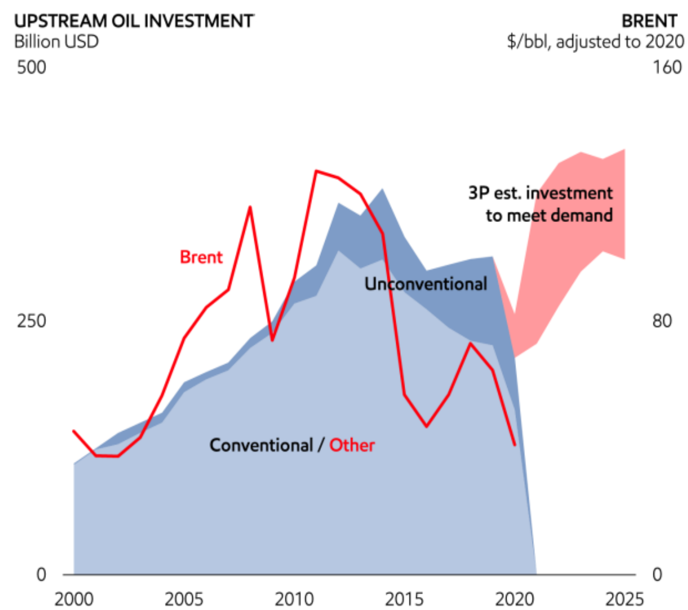
Meanwhile, the impact of the pandemic on the global economy, oil prices and resulting shutdown of capital markets access to energy companies has caused a sharp reduction in capital spending and thus drilling & completion activity worldwide. Specifically, the worldwide active rig count has fallen by 50% from 1Q20 average levels to 3Q20 average levels according to Baker Hughes. Of note, that implies a global rig count that is 29% below the 2016 low during the prior oil crisis. Meanwhile, global E&P capital spending is projected to decline by almost 30% in 2020 relative to 2019 and remain at similar levels in 2021 according to Rystad Energy (as shown below). [1] This includes more than a 52% projected decline in shale/tight oil, which, as we noted earlier, was responsible for the majority of recent U.S. oil supply growth.



Source: Rystad Energy UCube

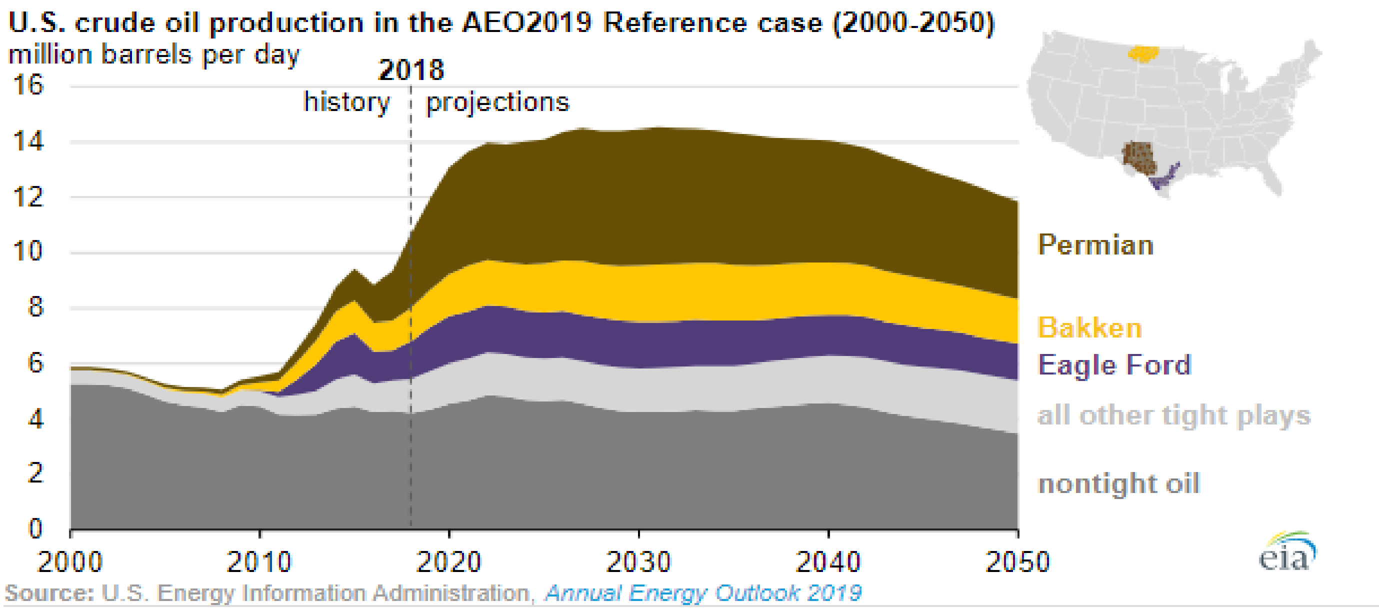
The next two graphs below are from ExxonMobil's third quarter earnings presentation. [16] Note in the left-hand graph where recent global oil production sits (red line) versus current and projected global oil demand over the next couple years, per the IEA. The graph on the right demonstrates how closely global oil investment tracks with crude oil prices (in this case Brent). **This graph implies that in order to meet the IEA's projected 2021-2022 demand increases, oil prices will need to have a meaningful recovery, or else investment, and therefore production, is likely to fall short. The long-term solution to low oil prices is…low oil prices.**





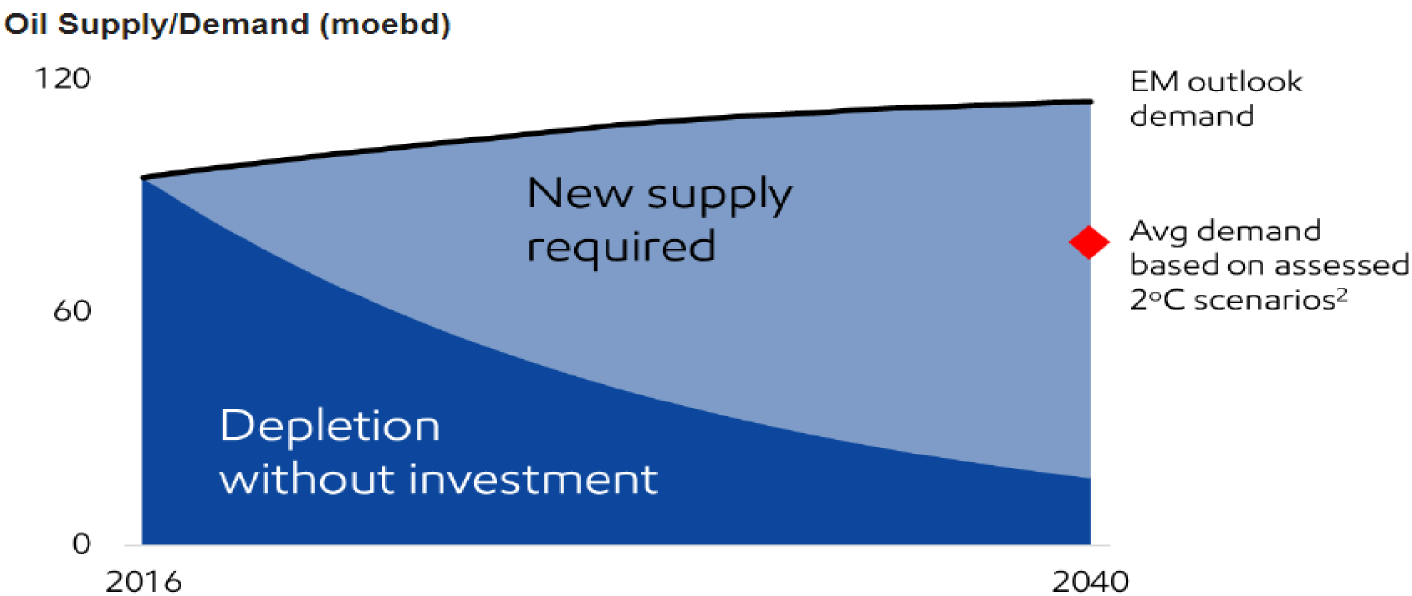
Source: ExxonMobil 3Q2020 Earnings Presentation

We expect long-term crude oil supply growth will depend heavily on pricing and the pace of investment. Over the past several years, U.S. unconventional basins have been responsible for a large portion of global supply growth and according to the EIA, that is expected to continue. [17] **As noted earlier, that growth in short-cycle supply came with a large price tag. Although there are a few near-to-intermediate areas of potential supply growth (waning OPEC+ cuts most notably), the severe reduction in capital budgets across the globe, including long lead time projects, is likely to have negative repercussions on the ease of medium term supply sourcing.**



In the wake of concerns over reduced oil consumption from passenger vehicles, **it is important to remind readers that even under a modest demand degradation view over the next 30 years, meaningful investment will still have to be made to replace supply lost to depletion rates.** One can argue over what global depletion rates truly are, and many have. One commonly thrown around figure is that global oil supply depletion rates are in the 7-8% range. That means if we take the 2019 exit rate of ~100 MMBpd of production, zero new investment over the following year (notwithstanding wells already in progress) would yield a 2020 exit rate of 92-93 MMBpd – all else being equal.

Over a multi-decade period this depletion rate adds up to more significant declines that would require meaningful new investment even under a more pessimistic 2040-2050 oil demand forecast. The following graph from a 2019 Exxon investor presentation illustrates this point perfectly. [18] You can see the "wedge" of new production needed to replace existing production after the impact of depletion. In Exxon's case, the implied annual depletion rate is approximately 7%, which by 2040 would take existing production down to ~23.5MMBpd from 100 MMBpd, and by 2050 that shrinks further to only ~11.5 MMBpd.

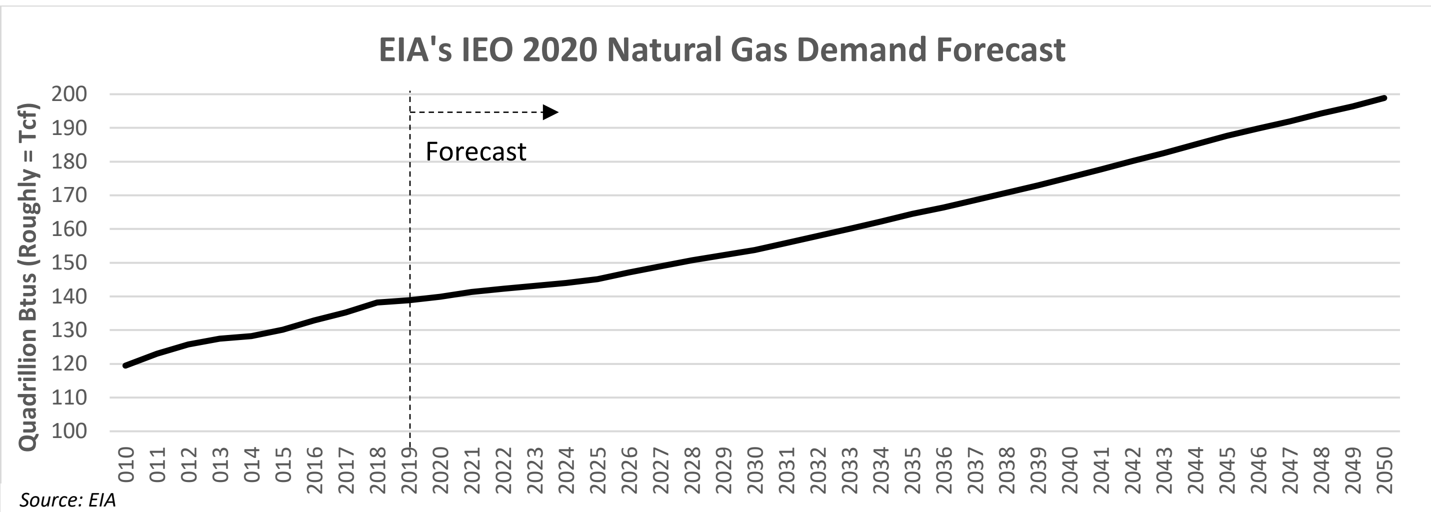


Source: Exxon US Sellside Conference Presentation June 18, 2019

However, in 2016 a collaboration between Cambridge Energy Research Associates (CERA) and IHS, Inc. released a study suggesting that annual depletion rates are closer to 4.5% annually. [19] The same point still holds true. Relative to a ~100MMBpd production rate at year-end 2019, base 2019 oil production would decline to ~40 MMBpd by 2040 and to ~25 MMBpd by 2050. **Both scenarios noted would still require massive investment to fulfill whatever realistic oil demand outlook one wants to model for 20-30 years out from today.**

NATURAL GAS OUTLOOK

Long term demand outlook. There is a wide variation in long range global natural gas demand forecasts resulting primarily on how one views economic growth, public policy, and pricing. The EIA long range forecast tends to fall in the middle of the various forecasts we've come across. Under the EIA's International Energy Outlook 2020 (IEO), global natural gas demand is estimated to grow to nearly 200 Tcf in 2050, from just under 139 Tcf in 2019, or ~43% growth (~1.2% annual growth). [3] In terms we're used to seeing (Bcf/day), that's roughly 545 Bcf/day in 2050, an increase of more than 160 Bcf/day!



To put that growth figure into perspective, that's the equivalent of finding more than 1.4x the current daily rate of U.S. gas production (per EIA statistics), or nearly 2.5x the current daily rate of Russian gas production (per BP statistics), or almost 6.8x the current daily rate of Iranian gas production (per BP statistics).

Alternatively, a 2019 report by McKinsey projects that the global gas market will grow at a 0.9% annual rate until 2035, driven by the power-generation and industrial sectors in Asia and North America and the residential and commercial sectors in Southeast Asia (including China). [20] Strong growth from these regions is expected to offset demand declines from mature gas markets in Europe and Northeast Asia.

