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It's Not Easy Being Green—The Future of Fossil Fuels

Advancements in electric cars, solar panels, wind farms, battery storage, and other green technologies recently have impressed. Will these technologies bring the end of oil and fossil fuel use in our lifetimes?

DEEPER ANALYSIS OF INVESTMENT TRENDS AND TOPICS

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Key Insights

- *Our lives revolve around energy—80% of it is generated by fossil fuels today.*
- *The future is renewables and green technology, and progress has been made.*
- *Fossil fuel use, however, is not going away anytime soon. It takes energy to create energy, and green technologies often require fossil fuel use too. Emerging market energy use also continues to march higher.*
- *By 2050, the planet's dominant fuel source is still likely to be fossil fuels.*

"It is well to remember that the entire population of the universe, with one trifling exception, is composed of others." —Andrew J. Holmes

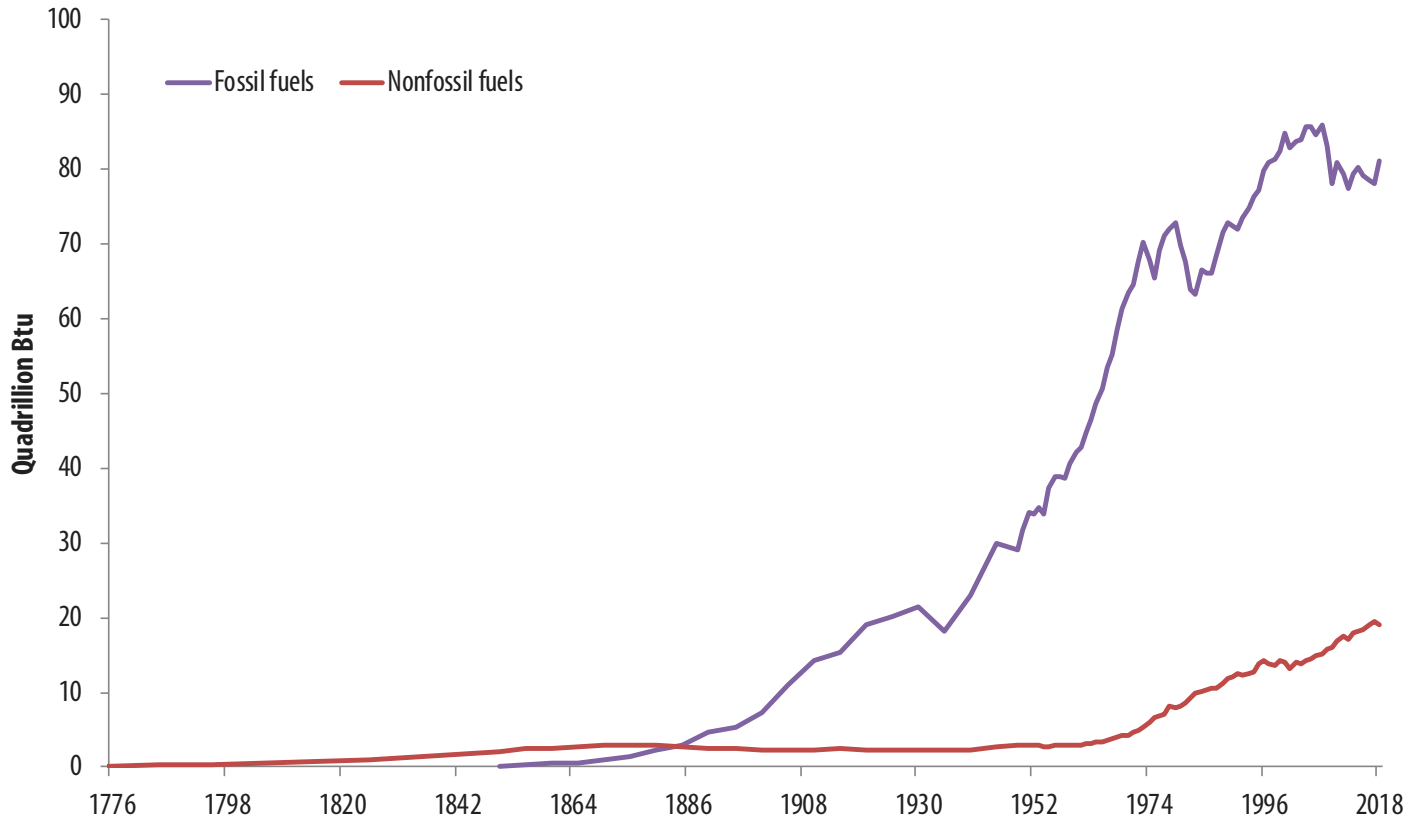
Oil literally permeates our lives. Take a close look at the room you are in right now. Oil is everywhere. It powers the lights in our homes and offices. Those shoes that you're wearing—what do you think they are made of, and how did they travel to you? Yep—oil. Oil is used to create the plastic in your computer screen, to bond the paint on your walls, and to help weave the carpet at your feet. Oil can be used to dry clean our clothing, to dig up the gold for our wedding bands, and to process the gel in our hair. The list is nearly endless. Try and point to something in your home that was not transported by or created using oil.

Most do not understand how pervasive oil really is. Be honest—until you read the paragraph above, had you thought about oil in those terms—that it is everywhere, and involved in nearly everything you do? Yet, daily, we hear from investors that the end of oil is near. "The future is here," we hear, "electric cars, solar panels, and wind farms will soon kill fossil fuel use." Our answer: Don't hold your breath. When that day comes, if it does, chances are that no one reading this will be around for it. Fossil fuel use will almost certainly live longer than any of us.

Our energy reality is this: Our lives revolve around energy use, and lots of it. Fossil fuels generate 80% of that energy (see purple line, Chart 1). While reducing this to zero is an admirable goal, it is not happening in your lifetime. By 2050, we figure that a best-case scenario is that energy generation by fossil fuels could drop from 80% to 50% (the best case). In fact, on our way to 2050, total fossil fuel use likely will rise (just not as fast as renewables). We'll show you this chart on page 13.

Today, we're going to talk about the realities of energy use—past, present, and future. Great progress has been made in reducing greenhouse gas emissions over the past decade, thanks to the tenacity of the green movement, $100 oil prices, some tax breaks, Millennials, and Al Gore's "An Inconvenient Truth" documentary—whose impact cannot be overstated.[1] With that said, we find that there are a number of ugly energy realities remaining, which need to be discussed. The future isn't all green. Let's begin by reviewing how we got into this energy mess.