As a part of this growth, LNG demand is expected to grow at 3.6% per annum through 2035. LNG demand is to outpace overall gas demand as Asian markets rely more on distant supplies, Europe increases its gas-import dependence, and U.S. producers seek overseas markets for their gas. China is expected to be a major driver of LNG-demand growth as will other parts of Southeast Asia and Europe. Japan recently noted it plans to import 100 million tonnes of LNG by 2030, more than a 30% increase from 2019 imports as a means to address decarbonization by switching away from oil and coal to natural gas and renewables.

Impact of electric cars on natural gas (electricity). Frost & Sullivan issued a report in late 2019 detailing the impact of electric vehicles on global energy (electricity) demand through 2040. The report highlights expected growth in annual sales to 34 million EVs in 2025, 121.2 million EVs in 2030 and 636.7 million EVs in 2040, relative to 2018 sales of 2.1 million EVs. [21] Such growth in the EV market is expected to drive an increase in electricity demand from 11,612.6 TWh in 2018 to 19,756.8 TWh in 2040.

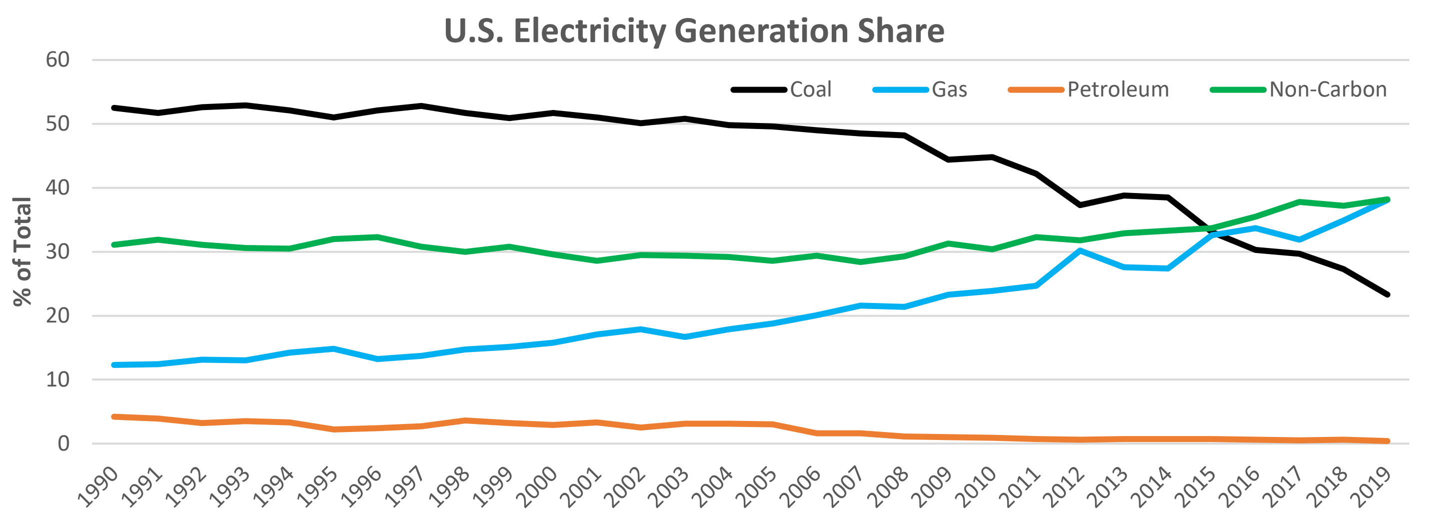
Another article from Power Magazine highlights a forecast from the IEA that the global EV fleet is expected to reach 130 million by 2030, up from just more than 5.1 million in 2018 per its 'new policies' scenario. [22] As EV adoption grows, utilities and other power generators are trying to determine the power load needed to charge those vehicles. Forecasting when and where that electricity will be needed is also a challenge. China accounts for a little over half of all EV sales worldwide, with EV sales there roughly 3x that of both the U.S. and the E.U. The article notes that the U.S. market is more difficult to predict right now given the battle between California (the EV leader in the U.S.) and the current administration over vehicle emissions and mileage requirements.

The article goes on to cite another article from The Conversation that was written by researchers at the University of Texas and the National Renewable Energy Laboratory, stating "if virtually all passenger cars in Texas were electrified today, that state would need approximately 110 more terawatt-hours of electricity per year – the average annual electricity consumption of 11 million homes. The added electricity demand would result in a 30 percent increase over current consumption in Texas." That same report went on to note complete electrification of passenger vehicle transportation in California "might require nearly 50 percent more electricity."

A partner with the Boston Consulting Group told Power Magazine that it expects that a representative U.S. utility (with 2-3 million customers and baseline electricity sales of about 40,000 GWh) with 1.1 million EVs in service by 2030 (roughly 15% of all vehicles in such a utility's service area) would need to invest between $1,700 and $5,800 in grid upgrades per EV through 2030. For the math challenged, that equates to an investment of between $1.9 billion and $6.4 billion for that representative utility. Assuming 15-20% of all vehicles in a representative utility's service area are EVs by 2030 and that the utility is somewhat successful at optimizing when and where EVs are charged, the Boston Group would expect a 5-10% increase in energy demand but a 25-33% increase in demand for grid capacity. Actual demand increases for a given utility will depend on local EV penetration, the extent to which EV charging happens when or where the grid is already constrained, and the mix of charging infrastructure installed.

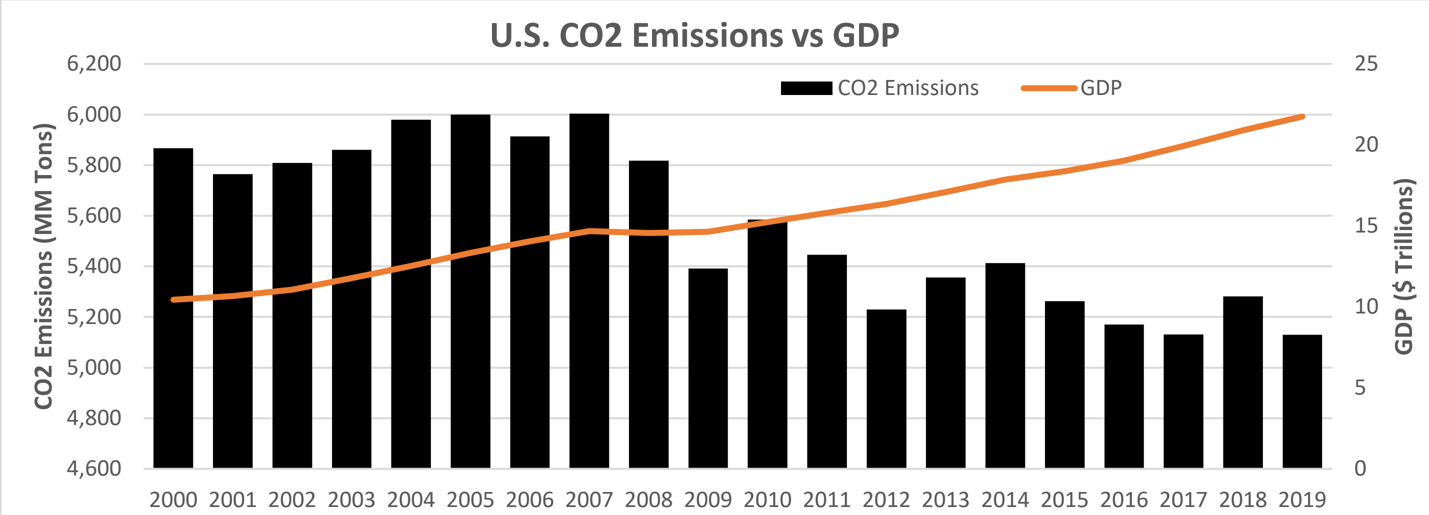
Any way you slice it, increased penetration of EVs across both the U.S. and the rest of the world is likely to boost demand for electricity, if only during the evening hours. The current global mix of electric generation is largely comprised of coal (36%), renewables (26%)– including hydro, natural gas (23%), nuclear (10%) and a few remaining sources. **We believe both renewables and natural gas are likely to account for the lion's share of incremental electricity generation growth over the next several decades, making the trend in EVs a likely positive for natural gas demand.**

Natural gas transition aided the decrease in CO_2 emissions despite doubling of economy over the last 20 years. There are several factors that have led to declining U.S. CO_2 emissions over the past several years, but one of the most significant factors has been the shift away from coal-fired electric power towards natural gas-fired electric power. This trend became possible through two step change events for the industry: 1) the gas-fired power generation build boom of the late 1990s/early 2000s, and 2) the shale gas spending boom in the mid-late 2000s that brought about much cheaper natural gas, placing it more competitive in many cases than "baseload" coal-fired generation. Increased regulations in the coal industry further exacerbated this shift, as have the most recent policy shifts away from the most carbon-intensive fuels. This growth in natural gas-fired electricity generation is very apparent in the following graph that shows its share has increased to more than 38% through 2019, versus less than 16% in 2000. [23]



Source: EIA

The combination of this massive shift away from coal-fired generation - now down to just 23% in 2019 from almost 52% in 2000 – and towards natural gas and to a lesser extent non-carbon generation has helped drive U.S. CO_2 emissions lower over the past several years. Since 2000, U.S. CO_2 emissions have fallen by nearly 13%, during a period in which the nominal GDP of the United States has more than doubled to almost $22 trillion last year. [24] Peak U.S. CO_2 emissions came just a few years later, which have since declined by nearly 15% through 2019. **Hence, in addition to the growth in renewables projected over the coming years, we continue to see natural gas as an attractive "transition fuel" that should further help reduce CO_2 emissions and do so very economically.** As a reminder, natural gas emits almost half of the amount of CO_2 as coal, and about one-third less than petroleum-based sources (such as residual fuel oil).



Source: EIA, Bureau of Economic Analysis

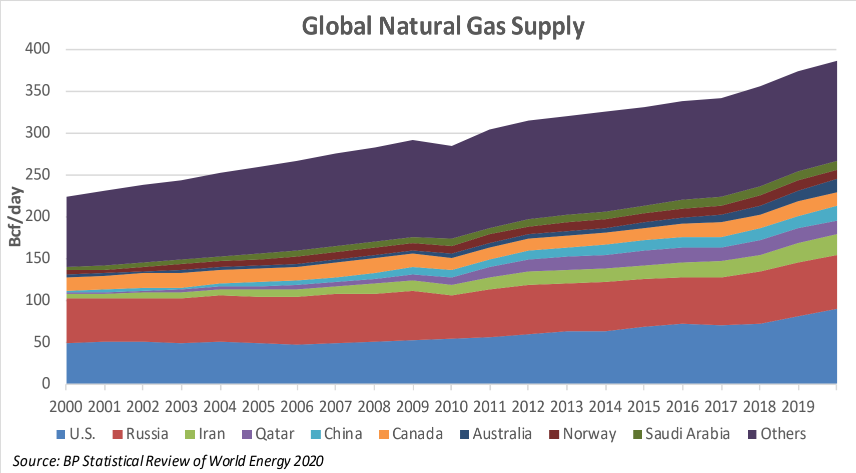
The shift away from coal and toward both renewables and natural gas is not just a U.S. phenomenon. The members of the Powering Past Coal Alliance, formed in 2017 and comprised of 34 national and 33 subnational governments, have decided to phase out coal entirely (over various timelines). Of the top 12 countries by coal-fired capacity, which collectively account for 89% of the worldwide total, only Germany is currently a member of the alliance. Japan is one of the top 12 that is planning a partial phase-out by 2030. There is currently more than 120 MW of coal-fired generation capacity in "phase-out" markets and as shown below is planning on replacing that capacity with a variety of renewables as well as natural gas, which would account for ~35% of the replaced capacity. [25]

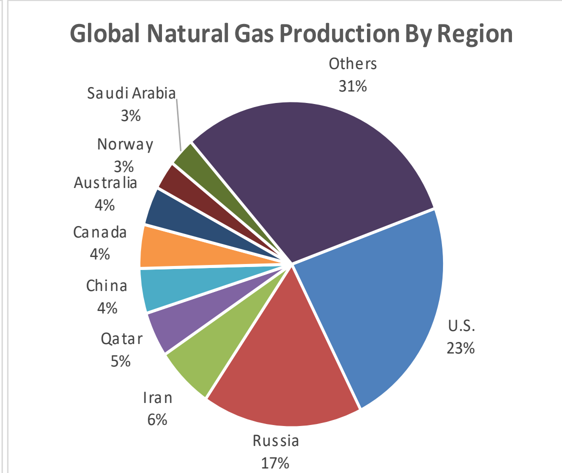
Coal-Fired Generation Capacity in Phase-out Markets, 2020 (MW)

			Likely Top Two Replacements
Germany	45,378		Natural gas, biomass
S. Chungcheong, Korea	18,000		Natural gas, solar
Italy	8,552		Solar, wind
Canada	8,472		Wind, natural gas
U.K.	6,328		Wind, natural gas
Mexico	5,378		Natural gas, solar
Israel	4,900		Natural gas, solar
Minnesota, U.S.	4,488		Wind, solar
Netherlands	4,152		Wind, biomass
France	3,864		Solar, wind
Greece	3,175		Solar, wind
Portugal	1,978		Solar, wind
New York, U.S.	1,738		Wind, natural gas
Finland	1,558		Wind, biomass
Washington, U.S.	1,460		Wind, solar
Denmark	1,180		Wind, biomass
Total	**120,601**		
	Of which, replaced by		
	63,316	**Wind, equating to 35% of output**	
	46,431	**Nat. gas, equating to 35% of output**	
	72,361	**Solar, equating to 20% of output**	
	12,060	**Biomass, equating to 10% of output**	

Source: Global Coal Plant Tracker, Powering Past Coal Alliance, Raymond James research

Natural gas supply outlook. One question that comes to mind under many of the global gas demand growth scenarios is where will the incremental supply be sourced? In the near-term, abundant recent growth in the U.S. and arguably excess LNG supply are the likely answer. For reference, the current mix of global natural gas production is weighted largely to the top few players. The U.S. accounts for the greatest share at over 23% in 2019, also accounting for over 38% of the growth over the past five years. Next is Russia at 17%, Iran at 6% and then Qatar, China and Canada in the low-mid 4% each. Overall global gas production has risen by approximately two-thirds over the past two decades. [12]

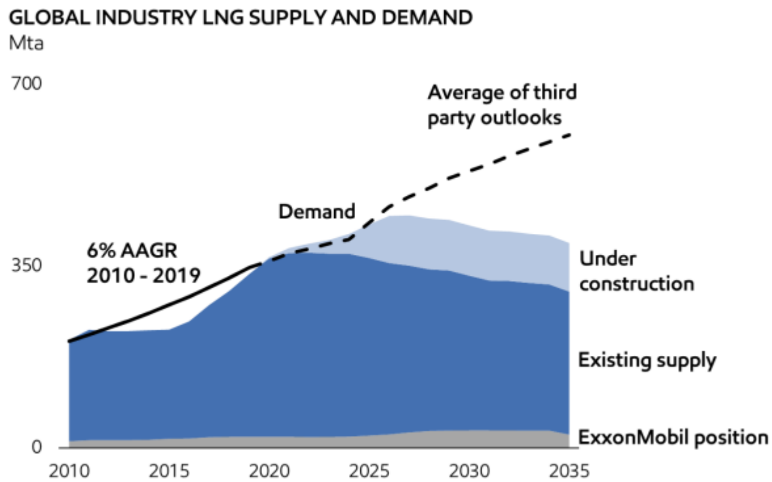




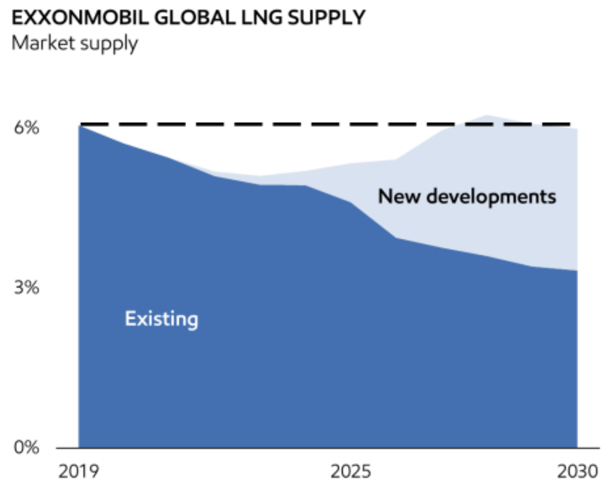
However, the impact of COVID-19 is likely to be felt on supply for at least the next couple years – especially given sharp U.S. activity declines. Over the longer haul, significant investment will have to be made globally in order to offset the sharp reduction to capital budgets that have transpired in 2020 as depletion rates take hold. Likewise, delays in longer-cycle projects such as LNG are cropping up a lot under the stress of the pandemic, which will undoubtedly push off the timing on numerous projects. In the U.S. alone, six LNG terminal projects for which final investment decisions were expected this year have been delayed, in addition to four additional projects that were experiencing delays prior to COVID. Collectively, those 10 projects amount to approximately 20 Bcf/d in liquefaction capacity. There have also been delays in other projects around the globe both related and unrelated to COVID.

Notwithstanding any pandemic-related setbacks, North America is expected to see the highest number of small-scale LNG capacity growth additions in the world according to a recent report from GlobalData. [26]. North America is expected to supply 37% of additions by 2024, including nine planned terminals and 17 announced projects that total 7,270 kilo-tonnes per annum (ktpa). Russia was next for growth in small-scale LNG, with seven planned and eight announced projects contributing 26% or 5,120 ktpa. China was next with 15% of LNG capacity between 2020-2024 from 14 planned and two announced projects. In total, a 2019 report highlighted the potential for 280 new LNG projects (including expansion trains).

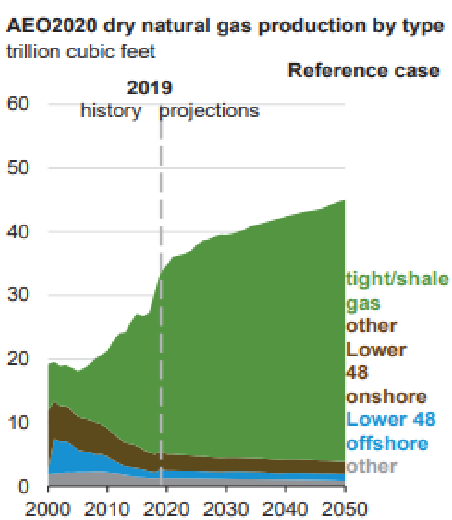
However, many of these projects are some time from happening and the recent delays certainly aren't going to help. A recent graph from an ExxonMobil presentation highlights Wood Mackenzie's current projections for LNG supply growth, relative to demand. [2] Later this decade, demand is projected to exceed supply and we suspect this projection was likely made prior to the pandemic outbreak.

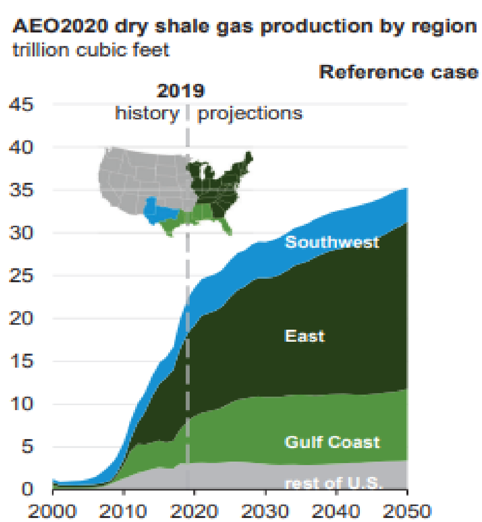


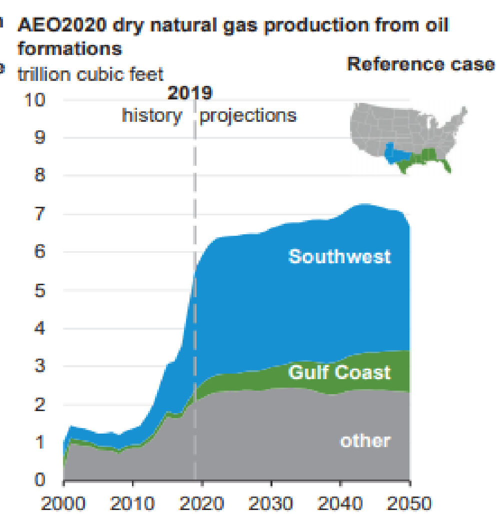
Source: Wood Mackenzie LNG tool and ExxonMobil analysis



The U.S. entered LNG exports in recent years, starting as a net exporter first in 2017. U.S. LNG export capacity has increased from less than 1 Bcf/day in 2016 to nearly 9 Bcf/day at the end of 2019. In 2015, U.S. LNG exports totaled 28 Bcf to seven countries, while in 2019 LNG exports totaled 1,819 Bcf to 38 countries. There are four additional LNG trains that have been commissioned in 2020, adding ~2.3 Bcf/day of capacity with two new facilities and a total of six trains under construction that would add another 4.6 Bcf/day by 2025. There are yet 65 additional LNG trains (8 projects) that have been approved by FERC that would add another 12.3 Bcf/day in export capacity if/when they are built. In total, this would bring total potential U.S. LNG export capacity up to nearly 28 Bcf/day if all the approved projects get built (not including additional projects under consideration). This would make the U.S. a leading LNG exporter. We don't expect all the current projects under consideration to get built, but it seems clear that the U.S. will be a significant player in the global LNG trade, requiring meaningful investment in order meet demand and offset depletion. Below was the pre-COVID long range gas production forecast from the EIA. [14]



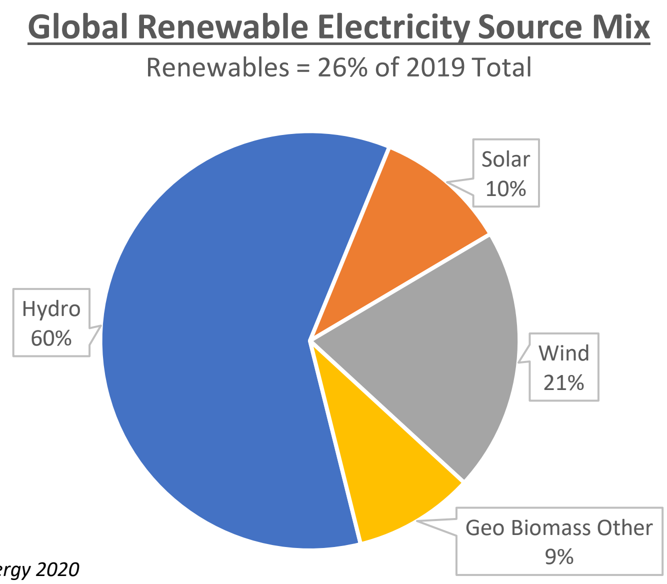




Source: EIA International Energy Outlook 2020

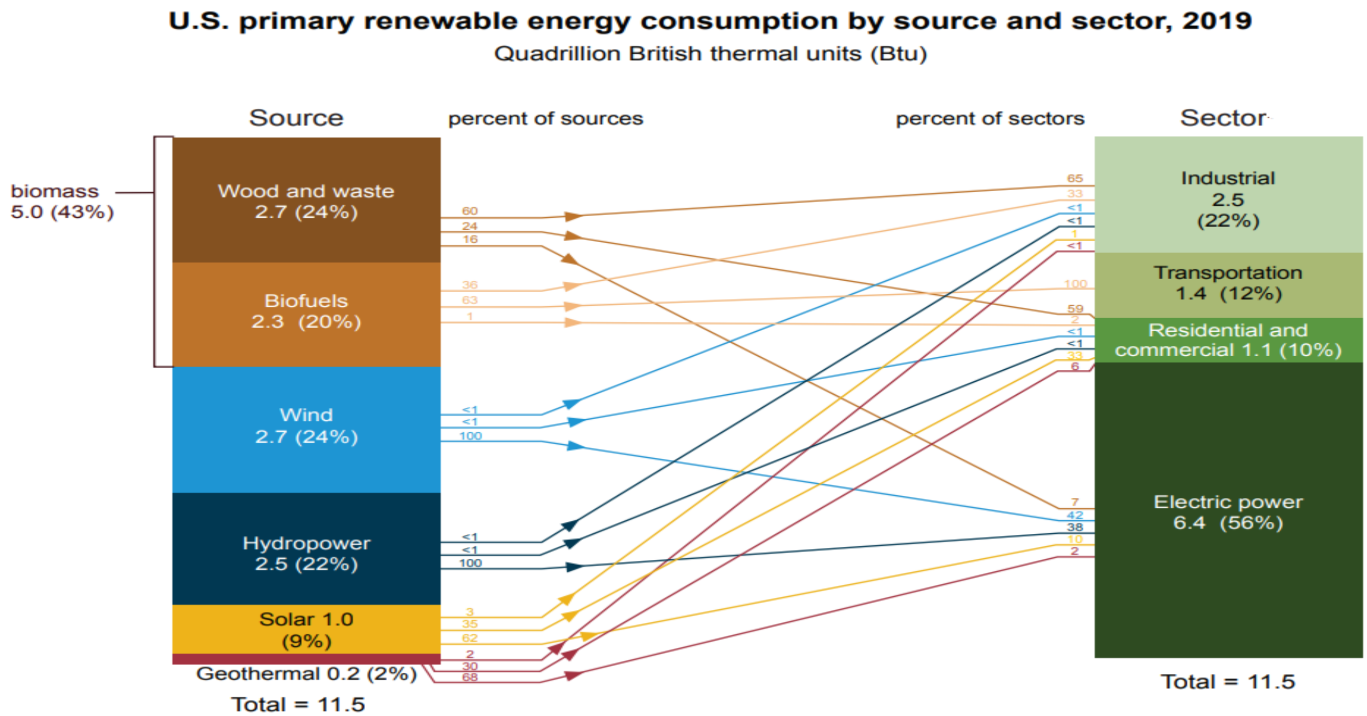
RENEWABLES OUTLOOK

Long term demand outlook (a winner, but not a one size fits all solution). Renewables investment is growing at a rapid pace as countries and states look to solve the greenhouse gas emissions challenges presented by public policy and climate concerns as costs continue to shrink. Additionally, the cost of generating electricity via renewables continues to decline. Through 2019, all renewable sources have grown to account for approximately 26% of worldwide electricity generation. That is a mix of different sources, including: hydro (60%), solar (10%), wind (20%) and geothermal/biomass/other (9%). [12] Of course, what sources of renewables work best depends highly on the location in which they serve.