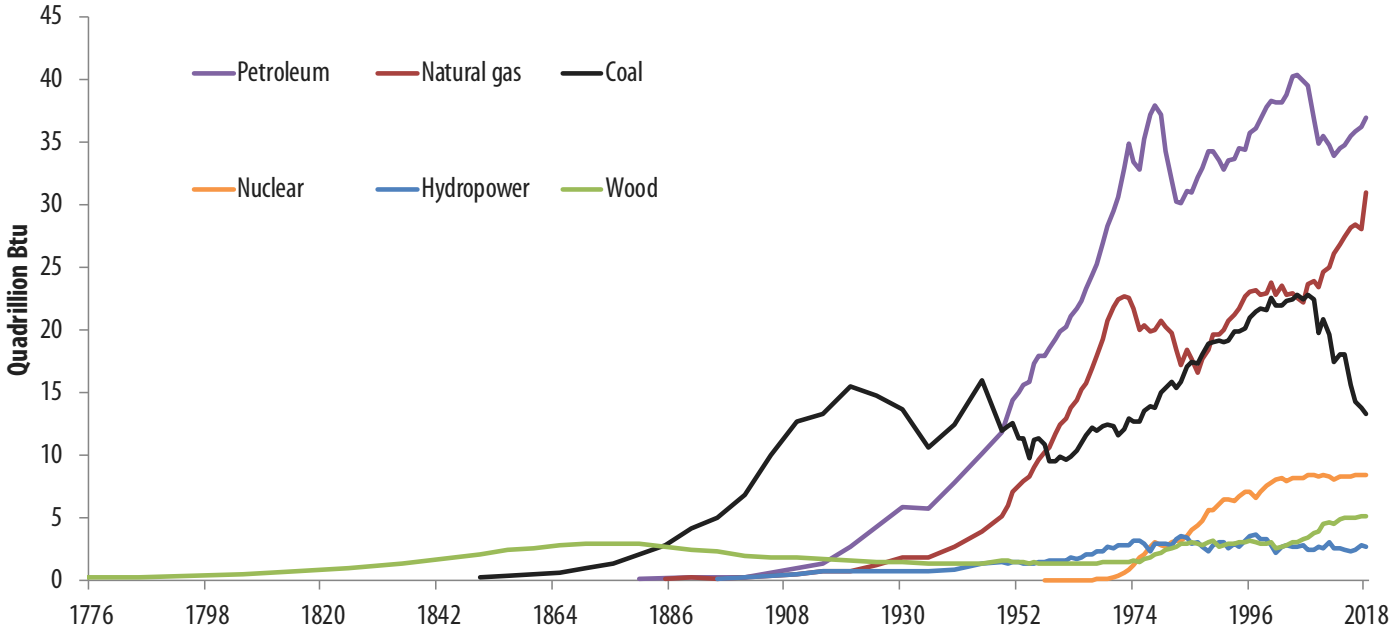
Chart 1. U.S. energy consumption: fossil fuels versus nonfossil fuels



Sources: U.S. Energy Information Administration (EIA), Wells Fargo Investment Institute. Yearly data: 1776-2018. Fossil fuels include coal, natural gas, and petroleum and other liquids. A *British thermal unit* (Btu) is a measure of the heat content of fuels or energy sources. It is the quantity of heat required to raise the temperature of one pound of liquid water by 1 degree Fahrenheit at the temperature that water has its greatest density (approximately 39 degrees Fahrenheit).

[1] Paramount, May 24, 2006.

Chart 2. U.S. energy consumption by fuel

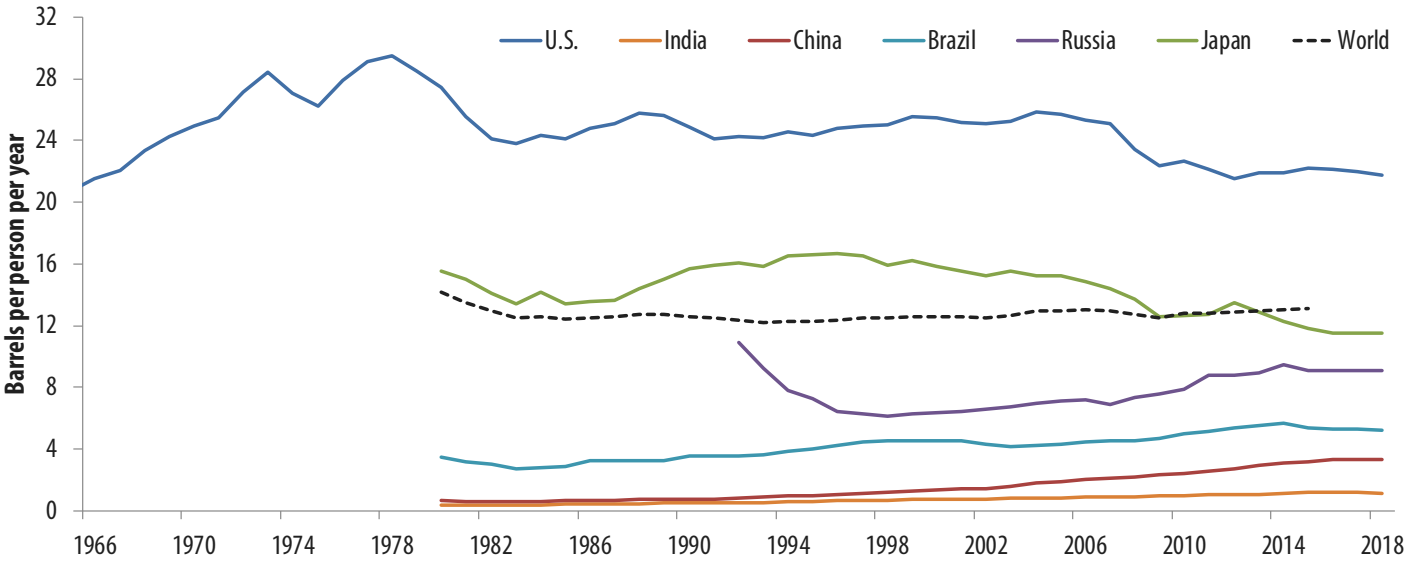


Sources: U.S. Energy Information Administration (EIA), Wells Fargo Investment Institute. Yearly data: 1776-2018.

The evolution of U.S. energy use

A world without fossil fuels, while hard to imagine, was not that long ago. Oil was found in the U.S. in 1859, in the small town of Titusville, PA. Up to that point in U.S. history, energy use was almost entirely renewable—wind, water, whale oil, tallow, wood (green line in Chart 2)—and so on. Chart 2 highlights U.S. energy consumption by fuel, since 1776. Notice that fossil fuels came onto the domestic scene in the 1850s, but they did not begin permeating our daily lives until the 1950s. Keep Chart 2 in mind as we discuss the future of energy. It is all a process. Fossil fuels entered our lives in a slow and staggered way. When the time comes, they likely will exit that way too.

Chart 3. Country oil consumption—per capita



Sources: Bloomberg, U.S. Energy Information Administration (EIA), U.S. Census Bureau, BP Statistical Review, Wells Fargo Investment Institute. Yearly data: 1966-2018.

As we fast forward to today, the U.S. now consumes more fossil fuels per citizen than any other country—by far. Take oil as an example. The dark blue line in Chart 3 shows that the average American consumes about 22 barrels of oil per year for driving, heating, etc. This is about twice the world average (black dashed line, Chart 3).