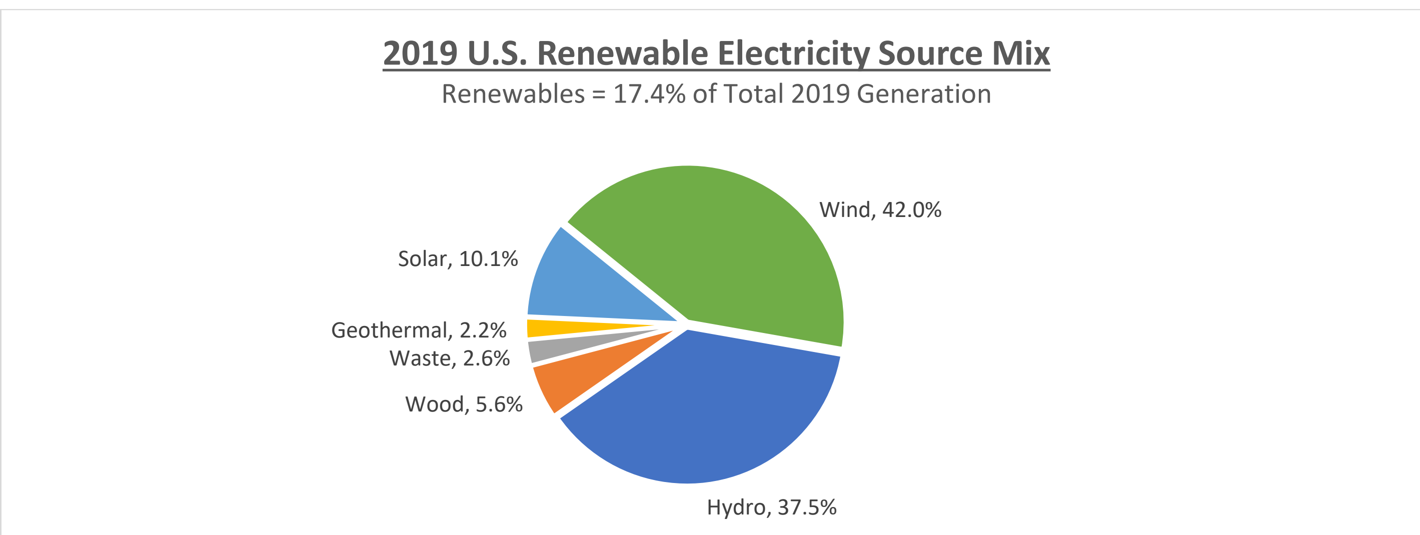
Source: BP Statistical Review of World Energy 2020

In the U.S., renewable energy set a record in 2019 at 11% of total U.S. energy consumption. A breakdown of the sources of renewable energy and the sectors which consumed them are highlighted below. [27] For overall renewable energy consumption, it breaks down into a somewhat similar mix between wood and waste (24%), biofuels (20%), wind (24%) and hydropower (22%), with solar (9%) and geothermal (2%) making up the difference. From a sector use perspective, electricity generation was the largest share at 56%, followed by industrial (22%), transportation (12%) and residential/commercial (10%).



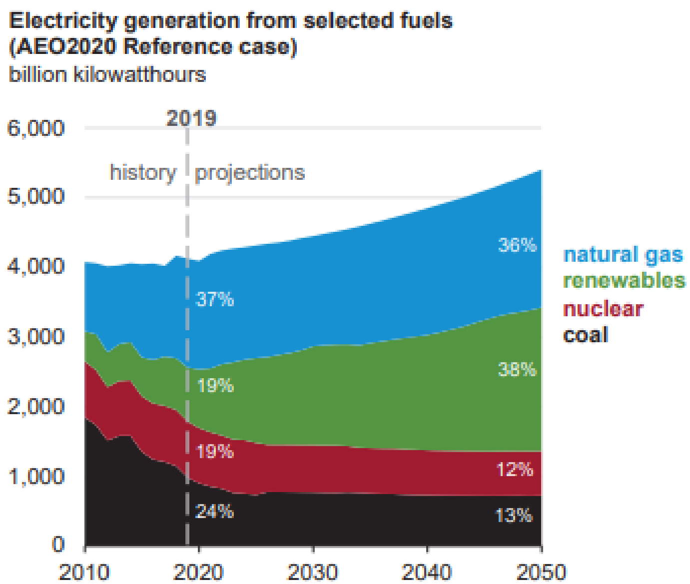
Source: EIA Monthly Energy Review

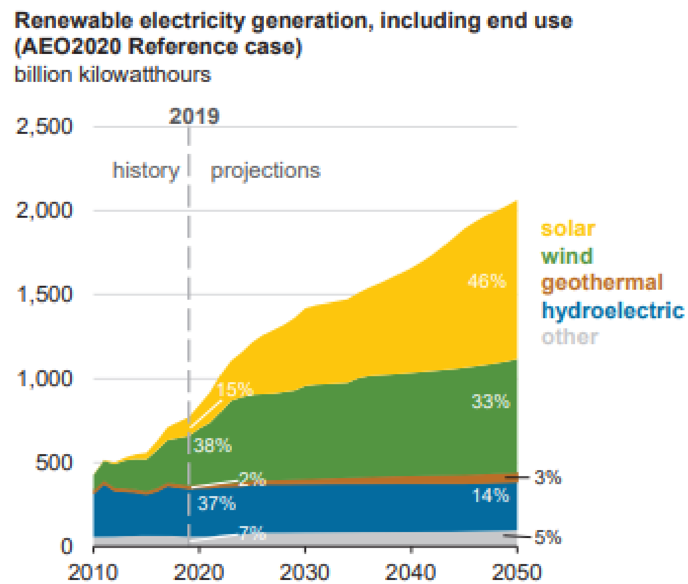
In terms of U.S. electricity generation, which comprised the largest sector consumer of renewable energy, renewable sources accounted for 17.4% of the 2019 total. That mix largely consisted of wind generation at 42% and hydro generation at 37.5%, followed by solar at 10% and other sources that accounted for the rest as shown below. [27]



Source: EIA Monthly Energy Review

Sticking with the U.S. outlook, the 2020 Annual Energy Outlook from the EIA shows the projected increase in renewables relative to other fossil-fuel based sources. As shown to the left, it expects renewables to double its share of U.S. electricity generation from a projected 19% in 2020 to 38% in 2050. [14] The increased share that renewables fulfil also incorporates a forecast for overall electric generation growth of roughly 1% per annum. The EIA notes that this would have been higher if not for the assumption of significant growth in generation from rooftop PV systems, which is expected to account for 4% of U.S. generation. The projected mix of renewables is on the right, where you can see the growth is largely expected to come from solar, followed by wind. In total, renewable electricity generation is projected to roughly triple.



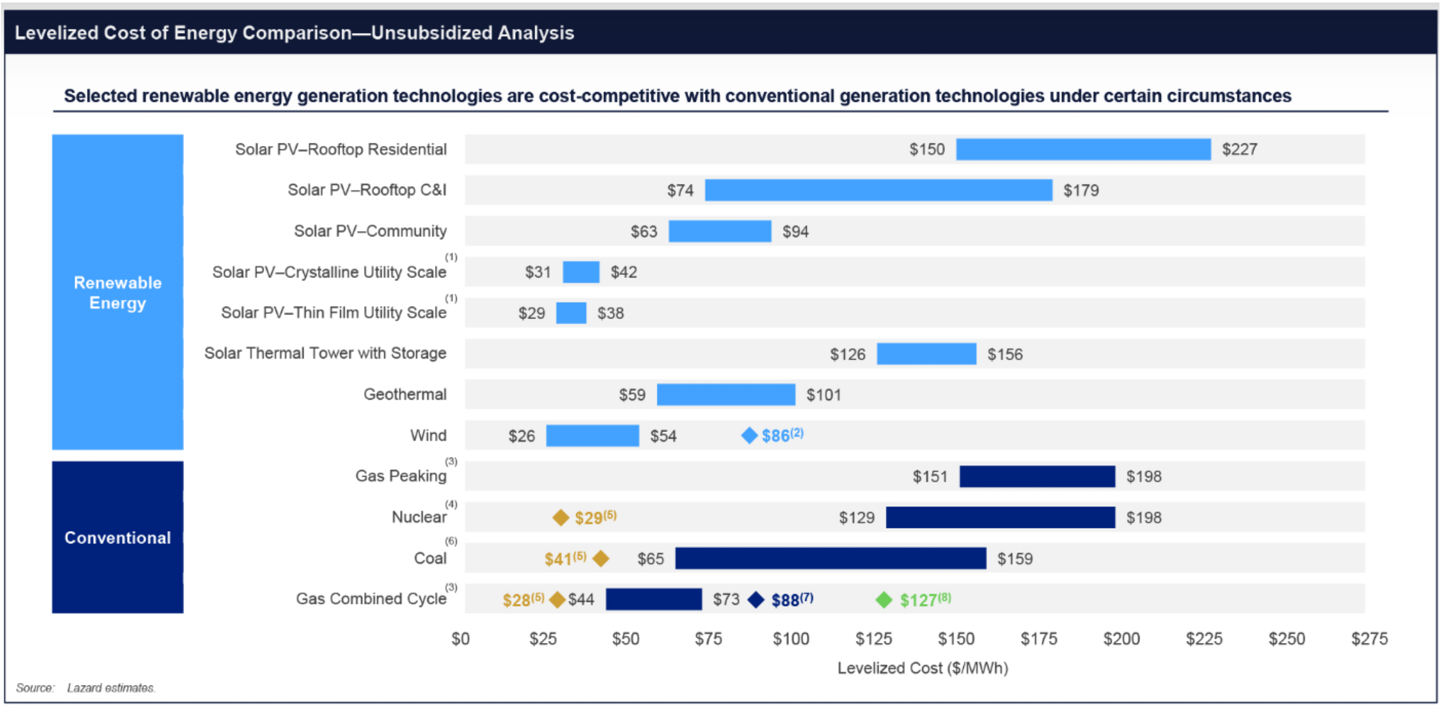


Source: EIA Annual Energy Outlook 2020

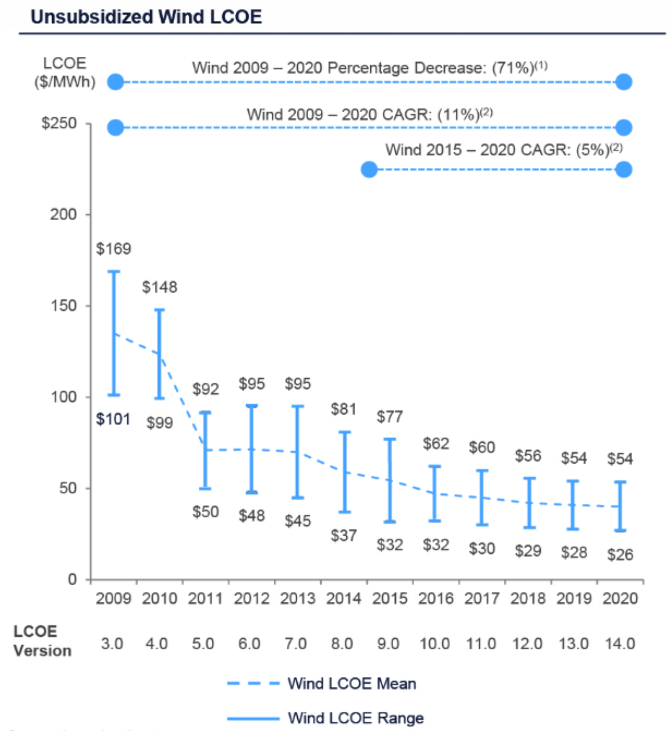
There can be several challenges to investing in renewables, but many of those challenges (public policy, sentiment, etc.) are currently going in the favor of such investments. While costs are coming down and returns are improving, one significant challenge that has arisen in recent years is the amount of assets chasing "ESG" investments. According to the U.S. SIF Foundation and Raymond James research, the current amount of professionally managed assets that were subject to some sort of ESG criteria was $11.6 trillion as of 2018. Thus, from an investor perspective, trying to find the right deals amidst a sea of capital chasing the same projects can lead to more challenging risks, returns, etc.

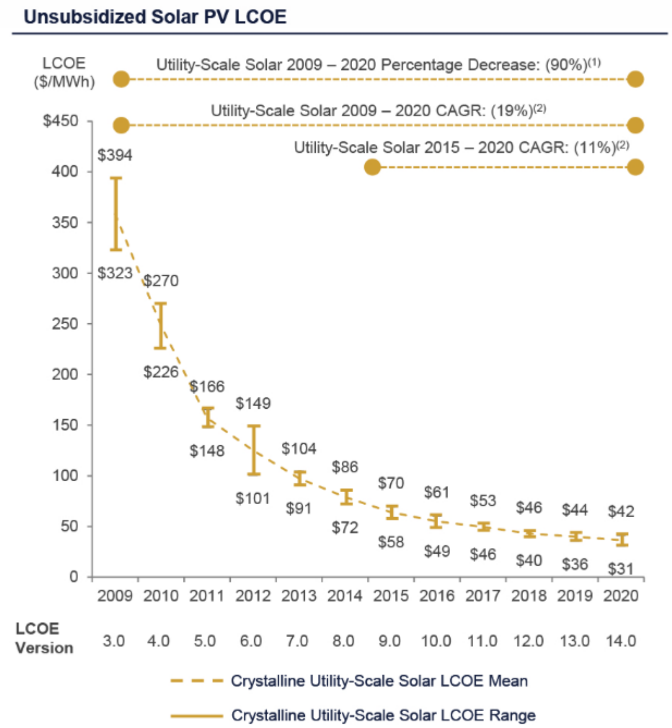
Costs/relative economics of renewables vs hydrocarbons. The cost of renewable energy has trended meaningfully lower over the past several years, which has been one of the main drivers behind its exponential growth. Hydroelectric power is the cheapest source of renewable energy at around $50/MWh, while the average cost of developing new power plants based on onshore wind, solar, biomass or geothermal energy has trended lower, now usually below $100/MWh. Not far behind that is offshore wind, which is close to $130/MWh. These figures are worldwide averages and it's important to note that individual project costs can vary widely. For example, the cost of producing electricity from a biomass plant can range from as low as $50/MWh to as high as nearly $250/MWh. This rapid reduction in the cost of electricity generation from renewables in recent years has made them more competitive with the cost of new power plants based on fossil fuels, which typically range from

$50/MWh to over $150/MWh. You can see the current ranges for most of these various generation sources according to a Lazard study of unsubsidized costs, given below. [28]



The next two Lazard charts plot the historical trends in average levelized cost of energy (LCOE) for solar PV plants and wind projects. [28] For reference, LCOE is a measure of the average net present cost of electricity generation for a plant over its lifetime. As you can see, LCOE's for both sources have fallen sharply over the past decade.