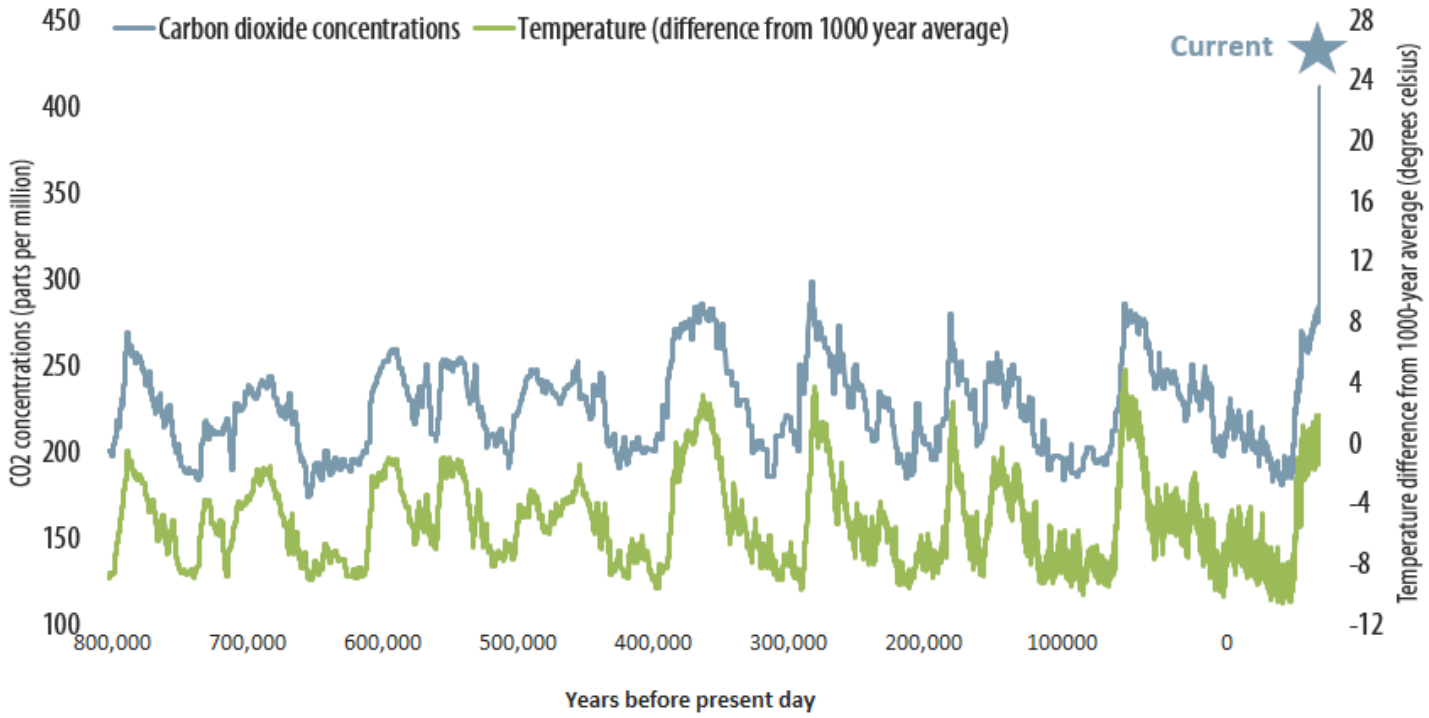
If you are sitting there aghast, wondering how the U.S. got itself into this over-consuming energy mess, just remember that it wasn't a mess in the beginning. Using fossil fuels was part of the grand plan. The U.S. would not be the superpower that it is today without the rise of coal and oil. Countries that didn't have access to fossil fuels in the 1800s and 1900s failed to industrialize. That often meant peasantry, poverty, limited education, and cottage industries. With the tailwind of fossil fuels, the likes of Commodore Vanderbilt (railroads) and John D. Rockefeller (oil), transformed the U.S. from what some might call a "backwater town" into a glowing city on the hill (relatively speaking, of course).

2006—The beginning of the end for fossil fuels?

During the early decades of the 20th century, fossil-fuel use largely went unchecked. The U.S. was growing, of course, and the political will to slow the fossil-fuel train was not particularly strong. That changed somewhat after the 1970s, as the U.S. introduced efficiency and emissions standards. This is why oil consumption per person in America has been dropping slowly (dark blue line, Chart 3). Even with increased efficiency, however, total U.S. fossil-fuel use continued to grow (see Chart 1). After all, the U.S. economy has grown, along with its population. The political will to stop the fossil-fuel train just wasn't there—and then Al Gore took the stage in 2006.

In May 2006, the rousing documentary film, "An Inconvenient Truth" was released.[2] Global warming and greenhouse gases instantly became household words. The film shows former Vice President Al Gore pacing back and forth on a stage, describing in great detail, with dramatic charts (such as Chart 4), that our planet was being destroyed by burning fossil fuels. His presentation, paraphrased, was: 1) burning fossil fuels releases carbon dioxide (CO_2) into the atmosphere; 2) CO_2 (greenhouse gas) clogs the atmosphere and traps heat; 3) the heat is "frying" our planet; and 4) stop releasing so much CO_2 into the atmosphere—or our planet is toast. Chart 4, a version of the one used in the film, shows the connection between high levels of CO_2 (blue line) and higher global temperatures (green line).

Chart 4. Carbon dioxide and the temperature of our planet



Sources: Earth System Research Laboratory, Wells Fargo Investment Institute, July 2019. Antarctic Ice Cores Study (Revised 800KYr CO2 Data): http://ncdc.noaa.gov/paleo/study/17975, July 18, 2019. Investigators: Bereiter, B.; Eggleston, S.; Schmitt, J.; Nehrbass-Ahles, C.; Stocker, T.F.; Fischer, H.; Kipfstuhl, S.; Chappellaz, J., Jouzel, J., et al, 2007. EPICA Dome C Ice Core 800KYr Deuterium Data and Temperature Estimates. IGBP pages/World Data Center for Paleoclimatology. Data Contribution Series # 2007-091. NOAA/NCDC Paleoclimatology Program, Boulder, CO.

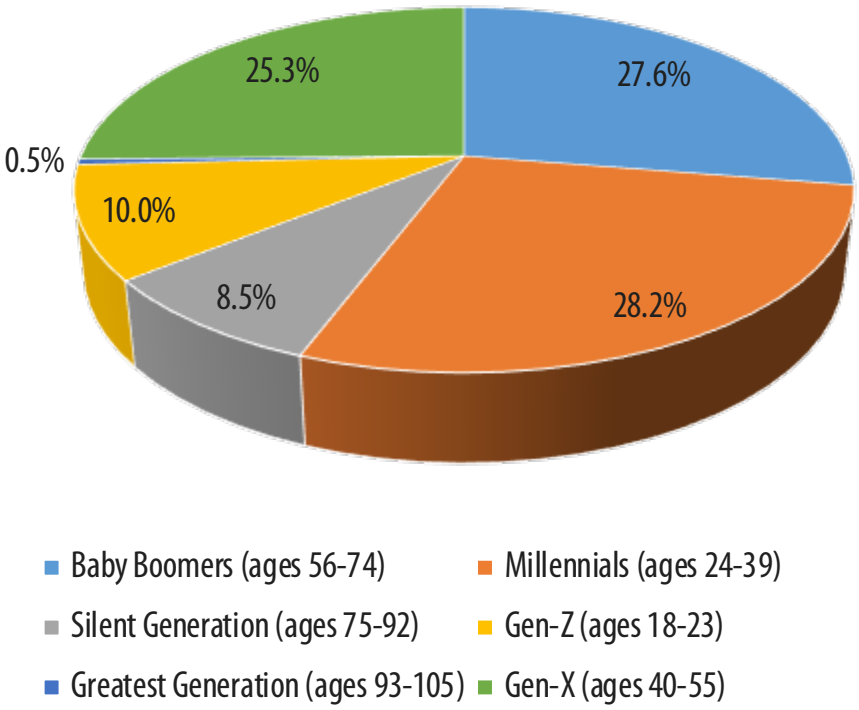
[2] Paramount, May 24, 2006.

Like it or not—and believe it or not—the documentary had a tremendous impact. It was released for maximum effect and produced by some of Hollywood's best. The same producer of "An Inconvenient Truth" also produced "Pulp Fiction," and "Good Will Hunting." The documentary won two Academy Awards, and Al Gore won the Nobel Peace Price, to thunderous applause.

The timing was right, too. It isn't like the green movement was new or that other environmental films had never been made. This one, though, hit at a time of rising demographics and rising oil prices. Millennials, who are now the largest and most environmentally conscious U.S. demographic group, were coming of age. At an average age of 18 in 2006, they started to vote and were ready to make their mark. Chart 5 shows that, by the 2020 election, Millennials will be a larger portion of the U.S. voting age population than any other demographic group today. Millennials also grew up in their teens watching oil prices spike from $10 in 1998 to $75 in 2006.

One interesting side note is that the fossil-fuel industry has been so successful, since the 1800s, that it was probably inevitable that it would sow the seeds of its own demise. One could say that Al Gore is one of those seeds. He attended Vanderbilt University on a Rockefeller Foundation scholarship.

Chart 5. Percent of voting age population by generation (2020)



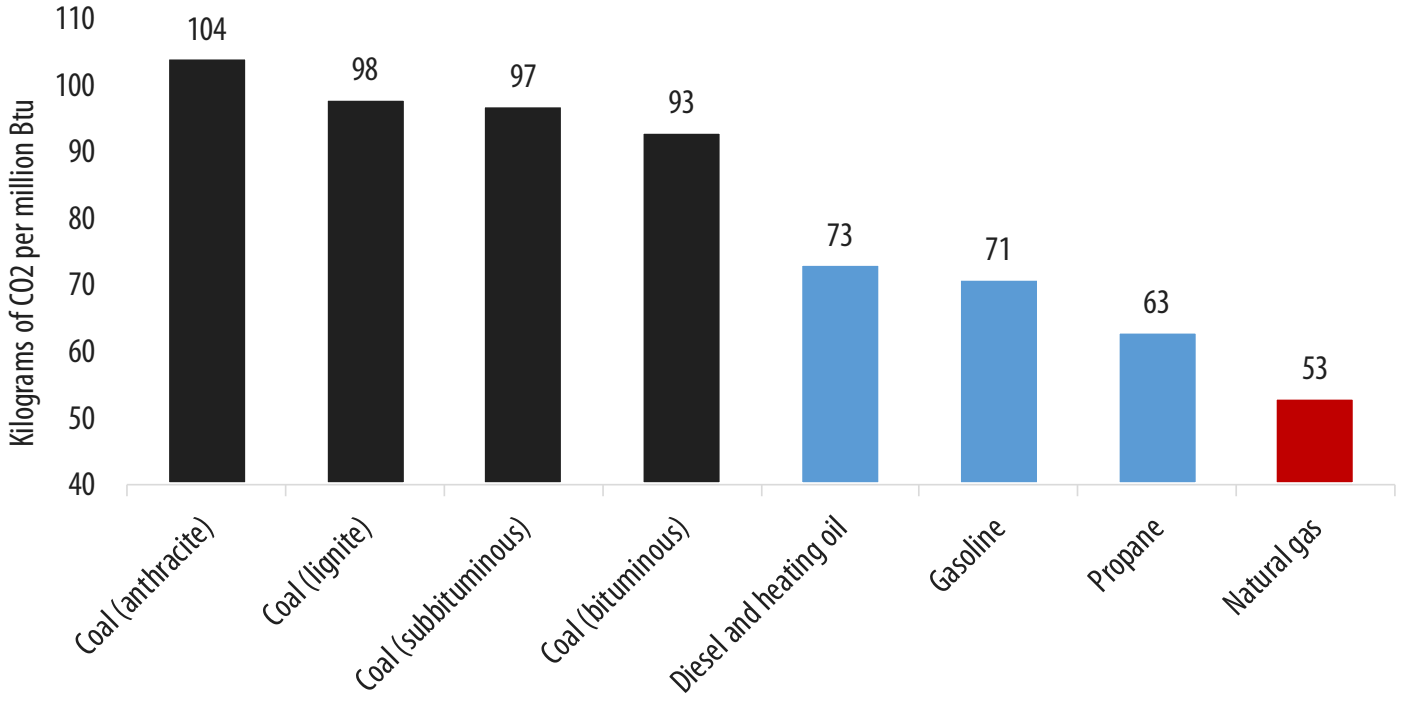
Sources: U.S. Census Bureau, Ned Davis Research Group, Wells Fargo Investment Institute, July 12, 2019.

Step 1 after Al Gore—Reduce greenhouse gas emissions

Reducing CO2 and other greenhouse gas emissions from fossil fuels was the immediate first step solution following Al Gore's global warming scare. With coal being the worst CO2 emmitter, it was an easy first target. Coal usage in the U.S. has dropped by 40%, since 2006.

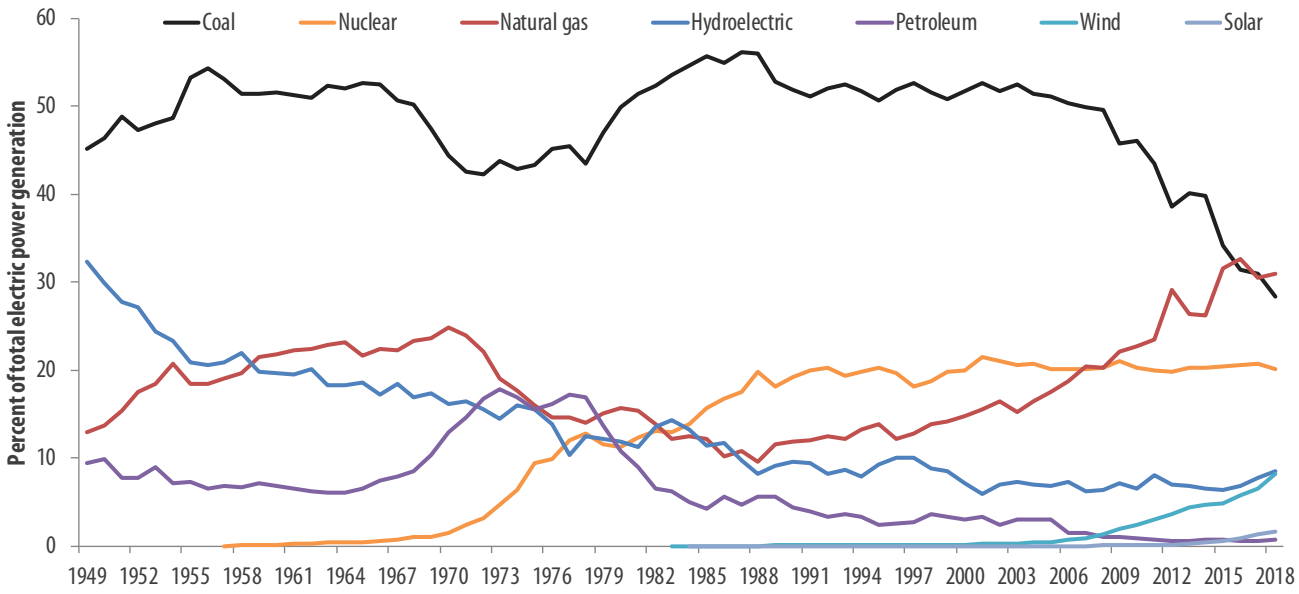
Coal is largely burned to generate electricity. With coal usage dropping by 40% since 2006, did the average American give up 40% of their electricity needs? Of course not. American's don't want their "go-go" lives interrupted, and politicians that want to get elected also don't want their plans to be disrupted. Many electric utilities switched to burning natural gas instead. Natural gas may be a fossil fuel, but it releases half the CO2 of coal, so the switch from coal to natural gas was a reasonable short-term compromise (see Chart 6). As expected, natural gas (red line, Chart 7) has since surpassed coal (black line, Chart 7) as U.S. electric utilities' burning fuel of choice.

Chart 6. Fossil fuel CO2 emitters



Sources: U.S. Energy Information Administration (EIA), Wells Fargo Investment Institute, July 12, 2019.

Chart 7. Electric power generation by energy source



Sources: U.S. Energy Information Administration (EIA), Wells Fargo Investment Institute. Yearly data: 1949-2018.

While the green movement would not likely consider burning one fossil fuel in exchange for another the ideal long-term solution, it has helped to reduce CO2 emissions in the electric utility sector (Chart 8, orange line). In essence, utilities are burning time as they wait for renewable fuel sources to grow up.

Chart 7 shows that the growth of renewables has been a slow grind. Yet, progress has been made. Wind has grown from less than 1% of electricity generation in 2006, to nearly 10% today (Chart 7, light blue line). Solar adoption has been frustratingly slow, but we are expecting that to change soon (Chart 7, grey line).

Why is it a slow grind for electric utilities to switch to renewables?