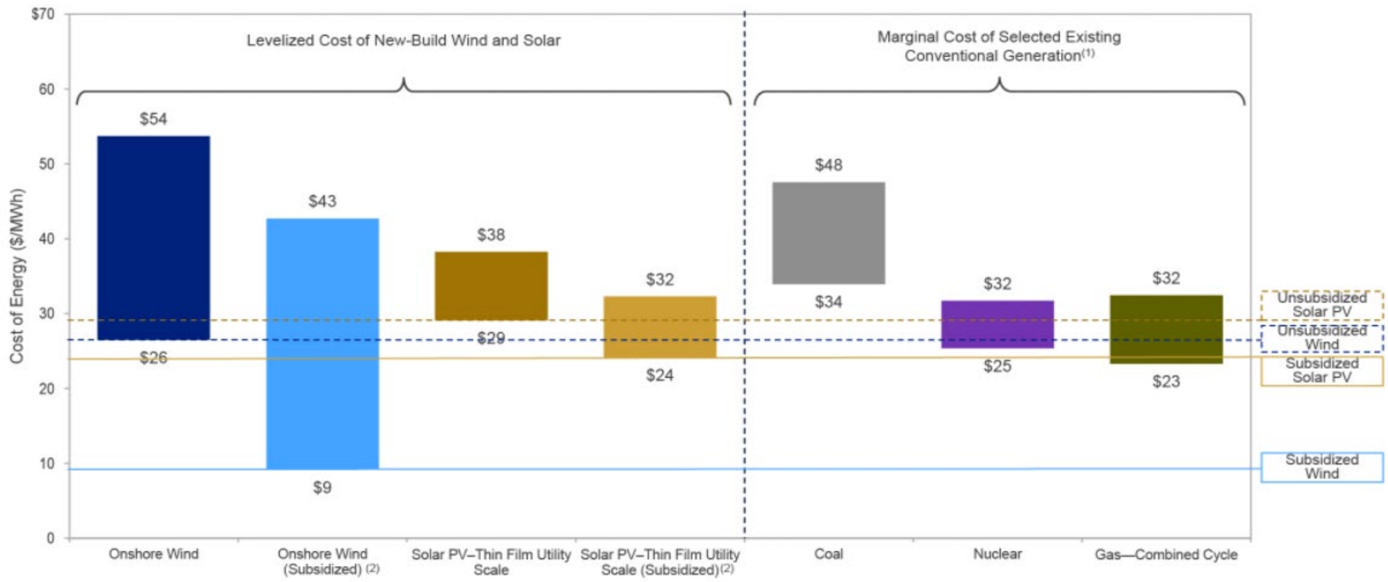
Source: Lazard estimates.

The LCOEs represented in the preceding two graphs assumes such renewable projects are financed 60% debt at an 8% interest rate and 40% equity at a 12% cost. An October 2020 article in Popular Mechanics suggests that solar PV is now the cheapest form of electricity to build (as low as $30/MWh), citing a new report from the International Energy Agency (IEA). The IEA notes this low cost is possible thanks to risk-reducing financial policies around the world – which include competitive bidding and improved capital costs. For wind energy, average LCOE has also continued to drift lower. As you can see, certain solar and wind technologies are now competitive with combined cycle natural gas (on an unsubsidized basis) at the plant level, and cheaper than coal and/or nuclear plants in many cases.

When comparing renewable energy generation against the marginal cost of existing generation, you can see in the following graph that renewable generation can be competitive, especially when subsidies are included [44]. Without them there are still cases where solar and wind may compete with existing nuclear and combined cycle gas plants. Again, this only takes into account plant level economics and no broader implications for necessary infrastructure or back up needs that may be brought on by constructing new renewable plants.

Levelized Cost of Energy Comparison—Renewable Energy versus Marginal Cost of Selected Existing Conventional Generation

Certain renewable energy generation technologies have an LCOE that is competitive with the marginal cost of existing conventional generation



Source: *Lazard estimates.*

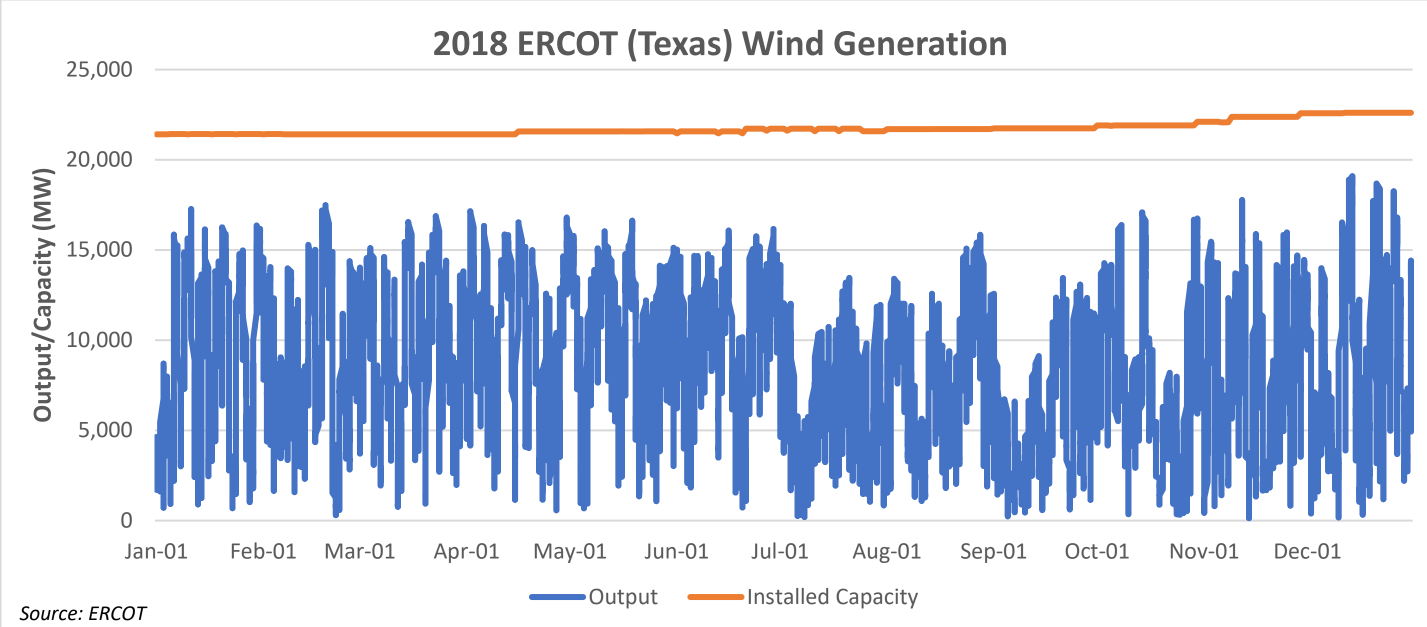
Note: Unless otherwise noted, the assumptions used in this sensitivity correspond to those used in the global, unsubsidized analysis as presented on the page titled "Levelized Cost of Energy Comparison—Unsubsidized Analysis".

(1) Represents the marginal cost of operating fully depreciated gas combined cycle, coal and nuclear facilities, inclusive of decommissioning costs for nuclear facilities. Analysis assumes that the salvage value for a decommissioned gas combined cycle or coal asset is equivalent to its decommissioning and site restoration costs. Inputs are derived from a benchmark of operating gas combined cycle, coal and nuclear assets across the U.S. Capacity factors, fuel, variable and fixed operating expenses are based on upper and lower quartile estimates derived from Lazard's research.

(2) The subsidized analysis includes sensitivities related to the TCJA and U.S. federal tax subsidies. Please see page titled "Levelized Cost of Energy Comparison—Sensitivity to U.S. Federal Tax Subsidies" for additional details.

Will renewable power completely displace fossil fuel-based power? A number of environmental groups have endorsed the idea of 100% renewable-sourced power and the future solution to the perpetuated climate crisis. And as noted above, costs have recently become favorable enough for sources like solar and wind power to conceptually make the claim that all incremental power plants would be from renewable sources. **The reality, however, is that the idea of 100% of all electric generation coming from renewable power sources for any realistic investible timeframe is highly unlikely to materialize , for several reasons.**

One stern example would be Texas wind generation reliability. The U.S. is the second largest producer of wind energy in the world with almost 110 GW of installed capacity and Texas is far and away the leader with over 29 GW of wind generation capacity (~27%). However, as the wind only blows on an intermittent basis, that capacity isn't online 24/7/365 like you would expect from a baseload coal, natural gas or nuclear plant. As a result, typical capacity utilization is often quite low. For example, in 2018, ERCOT (which is the Texas electric grid manager) recorded capacity utilization throughout the year of just 36.7% on an average of ~21.7 MW of installed wind capacity. That utilization factor looks even worse during "on peak" hours of 7am to 11pm as the wind tends to blow more in the evening. [29]

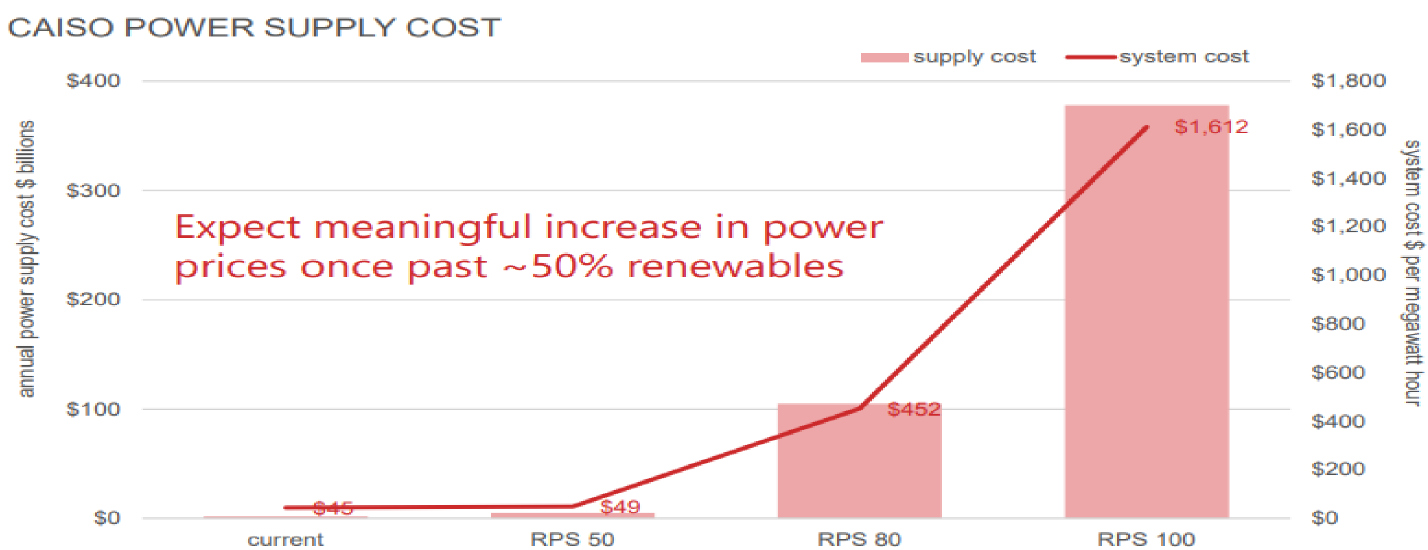


Solar PV power generation suffers from a similar trait of being intermittent. The solar generating cycle typically occurs opposite of wind – when the sun shines during daylight hours. This more closely matches up better with peak demand loads. **An interesting fact for both solar and wind - which are set to be the fastest growing segments for renewables – they are typically backed up by fast-ramping natural gas plants that can help fill in the gaps in intermittent power generation.** A 2016 paper by the National Bureau of Economic Research demonstrated this strong relationship between renewables on one hand and natural gas on the other. [30] The study looked at the erection of wind, solar and other renewable energy plants across 26 countries that are members of the OECD. "All other things equal, a 1% increase in the share of fast reacting fossil technologies is associated with a 0.88% increase in renewable generating capacity in the long term" the study reported.

A recent study conducted by Irish and U.S.-based researchers looked at the efficacy of renewable energy sources such as wind and solar in dealing with the climate crisis. [31] The study found that renewable energy sources are extremely costly and may be causing as much climate change as they purport to mitigate. Citing the Climate Policy Initiative's (CPI) annual Global Landscape of Climate Finance reports the study noted that $3.6 trillion was spent on global climate change projects from 2011-2018. 55% of this expenditure went towards wind and solar energy. According to world energy reports, the contribution of wind and solar to world energy consumption increased from 0.5% to 3% over this period, while coal, oil and natural gas continue to supply the largest share with hydro and nuclear providing the bulk of the rest. **It concluded that it cost the world $2 trillion to increase the share of wind and solar from 0.5% to 3% and it took eight years to do it. What would it cost to increase that to 100%, and how long would it take?**

The transition to renewable power sources makes perfect sense in certain areas. But it isn't necessarily a one size fits all solution either. It is likely to continue making great strides in developed countries with the appropriate infrastructure to support it. But according to World Bank estimates, there are still more than 10% of the world's population without access to any sort of electricity as of 2018. [32] In a world with more than 7.8 billion people, that's well over 800 million people without access to electricity. Many nations in Africa, for example lack such resources. Even some of the more developed nations still have large numbers of people without power – such as India, with more than 60 million inhabitants that aren't connected to any sort of grid. In many of these cases, simple access to any resources that are affordable and feasible are the most likely solutions to get them connected and that doesn't necessarily involve just renewable sources of energy.