For one, the sun doesn't always shine, and the wind doesn't always blow. American consumers, especially, want and need a consistent electricity source. As someone who has lost power for days on end because of Florida hurricanes, I empathize with this plight. For consistent electricity generation, gas and coal will be needed for some time still—probably for decades. Fossil fuels have a massive advantage over renewables, precisely because they can be burned on demand.

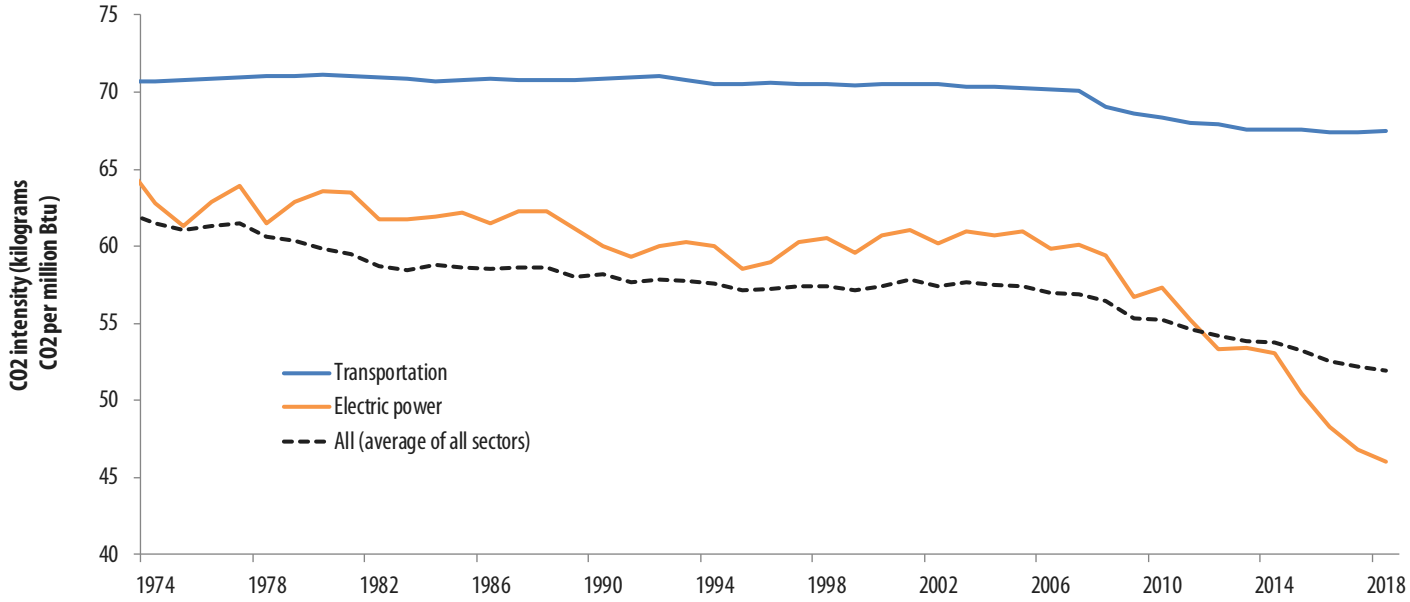
Second, the technology isn't there yet. Large-scale electricity storage is inefficient and expensive, and a good deal of electricity generated by renewables is lost. This is one of those areas, though, that does hold promise. Over the past few years, new lithium-ion batteries have been released that can hold up to 100 megawatts. And larger batteries are on the horizon—400-500 megawatt battery projects recently have been announced in Florida and Texas. This is an incredible technological leap, but we caution perspective here. These batteries aren't cheap, and 400 megawatts would power my hometown of Sarasota, Florida for less than a day.[3]

Third, the electrical grid in the United States is fragmented and old. Even when the U.S. does figure out how to store renewable energy in scale, that would help only the locations that generate the renewables, if the electrical grid isn't upgraded. Transmitting electricity to those areas that are not blessed with lots of wind and sun will require new transmission lines and huge capital investments.

Lastly, the move to renewables is as much a political challenge as it is a technological one. Americans like their go-go lifestyle, and few want to return to the pre-modern world. Politicians know this, and they know that billions of investment dollars are needed. The switch from fossil fuels to renewables is a process, and it is not an overnight fix.

[3] Based on FPL presentation, which showed its 409 megawatt project being able to power 329,000 homes for two hours and Sarasota having roughly 29,000 homes.

Chart 8. U.S. CO2 intensity by sector



Sources: U.S. Energy Information Administration (EIA), Wells Fargo Investment Institute. Yearly data: 1974-2018.

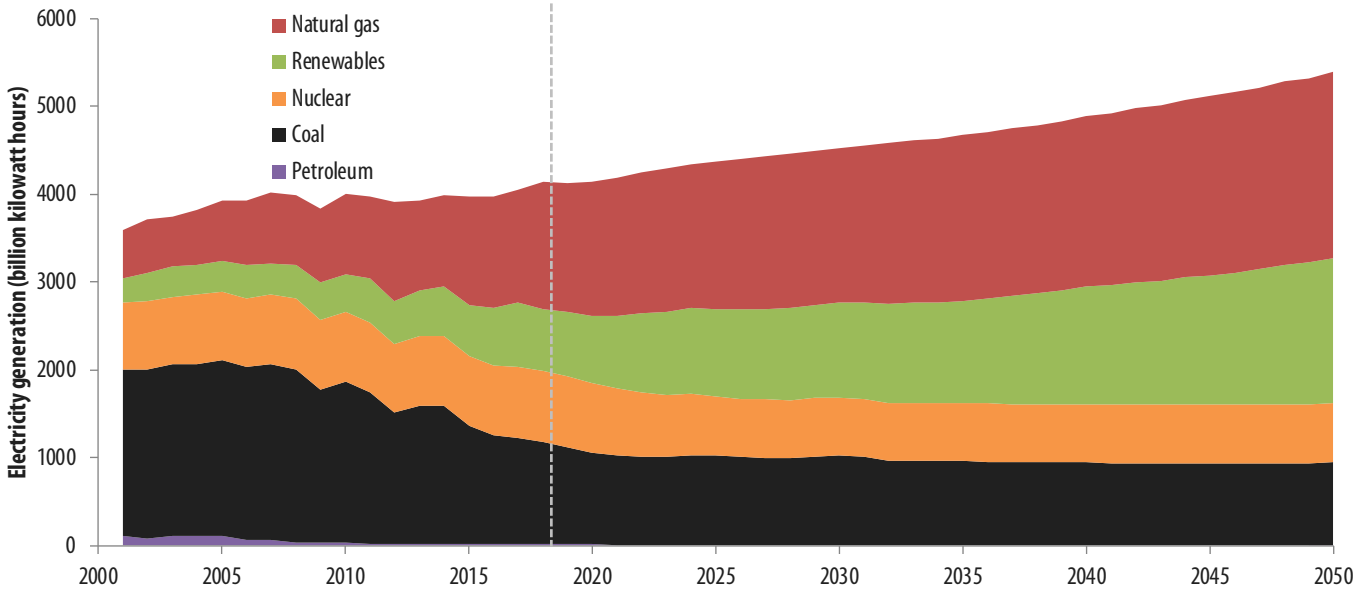
U.S. electricity's burning future—lots of fossil fuels

Our view of electricity's future is similar to that of the Energy Information Administration (EIA)—the United States' main energy information source. The EIA is projecting that U.S. electricity demand will rise 30% through 2050 (Chart 9). A 30% demand increase over 30 years should not shock you, but the fuel sources generating that electricity may. Chart 9 shows that renewables (green area) are the fastest growing fuel source for electricity, but they aren't the largest source. That designation goes to natural gas (red area).

By 2050, the EIA expects natural gas to account for 40% of U.S. electricity generation—and renewables, 30%.

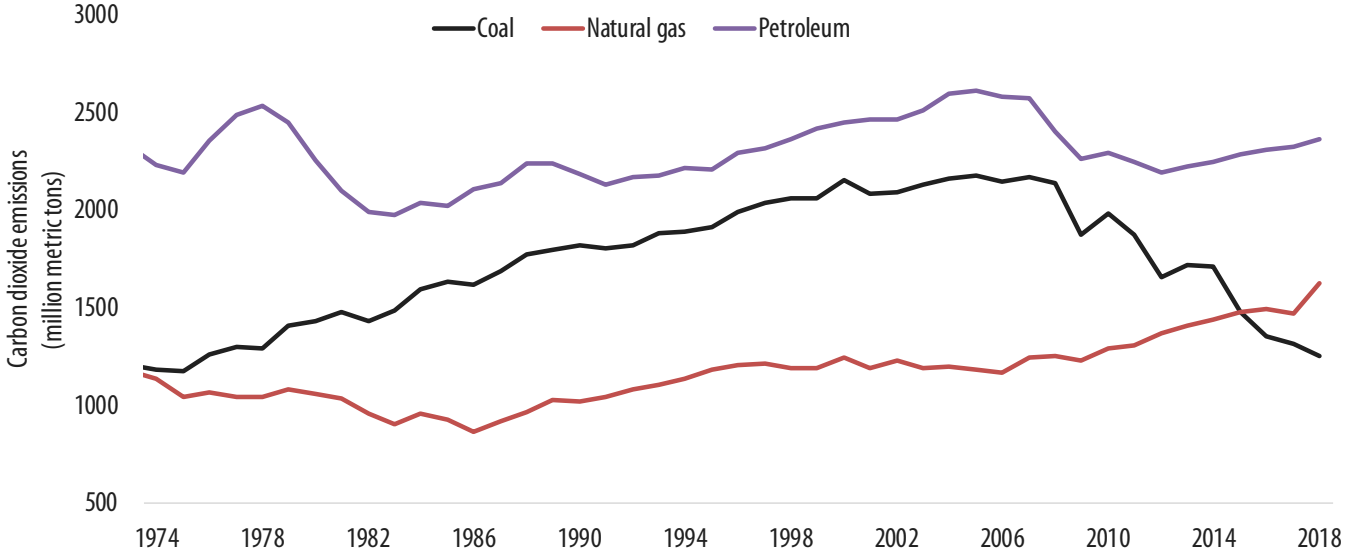
One of the hard realities to remember is that consumers want reliable, on-demand energy, and at this point in our energy evolution, that requires fossil fuels. Since natural gas releases less CO2 than other fossil fuels—while being abundant, cheap, and highly efficient (via natural-gas turbines)—it should continue to be electric utilities' fossil fuel of choice. Of course, should natural-gas prices stop being so cheap, it could accelerate the adoption of renewables.

Chart 9. Electric power generation by energy source



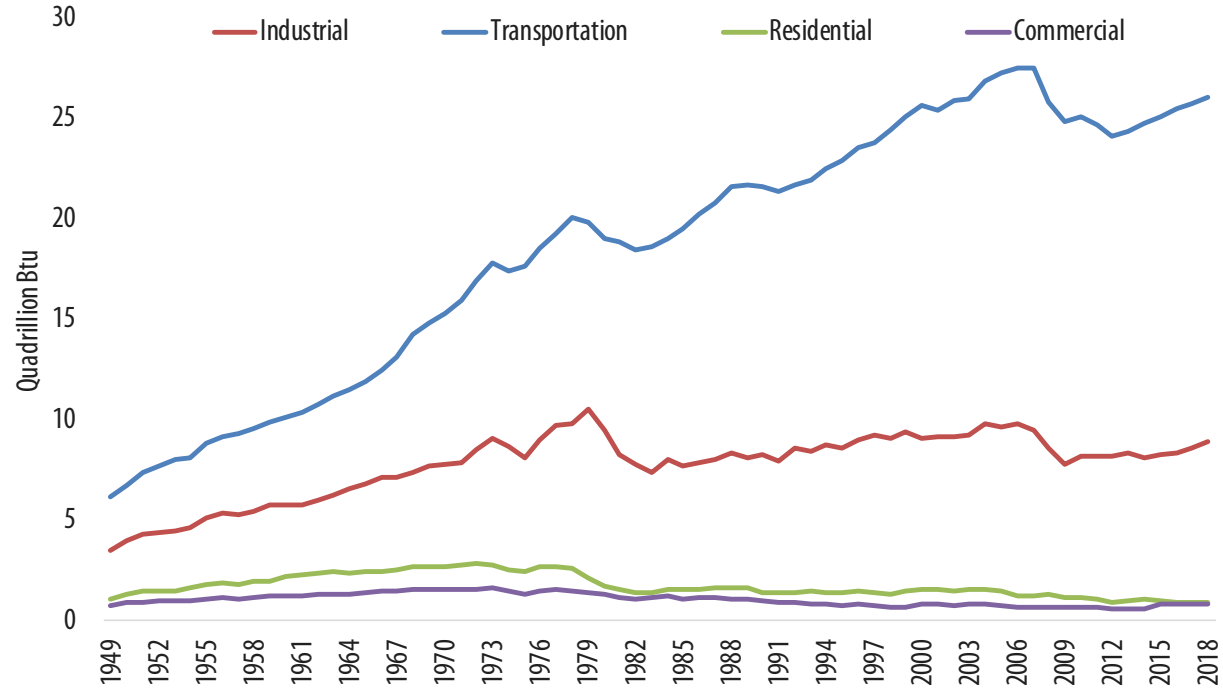
Sources: U.S. Energy Information Administration (EIA), Wells Fargo Investment Institute. Yearly data: 2000-2050.

Chart 10. Total U.S. CO2 emissions by fuel



Sources: U.S. Energy Information Administration (EIA), Wells Fargo Investment Institute. Yearly data: 1974-2018.

Chart 11. U.S. oil consumption by sector

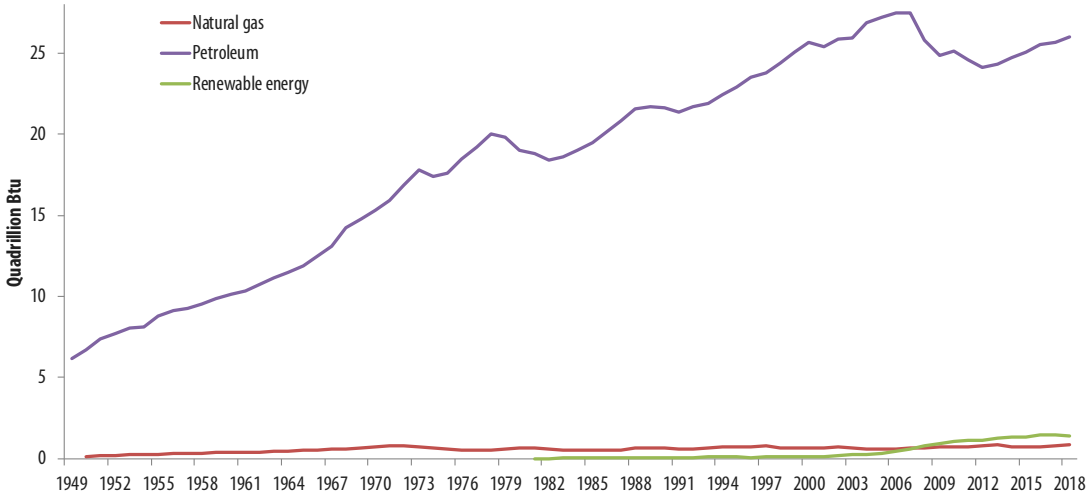


Sources: U.S. Energy Information Administration (EIA), Wells Fargo Investment Institute. Yearly data: 1949-2018.