Although wind and solar costs have declined, total system costs become challenging at high levels of renewable penetration. As the level of renewable penetration increases in each Renewable Portfolio Standard (RPS) scenario, intermittency in the power supply increases as well. **Such intermittency creates the need for a significant amount of incremental battery capacity to maintain reliability, which rapidly drives up system costs.** During periods when renewable output is very high, the California energy system would need to generate substantial additional energy to charge a massive amount of battery capacity to ensure that load/demand is also served during periods when renewable output is relatively low. Based on a 2019 analysis by the Clean Air Task Force of CAISO data that was presented in a Kinder Morgan presentation, demonstrates how quickly total system costs ramp up beyond the RPS50 standard. [33] At the renewable "dream" RPS100 standard, costs are projected to increase by more than 30x vs the RPS50 level.



Source: Kinder Morgan November 2020 Presentation / February 2019 Clean Air Task Force analysis of CAISO data

In this same slide, Kinder also quoted a statement made by Xcel Energy CEO Ben Fowke to the U.S. Senate Committee on Energy & Natural Resources on June 4, 2019: **"Wind and solar resources are not consistently available and controllable to service the energy needs of all customers all the time on the whole energy system. For our system today, the cost of integrating renewable energy is manageable up to about 50% to 60% renewable penetration. At that point, however, the cost of integrating additional renewable energy begins to climb."**

Could solar photovoltaic (PV) manufacturing diversification bring about higher supply chain costs? Market participants have increasingly acknowledged the vulnerability of the global solar photovoltaic supply chain given the manufacturing capacity concentration in only a few countries – most notably China. In fact, according to Statista, China accounted for nearly three-quarters of all solar PV module production as of 2018, with the next largest supplier being Korea at 6%, followed by Malaysia at 5%. [34]

One example of a concerned country is Japan, who while solar only accounted for 7% of its total power generation in 2018, it contributed one-third of its power from renewable sources. As countries increase their reliance on renewables, having access to multiple supply sources becomes increasingly important for the sustainability of renewable energy power generation. **2020 has been a solid reminder of the need for supply diversification following the outbreak of COVID-19, which caused a number of disruptions in manufacturing and shipping ability. With that diversity may come some cost increases, at least temporarily.** The long-term trend in solar production costs has been pretty amazing, falling by more than 70% between 2010 and 2018, with expectations of further declines over time due to gains in technology/efficiency.

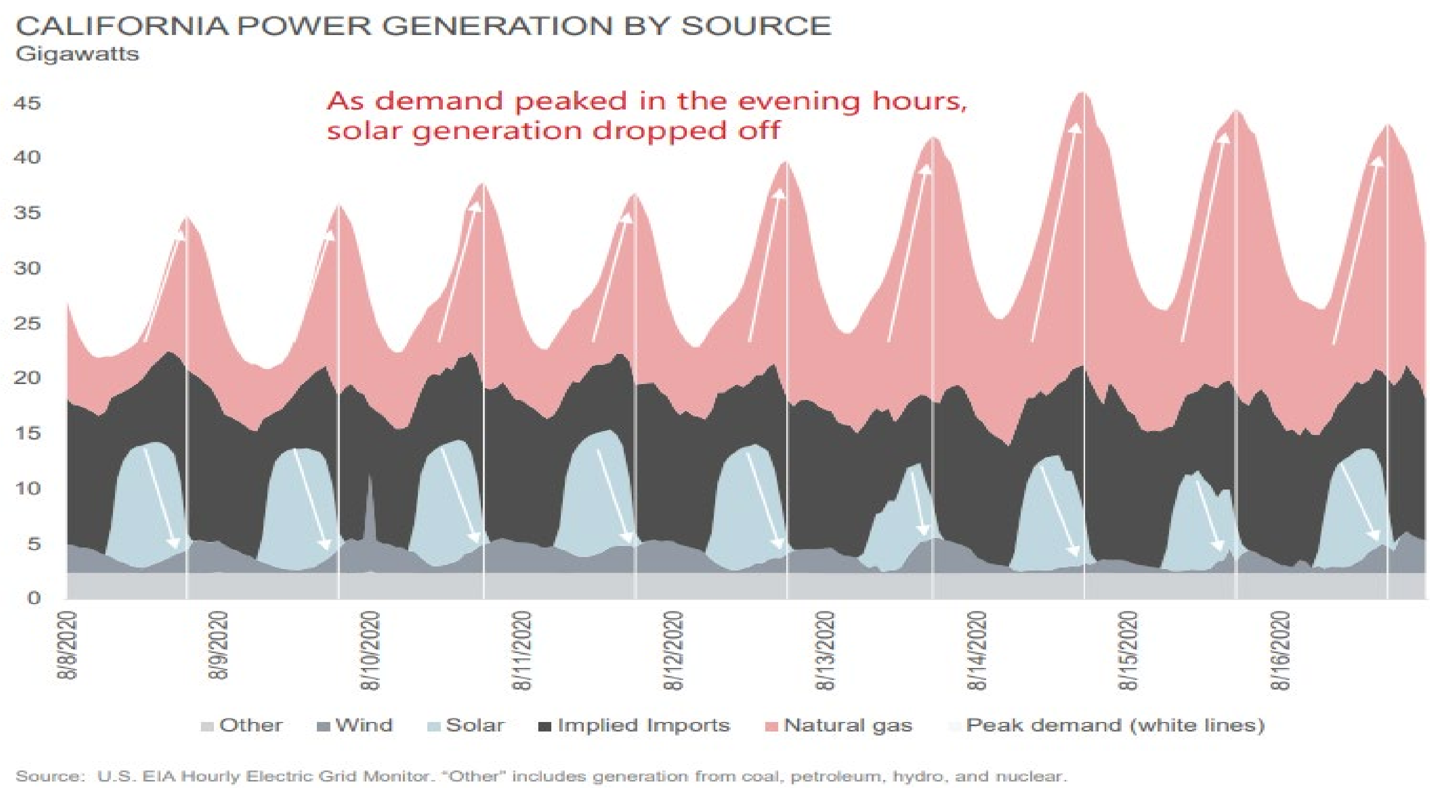
Renewable energy isn't always as "green" or sustainable as it's made out to be. Solar, wind, hydro and biomass are commonly identified as the main sources of sustainable electricity sources. Each of them is renewable, but that doesn't necessarily make them sustainable. Sustainability is determined by three parameters: environmental sustainability, social sustainability and economic sustainability. Environmental sustainability means that it doesn't harm the environment. That means there must be a positive energy balance to start with. **If producing a renewable energy device costs more energy than it produces during its lifetime, it's not sustainable as it's a net consumer of energy. Mining coal is understood to be bad for the environment, but mining neodymium and other rare earth metals for wind turbines is equally polluting.**

Another example comes from a recent report by the Environmental Defense Fund about hydropower, which according to the article accounts for two-thirds of "renewable" electricity generation globally with expectations of growing an additional 45% by 2040. [35] The article asserts that while it is broadly assumed that hydropower facilities emit greenhouse gases on par with wind, there is mounting evidence that emissions can be considerably greater, with some facilities even on par with fossil fuels. The genesis of the argument stems from the fact that analyses of climate impacts from hydropower have been simplistic in emphasizing 100-year impacts from a one-year pulse of emissions, which tend to mask the near-term impacts of methane emissions central to many current policy regimes as well as omitting carbon dioxide emissions associated with initial plant development. **The conclusion is that if minimizing climate impacts are not a priority in the design and construction of new hydropower facilities, it could lead to limited or even no climate benefits.**

There were several claims made in a study released by a collaboration of Irish and U.S. researchers in September 2020 regarding the impact of "green energies" on biodiversity. [31] Wind farms increase the temperature of the soil beneath them, which causes soil microbes to release more CO_2, offsetting the impact of less CO_2 from "human caused" sources. Also, solar and wind farms require up to 100x the land area that fossil fuel-generated electricity plants do. This could be devastating to the pristine areas of nature that environmental groups claim to care about. Politicians that have expressed a desire to rid the world of fossil fuel powered automobiles by switching to EVs. Such a move would require a massive increase in the amount of batteries used to power such vehicles. This, in turn would require a vast increase in the production of certain rare minerals such as cobalt, neodymium and lithium, which would push the environmental impacts of such mining to fall disproportionately on some impoverished countries.

As the U.S. becomes more electrified, need stability in the system with natural gas. For better or worse, California has been the ideological model for the transition to primarily renewable sources of energy. During this transitionary period, one thing has become evident – maintaining sufficient reserve capacity in the event of demand peaks, disruptions or the intermittent nature of solar and wind power has not been well planned for and has led to resulting power shortages. A combination of poor planning and record temperatures in August 2020 led to power outages in California. Several plants were either offline or not producing at peak capacity, which totaled about 15% of California's grid. One such shortfall was the reliance on hydroelectric power to help make up the difference, which failed to meet those objectives due to lower than accounted for water levels. Actual solar production during the demand peak on August 14th was 40% below plan and on the 15th was 35% below plan. Similarly, wind power within the California ISO (CAISO) was 57% less and 20% less than plan on the same two days.

Interestingly, when utilities cut power to their customers, the peak demand had reached 47,000 MW on a Friday and 45,000 MW on a Saturday. Those figures were far below the highest day – 50,270 achieved on July 24, 2006 or the 50,116 MW reached just three years ago. Perhaps the focus to end its reliance on fossil fuels has been handled too swiftly, especially when also considering that the state's nuclear fleet is in its final years with the San Onofre plant shut down in 2013 and the Diablo Canyon plant set to close by 2025. [31]



As we noted earlier, the increased reliance on intermittent power sources like wind and solar will necessarily require natural gas power as a back up to fill the void. The California example makes one thing very clear, whatever the power mix looks like for the U.S. in the future should require careful planning and not a rush to end reliance on old school power plants that have served its customers for decades.

Does the impact of COVID-19 speed up or slow down the energy transition? We've already discussed some of the impacts that the pandemic is having on traditional energy, but what about its impact on energy transition? After all, the widespread shutdowns that occurred during 2020 caused the IMF to project the worst recession since the Great Depression. To that point, the American Council on Renewable Energy reported earlier in the year that the renewable sector had lost 600,000 jobs between February and May. Still, the IEA projects that renewable energy will be the only sector to experience growth in demand this year. However, forecasts for renewable growth have been lowered throughout the year also, with BloombergNEF having reduced its forecast for new wind and solar installations by 12% and 8%, respectively due to COVID-19. [36]

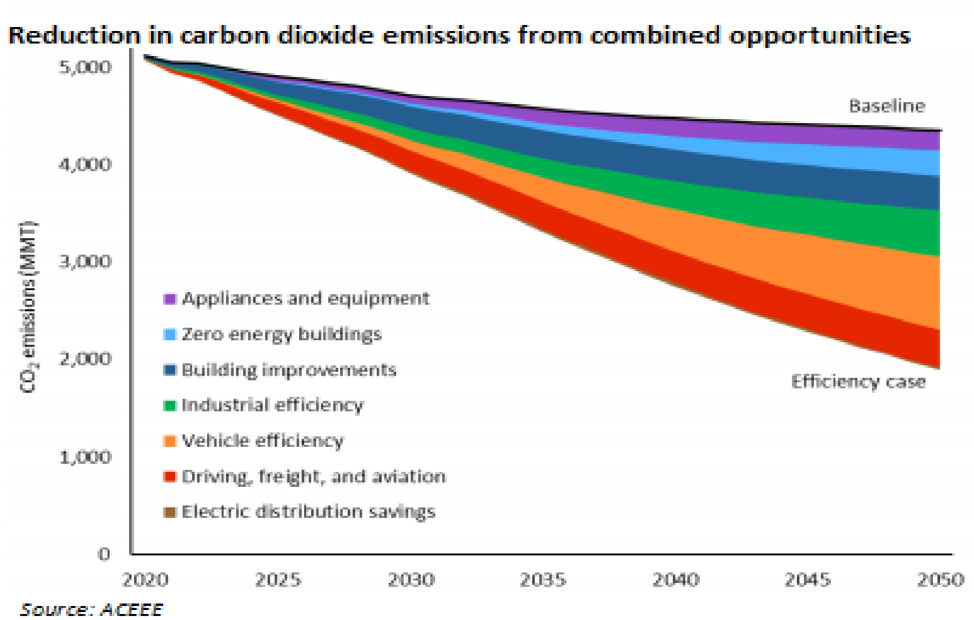
At the end of the day, it appears that the fallout from the pandemic is creating multiple challenges for the renewables sector, just as it is for the oil and natural gas sector. Interestingly, a recent press release by the World Meteorological Organization in November suggested that despite the massive global lockdowns related to COVID-19, preliminary estimates suggest annual global emissions have only fallen between 4.2% and 7.5%. An emissions reduction of this global scale would not cause atmospheric CO2 to go down, but rather go up at a slightly reduced pace (0.08-0.23 ppm per year lower). This falls within the 1 ppm natural inter-annual variability (meaning COVID-19 impacts cannot be distinguished from natural variability).

$50 trillion in spending required by 2050 to meet the Paris Agreement goal of curbing global warming. According to a report put out by Morgan Stanley in late 2019, the world needs to spend **$50 trillion** on five areas of technology by 2050 to meet the Paris Agreement's goals. [37] To reduce net emissions of carbon to zero, the world would have to eradicate the equivalent of 53.5 billion metric tonnes of carbon dioxide per year. According to the report, which identified renewable energy, electric vehicles, hydrogen, carbon capture and storage and biofuels as the key technologies that could help meet that target. The projected breakdown in spending among those key technology areas is as follows.

- Renewable power generation – would require **$14 trillion** by 2050, including investments in energy storage. Renewables would need to deliver about 80% of global power by then, up from less than 40% today, meaning an additional 11,000 GW of capacity (excluding hydro). Solar's rapid cost decline will make it the fastest growing renewable technology over the next decade (~13% CAGR).
- Electric vehicles – passenger cars currently represent about 7% of greenhouse gas emissions, which to offset would require approximately **$11 trillion** of investment needed to build factories, expand power capacity and develop batteries and infrastructure needed to switch to EVs. With increased investment, annual EV sales could grow from 1.3 million units in 2018 to 23.2 million in 2030, lifting the total number of EVs to 113 million by 2030 and 924 million by 2050.
- Carbon capture and storage – almost **$2.5 trillion** would be needed for technologies that capture carbon and store it. While it currently costs about $700 million to capture a million tonnes of carbon per year, the cost of building CCS plants is expected to drop 30% by 2050. With more than 200,000 MW of new coal-fired generation capacity under construction, CCS is the only option to offset the emissions of those plants per Morgan Stanley.
- Hydrogen – about **$5.4 trillion** in needed for electrolysers to make the gas, which can help provide clean fuel for power generation, industrial processes, vehicles and heating. In addition, **$13 trillion** would be required to increase renewable energy capacity to power the plants. Another **$1 trillion** would be needed for storage, with additional investment for transportation and distribution.
- Biofuels – almost **$2.7 trillion** should go into biofuels like ethanol, which are currently mixed with petroleum products but will spread eventually to areas such as aviation. About 4% of global transportation fuel is expected to come from biofuel in 2030. Ethanol, the most-used biofuel at the moment will grow at ~3%/year, while a type of biodiesel called hydrotreated vegetable oil will achieve much faster growth, quadrupling production by 2030.

As a reminder, the Paris Agreement set a goal to limit global warming to under 2 degrees Celsius by 2030. Set in 2016, the report projected emissions were expected to reach 54-56 gigatonnes of carbon dioxide equivalent – far above the level of 42 needed to have a chance of limiting warming to 2 degrees this century. This lower level is what scientists suggest will reduce the likelihood of more-intense storms, longer droughts, sea-level rise and other severe climate impacts. Under the predicted 2030 emissions, the world would be on track for a temperature rise of 2.9 to 3.4 degrees Celsius.

Efficiency improvements through technology could help account for a meaningful amount of reduced emissions. Various reports out there estimate the efficiency gains could represent 30% to almost 50% of the targeted emissions reductions by 2050 if investment in technologies are made. A report by the American Council for an Energy-Efficient Economy (ACEEE) reports that energy efficiency could slash U.S. energy use and greenhouse gas emissions by about 50% by 2050. [38] That report suggests these efficiency gains could cut primary energy use by 49%, reduce CO_2 emissions by 57% and reduce total GHG emissions by 49%. The top saving opportunities by sector include: 1) efficient and electric vehicles, 2) industrial efficiency and decarbonization, 3) transportation system efficiency, 4) upgrades to existing buildings and homes, 5) zero energy new buildings and homes, and 6) efficient appliances and equipment.



A different report by Sustainability Ventures Group demonstrates $1.5 trillion of cost savings could be achieved through improved efficiencies in the oil & gas and process manufacturing industries alone. [39] Other key areas noted for efficiency gains estimate include grid optimization, advanced material and thermal efficiencies and broader digital transformation. We believe that efficiency improvements within what we already have represent the "low hanging fruit" of sustainability improvements.

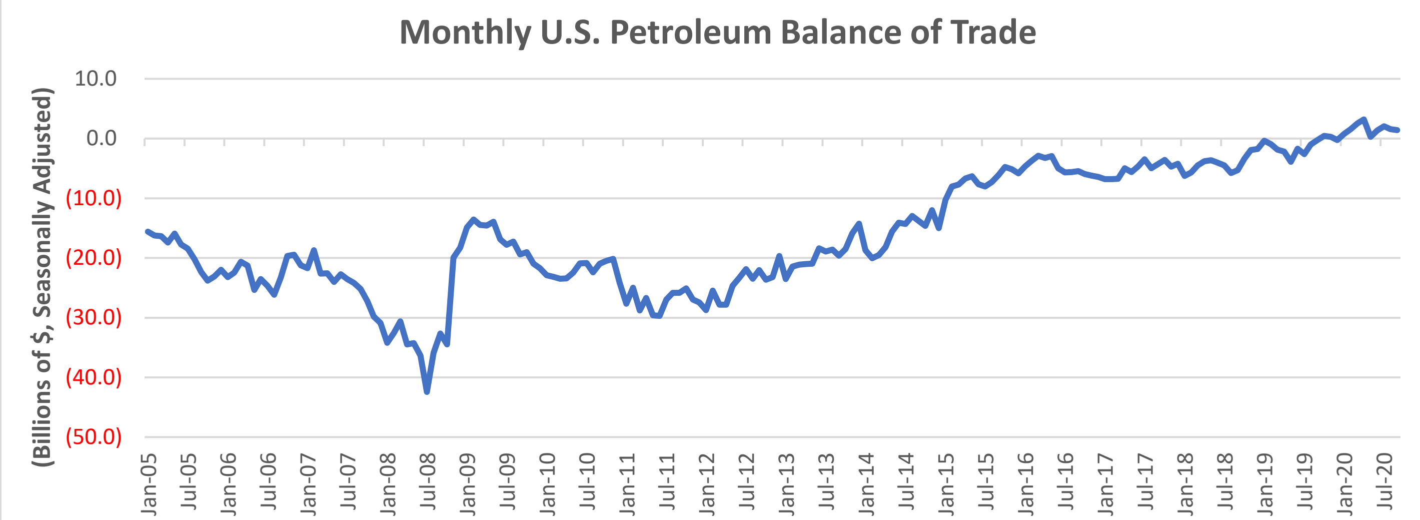
ELECTION OUTCOME CONSEQUENCES

Will a Biden win enable a ban on domestic fracking? Elimination of oil and gas? During his campaign, Joe Biden repeatedly suggested the first step he would take towards the oil and gas industry is to ban fracking on Federal lands. This accounts for roughly 10% of the U.S. industry. More importantly, ~65% of oil and gas production in New Mexico is from Federal acreage, including ~85% of well permits in 2020. [40]

Given the recent growth in oil supply out of the Permian, most notably the Delaware Basin that includes New Mexico, this would be problematic for the industry players that have invested billions of dollars there and prior to the impact of COVID-19, help drive domestic oil production growth. The state has witnessed its crude oil production grow from just over 400,000 Bpd in 2016 to over 1 MMBpd thus far in 2020, representing nearly 9% of current U.S. oil production. In response to the risk that Biden wins and follows through on a fracking ban, companies operating in New Mexico (and likely elsewhere) have been proactively securing months and even years, worth of drilling permits ahead of the election. For reference, nearly 40% of New Mexico's budget is funded by oil and natural gas production. [41].

Although only a small portion of current activity falls on Federal lands that would be subject to a fracking ban from the Federal government, one must wonder if this would spread to states with Democratic/liberal leadership and ultimately have a wider impact. As a reference, currently 85-90% of all drilling in the U.S. is done horizontally, which involves fracking. Shutting down modern completion techniques that include fracking would be highly detrimental to overall U.S. oil and natural gas supply over time.

If fracking is banned, where does supply come from to feed 280 million ICE automobiles in the US? What happens to the trade deficit? Under the pretense of a potential fracking ban, or worse – an attempt to shut down the oil and gas industry – how would the U.S. supply enough gasoline and diesel to keep the nearly 280 million passenger vehicles and trucks on the road? The U.S. oil and gas industry has fought hard over multiple decades to end reliance on Middle Eastern oil. As we highlight later, this has paid dividends allowing the U.S. to recently become a net energy exporter. Impairing the industry would only reverse this achievement and reverse the positive momentum on the petroleum balance of trade as shown below [58]



Source: U.S. Census Bureau

The U.S. Chamber of Commerce's Global Energy Institute found that a fracking ban would double gasoline prices as oil prices spike to $130/bbl, raise the average cost of living by $5,661 per person, and reduce employment by 19 million people over a five-year period. It would also quadruple electricity prices, reduce GDP by $7.1 trillion and increase natural gas prices by 324 percent from 2021 to 2025, causing household energy bills to more than quadruple. [43]

Green New Deal – would clearly accelerate plans for the energy transition, likely at a huge cost. The Green New Deal proposed by Rep. Alexandria Ocasio-Cortez from New York has been widely discussed since its release. Aside from some of the crazy parts of the proposal (such as the elimination of "farting cows" and air travel), the price tag for the plan is astronomical. According to a study co-authored by the former director of the nonpartisan Congressional Budget Office, this plan could cost as much as $93 trillion, or approximately $600,000 per household. [44] It would clearly be very expensive, further expand the federal government's role in some of the most basic decisions of daily life, and likely have a more lasting and damaging impact aside from its enormous price tag. Among the impacts the study found that electricity costs, optimistically, could be expected to increase by 22% and that "with an average monthly electric bill in 2017 of $117, the average household could expect around $295 of increase annual expenditures on electricity.

According to a September 2019 article in Forbes, achieving net-zero carbon dioxide emissions globally by 2050 would require the deployment of >1 mtoe of carbon free energy consumptions (~12,000 mtoe/11,051 days) every day, starting the day after the article was written and continuing for 30+ years. [45] Achieving this net-zero would also require the decommissioning of more than 1 mtoe of energy consumption from fossil fuels every single day. The author goes on to note that anticipated increases in energy consumption in the coming decades is another important factor – citing the IEA that projects global energy consumption will increase by about 1.25% annually to 2040. That rate of increase would drive another ~5,800 mtoe of energy consumption by 2050, or 0.5 of an mtoe per day to 2050. This would bring the total needed deployment level to achieve net-zero emissions to about 1.6 mtoe per day to 2050.

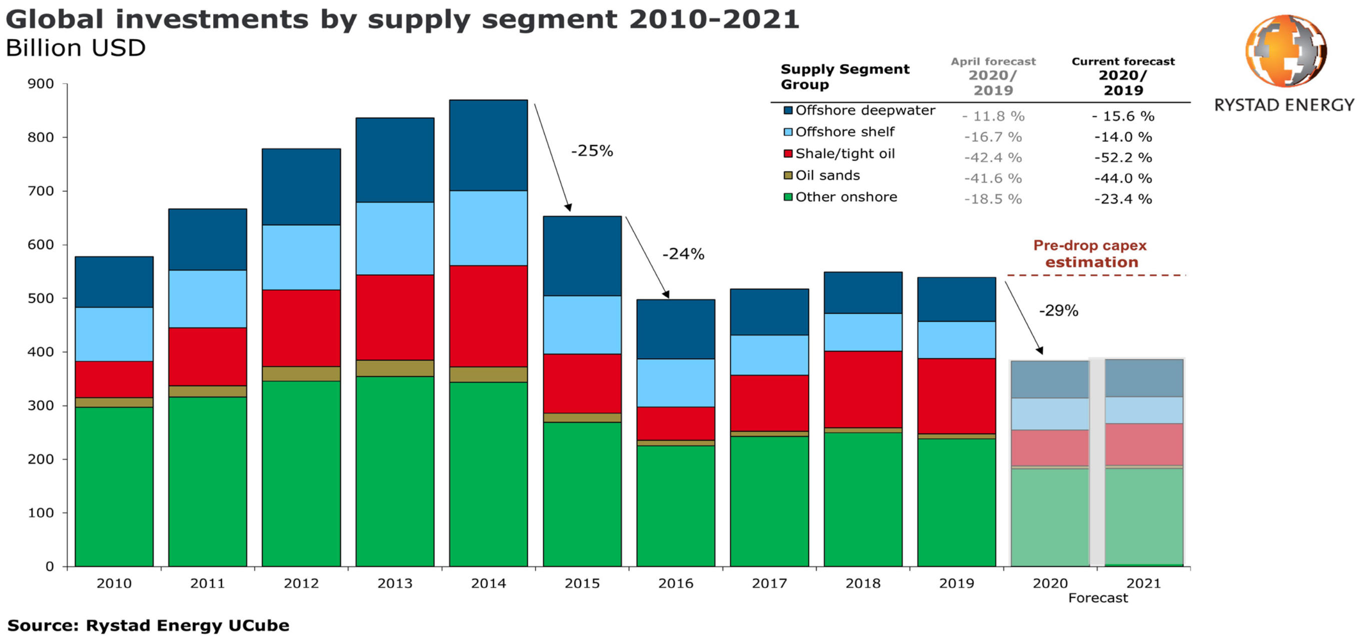
Breaking down an mtoe of energy into something more comprehensible, the Forbes article notes the Turkey Point Nuclear Generating Station in Homestead, Florida generates approximately 1 mtoe of energy over the course of a year. **In simple math terms, to achieve net-zero carbon dioxide emissions by 2050, the world would need to deploy three Turkey Point nuclear plants worth of energy every two days, all the way to 2050. At the same time, a Turkey Point nuclear plant worth of fossil fuels would need to be decommissioned every day to 2050.** Alternatively, net-zero carbon dioxide by 2050 would require the deployment of ~1500 wind turbines (2.5 MW) over ~300 square miles, every day to 2050. This analysis simply looks at scale and ignores the significant complexities of actually deploying such technologies or that fossil fuels are the basis more many products central to the global economy (as we noted earlier).