Step 2 after Al Gore—Detox America from its oil addiction

With coal usage now in free fall (black line, Chart 2), oil (purple line, Chart 10) is the unchallenged leader of CO2 emissions in the U.S. Step 2 to help fix global warming trends is to get the U.S. off of oil usage (petroleum). Americans are addicted to oil, so this will not be easy. It is the most used fossil fuel in the U.S., and as Chart 11 shows, its use throughout the economy is broad-based—mostly from transportation and industrial sectors. There is lots of talk that the United States' first target in detoxing Americans from our oil addiction should be transportation (blue line, Chart 11), and we agree. Nearly all transportation in the U.S. is fueled using oil (purple line, Chart 12).

Chart 12. U.S. transportation sector consumption by fuel



Sources: U.S. Energy Information Administration (EIA), Wells Fargo Investment Institute. Yearly data: 1949-2018.

Electric vehicles—the game changer for oil use

Leaps in technology—and political strides—have allowed alternative fuels, such as compressed natural gas (CNG) and E85 (ethanol), to become fuel options. None of these alternative fuels, however, could change the oil-consuming dynamic like electric vehicles. The reason why electric vehicles could be an oil-consuming game changer is best understood if you consider why oil became the dominant transportation fuel. Oil has been the go-to transportation fuel source, because it offers "great energy bang for the buck." Oil packs a great energy punch, and it can be stored in a relatively small space (tank). Few other fuels can compare. There is good reason why most of us don't fill our cars up with lumps of coal or dry natural gas.

Electric vehicles, though, give oil a run for its money. In fact, electric vehicles' "energy bang for the buck" is even better than oil's. Table 1 compares five well-known cars that are fueled by different sources. MPGE stands for Miles Per Gallon Equivalent, and it was created by the Environmental Protection Agency (EPA) to help compare electric vehicles, on an "apples-to-apples" basis, with fossil-fuel-burning vehicles. After all, electric vehicles are not being directly powered by a fossil fuel ("directly" being the operative word). MPGE basically tells you how far you can travel on the electric equivalent of a gallon of gasoline. Notice how much farther one can drive on an electric equivalent of gasoline in an electric car vs. regular gasoline powered cars (yellow highlights). Keep in mind, of course, that range is a factor here too, and that still favors fossil-fuel powered cars. Electric battery technology still has a ways to go. Most electric batteries cannot hold enough charge to take you the long distances that a fossil fueled vehicle can.

Table 1. Vehicle cost comparison: MPGE

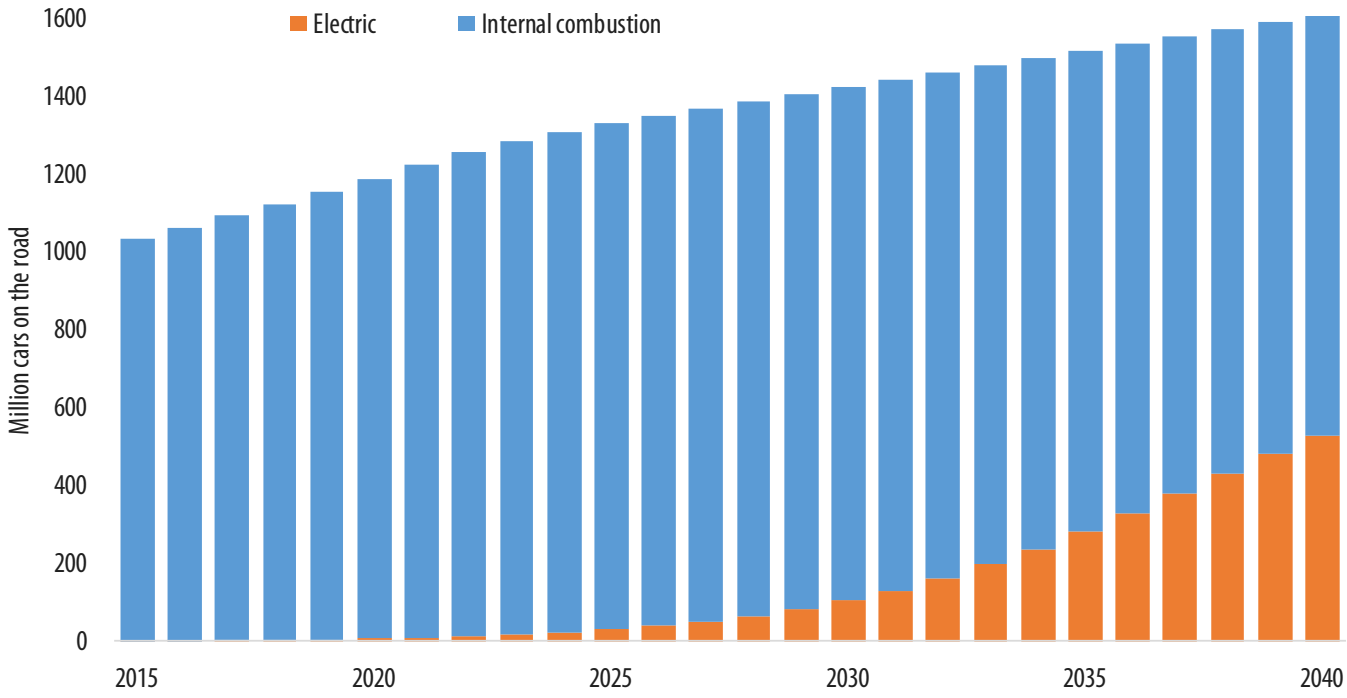
Vehicle cost comparison				
Vehicle	**Fuel type**	**Cost to drive 25 miles**	**Annual fuel cost**	**MPGE**
2018 Tesla Model S P100D	Electricity	$1.12	$650	98
2018 Chevrolet Impala	E85	$3.28	$1,950	16
2018 BMW 328d 2.0L	Diesel	$2.24	$1,350	36
2018 Honda Accord 1.5L	Regular gasoline	$2.14	$1,300	33
2018 Toyota Camry 2.5L	Regular gasoline	$2.08	$1,250	34

Sources: Environmental Protection Agency (EPA), U.S. Department of Energy, Wells Fargo Investment Institute.

Electric vehicles clearly offer great energy efficiency, but the transition from oil to electric won't be all rainbows and unicorns. As noted, Americans clearly like their go-go lives, and they often think twice about anything that gets in the way of that. Not all electric vehicles are created equal. As an example, power, range, and cost are issues for many electrics. Accessibility to charging stations away from the home is another. Many Americans, because of these issues, are not ready to move away from their oil-fueled vehicles yet, and it shows in the numbers. Of the 17.2 million vehicles sold in the U.S. last year, only 361,000 of them were electric.[4]

Electric vehicle sales are set to rise, though. Still, keep in mind that—as electric sales gain traction—there will be plenty of oil-propelled cars on the road. Chart 13 breaks down future projections of cars on the road between electric vehicles (orange bars), and oil-fueled cars (blue bars). As we like to say, adopting energy efficiency is a process.