CONCLUSION

Cash flows matter! Through all the ups and downs that the energy sector and its investors have endured, we believe that companies with strong cash flow generating abilities, quality assets, and low leverage remain attractive investments. We believe those remaining investors that can fill the voids left in the energy capital markets going forward will be in a position for solid returns. Energy investing has become increasingly selective and we think the focus should remain on private markets and businesses such as: 1) pipelines/energy infrastructure that are essential to operations and not easily replicated, 2) quality minerals investments, with a focus on PDPs and cash flow visibility, 3) private credit or even structured equity that fills the void left by the departure of banks and other investors and allows for better structures and higher returns.

Be prepared for surprises! Unlike the period from 2001-2008 and again from 2009-2014, it's difficult to invest in energy with an "up and to the right" strategy where the tide will lift all boats. We clearly expect investors to have some sort of macro view, but one must make investments with strong consideration to downside risk. In other words, prepare for the unexpected. Remember after the November 2014 OPEC decision to keep pumping oil that ultimately took oil prices down below $30/bbl, while most E&P companies weren't running "doomsday scenarios" with anything below $50/bbl and were caught by surprise. Long range forecasts for commodity prices are often wrong. After the Asian contagion in the late 1990s, the super majors were planning on sub-$20/bbl oil as the new normal. Then after recovering from the 2008-2009 recession after oil prices rose back over $100/bbl (following the spike to $140/bbl in 2008), investors and energy companies alike thought $100/bbl oil was the new normal. Finally, after the 2015/2016 event and now especially after the impact of COVID on global economies, investors probably expect $40/bbl oil to be the new normal. It likely isn't, but we must invest as if it is.

The collapse in global upstream capital spending sets up for a bullish recovery as demand recovers over the next 3-5 years. Precisely timing a recovery is a difficult task, but given a long enough timeframe makes it somewhat more possible. Since the pandemic hit, not only has energy demand collapsed, but so too has upstream capex which over time will drive production lower. As previously noted, the folks at Rystad Energy project 2020 global capex to fall by nearly 30% to under $400 billion, [1] holding steady in 2021. This falls well below the IEA's estimated $1 trillion/year pace necessary to replace oil and natural production to depletion (for its 2040 target). This is likely to be especially acute in the short-cycle shale/tight oil arena that has been responsible for much of the production growth in recent years as spending there is expected to fall by more than 50% in 2020. Thus, we expect that as demand returns and non-OPEC+ production falls, the set up for a recovery is present.



Energy transition will continue to occur and involves the use of fossil fuel energy. Despite the headlines of 100% of energy needs being met by renewable energy sources, we do not think that is a reality based in science or economics. Clearly, the growth rate of renewable energy sources such as solar and wind will far exceed that of fossil fuels going forward and relative costs have improved dramatically, albeit working from a much smaller base. However, the notion of satisfying all of the world's energy needs from such sources ignores the financial reality that costs would rise dramatically past a certain level of renewables contribution. As a result, we believe fossil fuels – most notably natural gas – will continue to be important to the future energy needs of the world. This especially rings true in as nearly 900 million people still don't have access to energy today and the world population is expected to grow by ~30% over the next three decades, with the middle class expected to double over the next decade. A focus on improving energy efficiencies within the fossil space will be equally important to hitting the climate sustainability goals over that timeframe.

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Glossary

Alerian MLP Total Return Index (AMZX): Index that tracks the Master Limited Partnership/Midstream energy sector.

Barrel (Bbl): Crude oil is typically measured in barrels or variations of barrels – thousands (M), millions (MM) or billions (B). One barrel of crude oil is defined as 42 U.S. gallons.

Barrels per day (BPD): BPD is a daily measure of the number of crude oil barrels (including equivalents) produced. In can be represented in absolute barrels, or in variations - thousands (M), millions (MM) or billions (B).

Biomass energy: Biomass is a modern name for the ancient technology of burning plant or animal material for energy production (electricity or heat), or in various industrial processes as raw substance for a range of products. It can be purposely grown energy crops (e.g. miscanthus, switchgrass), wood or forest residues, waste from food crops (wheat straw, bagasse), horticulture (yard waste), food processing (corn cobs), animal farming (manure, rich in nitrogen and phosphorus), or human waste from sewage plants.

Bloomberg Barclays High Yield Energy Index: a subset of the Bloomberg Barclays U.S. High Yield Index consisting of issuers that are identified as being in the energy sector.

Capex: Capital expenditures (Capex) are funds used by a company to acquire, upgrade, and maintain physical assets such as property, plants, buildings, technology, or equipment. Capex is often used to undertake new projects or investments by a company. In the context of this document, we often refer to capex as an investment made in extracting oil and natural gas resources.

Carbon Dioxide (CO_2): a colorless, odorless, incombustible gas, CO_2, present in the atmosphere and formed during respiration, usually obtained from coal, coke, or natural gas by combustion, from carbohydrates by fermentation, by reaction of acid with limestone or other carbonates, or naturally from springs: used extensively in industry as dry ice, or carbon dioxide snow, in carbonated beverages, fire extinguishers, etc.

Climate change: Climate change includes both the global warming driven by human emissions of greenhouse gases, and the resulting large-scale shifts in weather patterns.

COVID-19: COVID-19, COVID or pandemic for the purposes of this document refer to a mild to severe respiratory illness that is caused by a coronavirus (Severe acute respiratory syndrome coronavirus 2 of the genus Betacoronavirus), is transmitted chiefly by contact with infectious material (such as respiratory droplets) or with objects or surfaces contaminated by the causative virus, and is characterized especially by fever, cough, and shortness of breath and may progress to pneumonia and respiratory failure.

Depletion: Depletion, as it relates to oil or natural gas, is the decline in production of a well, field, or geographic area. The Hubbert peak theory makes predictions of production rates based on prior discovery rates and anticipated production rates. Hubbert curves predict that the production curves of non-renewing resources approximate a bell curve. Thus, according to this theory, when the peak of production is passed, production rates enter an irreversible decline.

EIA: The U.S. Energy Information Administration (EIA) is a principal agency of the U.S. Federal Statistical System responsible for collecting, analyzing, and disseminating energy information to promote sound policymaking, efficient markets, and public understanding of energy and its interaction with the economy and the environment. EIA programs cover data on coal, petroleum, natural gas, electric, renewable and nuclear energy. EIA is part of the U.S. Department of Energy.

Environmental, Social and Corporate Governance (ESG): Environmental, Social, and Corporate Governance refers to the three central factors in measuring the sustainability and societal impact of an investment in a company or business. These criteria help to better determine the future financial performance of companies (return and risk).

Electric Vehicles (EVs): An EV is a vehicle that uses one or more electric motors or traction motors for propulsion. An electric vehicle may be powered through a collector system by electricity from off-vehicle sources, or may be self-contained with a battery, solar panels, fuel cells or an electric generator to convert fuel to electricity. EVs include, but are not limited to, road and rail vehicles, surface and underwater vessels, electric aircraft and electric spacecraft.

Federal Energy Regulatory Commission (FERC): The Federal Energy Regulatory Commission is the United States federal agency that regulates the transmission and wholesale sale of electricity and natural gas in interstate commerce and regulates the transportation of oil by pipeline in interstate commerce. FERC also reviews proposals to build interstate natural gas pipelines, natural gas storage projects, and liquefied natural gas (LNG) terminals, in addition to licensing non-federal hydropower projects.

Fossil fuels: A fossil fuel is a fuel formed by natural processes, such as anaerobic decomposition of buried dead organisms, containing organic molecules originating in ancient photosynthesis that release energy in combustion. Such organisms and their resulting fossil fuels typically have an age of millions of years, and sometimes more than 650 million years. Fossil fuels contain high percentages of carbon and include petroleum, coal, and natural gas. Commonly used derivatives of fossil fuels include kerosene and propane. Fossil fuels range from volatile materials with low carbon-to-hydrogen ratios (like methane), to liquids (like petroleum), to nonvolatile materials composed of almost pure carbon, like anthracite coal.

Geothermal energy: Geothermal energy is the thermal energy generated and stored in the Earth. Thermal energy is the energy that determines the temperature of matter. The geothermal energy of the Earth's crust originates from the original formation of the planet and from radioactive decay of materials.

Greenhouse Gases (GHG): A GHG is any of various gaseous compounds (such as carbon dioxide or methane) that absorb infrared radiation, trap heat in the atmosphere, and contribute to the greenhouse effect.

Hydrocarbon: An organic compound (such as acetylene or butane) containing only carbon and hydrogen and often occurring in petroleum, natural gas, coal, and bitumens.

Hydroelectric power: Hydroelectric power (aka hydro) , also called hydropower, electricity produced from generators driven by turbines that convert the potential energy of falling or fast-flowing water into mechanical energy. In the early 21st century, hydroelectric power was the most widely utilized form of renewable energy; in 2019 it accounted for more than 18 percent of the world's total power generation capacity.

Internal Combustion Engine (ICE): An internal combustion engine (ICE) is a heat engine in which the combustion of a fuel occurs with an oxidizer (usually air) in a combustion chamber that is an integral part of the working fluid flow circuit. In an internal combustion engine, the expansion of the high-temperature and high-pressure gases produced by combustion applies direct force to some component of the engine. The force is applied typically to pistons, turbine blades, rotor or a nozzle. This force moves the component over a distance, transforming chemical energy into useful work.

International Energy Agency (IEA): The IEA is a Paris-based autonomous intergovernmental organization established in the framework of the Organization for Economic Co-operation and Development (OECD) in 1974 in the wake of the 1973 oil crisis. The IEA was initially dedicated to responding to physical disruptions in the supply of oil, as well as serving as an information source on statistics about the international oil market and other energy sectors.

International Monetary Fund (IMF): The IMF is an international organization, headquartered in Washington, D.C., consisting of 190 countries working to foster global monetary cooperation, secure financial stability, facilitate international trade, promote high employment and sustainable economic growth, and reduce poverty around the world while periodically depending on the World Bank for its resources. Formed in 1944 at the Bretton Woods Conference primarily by the ideas of Harry Dexter White and John Maynard Keynes, it came into formal existence in 1945 with 29 member countries and the goal of reconstructing the international payment system. It now plays a central role in the management of balance of payments difficulties and international financial crises. Countries contribute funds to a pool through a quota system from which countries experiencing balance of payments problems can borrow money.

Liquified Natural Gas (LNG): Liquefied natural gas (LNG) is natural gas (predominantly methane, CH4, with some mixture of ethane, C2H6) that has been cooled down to liquid form for ease and safety of non-pressurized storage or transport. It takes up about 1/600th the volume of natural gas in the gaseous state (at standard conditions for temperature and pressure). It is odorless, colorless, non-toxic and non-corrosive.
OPEC: Organization of Petroleum Exporting Nations is an intergovernmental organization of 13 nations. Founded on 14 September 1960 in Baghdad by the first five members (Iran, Iraq, Kuwait, Saudi Arabia, and Venezuela), it has since 1965 been headquartered in Vienna, Austria, although Austria is not an OPEC member state. As of September 2018, the 13 member countries accounted for an estimated 44 percent of global oil production and 81.5 percent of the world's "proven" oil reserves, giving OPEC a major influence on global oil prices that were previously determined by the so-called "Seven Sisters" grouping of multinational oil companies. A larger group called OPEC+ was formed in late 2016, to have more control on global crude oil market.

Proved Developed Producing (PDP): PDP means those Oil and Gas Properties designated as proved developed producing (in accordance with the Definitions for Oil and Gas Reserves approved by the Board of Directors of the Society of Petroleum Engineers, Inc. from time to time) in the Reserve Report.

Photovoltaics (PV): PV) is the conversion of light into electricity using semiconducting materials that exhibit the photovoltaic effect, a phenomenon studied in physics, photochemistry, and electrochemistry. PV has become the cheapest source of electrical power in regions with a high solar potential,

Renewables: Short for renewable energy. Renewable energy is energy that is collected from renewable resources, which are naturally replenished on a human timescale, including carbon neutral sources like sunlight, wind, rain, tides, waves, and geothermal heat. The term often also encompasses biomass as well, whose carbon neutral status is under debate.

Renewable Portfolio Standard (RPS): A renewable portfolio standard (RPS) is a regulation that requires the increased production of energy from renewable energy sources, such as wind, solar, biomass, and geothermal. Other common names for the same concept include Renewable Electricity Standard (RES) at the United States federal level and Renewables Obligation in the UK. It is often represented with a number after RPS, such as 30, 50 or 100 – each representing the percentage of energy derived from renewable sources of energy.

S&P 500: a market capitalization weighted index of 500 of the larges U.S. companies, designed to measure broad U.S. equity performance.

S&P GSCI: A composite index of commodities that seeks to measure the performance of the commodity market.

Solar energy: Solar energy is radiant light and heat from the Sun that is harnessed using a range of ever-evolving technologies such as solar heating, photovoltaics (PV), solar thermal energy, solar architecture, molten salt power plants and artificial photosynthesis.

SPDR S&P Oil & Gas Exploration & Production ETF (XOP): Seeks to provide investment results that, before fees and expenses, correspond generally to the total return performance of an index derived from the oil and gas exploration and production segment of a U.S. total market composite index.

Unconventional resources: Unconventional oil or gas resources are much more difficult to extract relative to conventional resources. Some of these resources are trapped in reservoirs with poor permeability and porosity, meaning that it is extremely difficult or impossible for oil or natural gas to flow through the pores and into a standard well.[4] To be able to produce from these difficult reservoirs, specialized techniques and tools are used. For example, the extraction of shale oil, tight gas, and shale gas must include a hydraulic fracturing step in order to create cracks for the oil or gas to flow through.

VanEck Vectors Oil Services ETF (OIH): Seeks to replicate, before fees and expenses, the price and yield performance of the MVISA US Listed Oil Services 25 Index.

Wind energy: Wind power or wind energy is the use of wind to provide mechanical power through wind turbines to turn electric generators for electrical power. Wind power is a popular sustainable, renewable source of energy. Wind farms consist of many individual wind turbines, which are connected to the electric power transmission network.

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