Chart 13. Number of light duty vehicles—Electric versus internal combustion



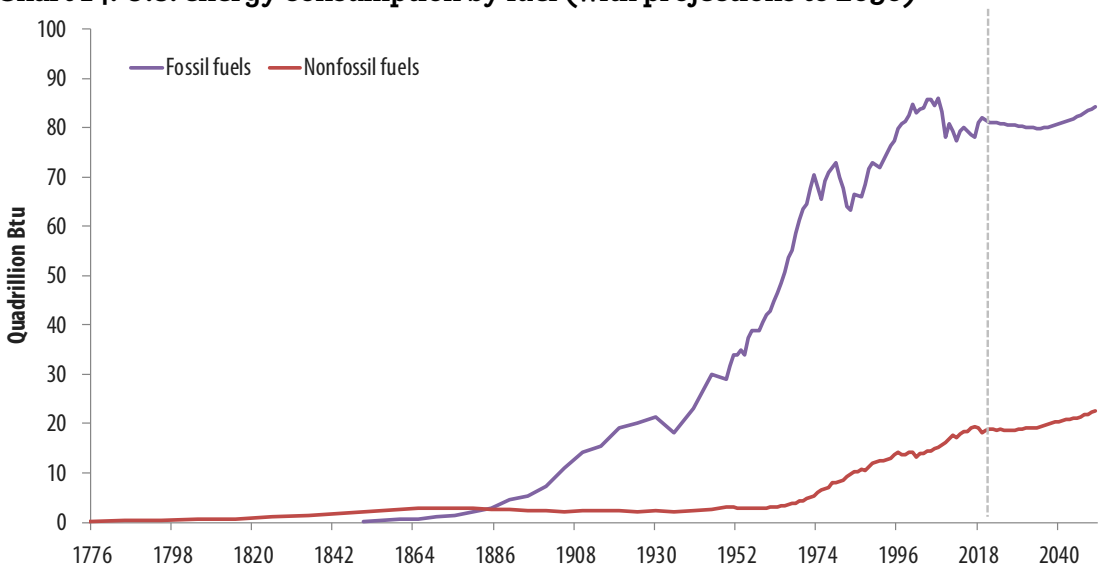
Sources: Bloomberg New Energy Finance, Wells Fargo Investment Institute. Yearly data: 2015-2040.

[4] Data from EV-Volumes.

Energy tough reality #1—Electric cars will not kill fossil fuels

The newer electric cars, with greater range and power, are amazing inventions. If they are broadly adopted, they will curb oil use. Electric cars, though, will not kill fossil-fuel use. Electric cars run on electricity, and most U.S. electricity today is generated by burning natural gas and coal. And if the EIA is correct in its projections, this will remain the case in 2050 (Chart 14). Remember—it takes energy to produce energy.

Chart 14. U.S. energy consumption by fuel (with projections to 2050)



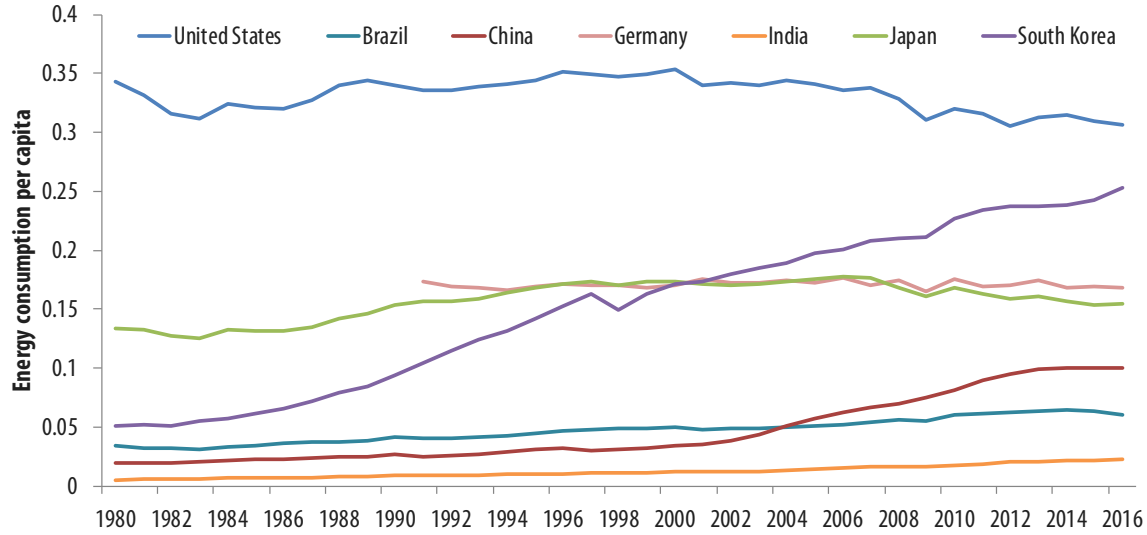
Sources: U.S. Energy Information Administration (EIA), Wells Fargo Investment Institute. Yearly data: 1776-2050. Fossil fuels include coal, natural gas, and petroleum and other liquids.

Energy tough reality #2—global energy use will rise in the coming decades

We have done a lot of writing on U.S. energy use. And rightfully so, as the U.S. is a disproportionate user of the world's energy. The U.S. accounts for only 4.6% of the world's population, but it burns 20% of the world's oil, and it emits 14% of the world's CO_2.

Emerging markets are where the future is, however. Future energy use—and its impact on the planet's health—is shifting from developed countries like the U.S. to emerging ones. Chart 15 shows that most developed countries (the U.S. included) have shrinking energy use per-person trends. On the flip side, most emerging markets' per-person energy use trends are rising.

Chart 15. Country energy use per capita

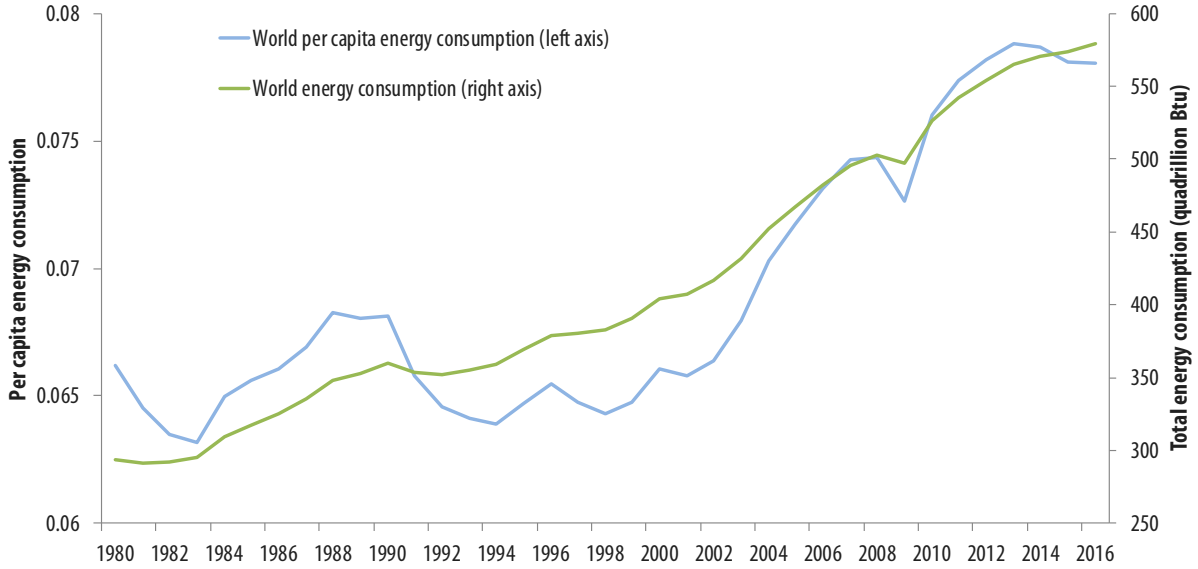


Sources: U.S. Energy Information Administration (EIA), IMF, Wells Fargo Investment Institute. Yearly data: 1980-2016.

Energy tough reality #3—The green movement may always be fighting an uphill battle

The green movement has been involved in an unfair fight, frankly—and likely always will be. The history is clear. Chart 16 shows that as the world has grown, so has energy use. And not just total energy use (Chart 16, green line), but per-person energy use too (Chart 16, blue line). Fighting the growth in energy use is effectively fighting the growth of the global economy—and the desire of humans to live more convenient lives.

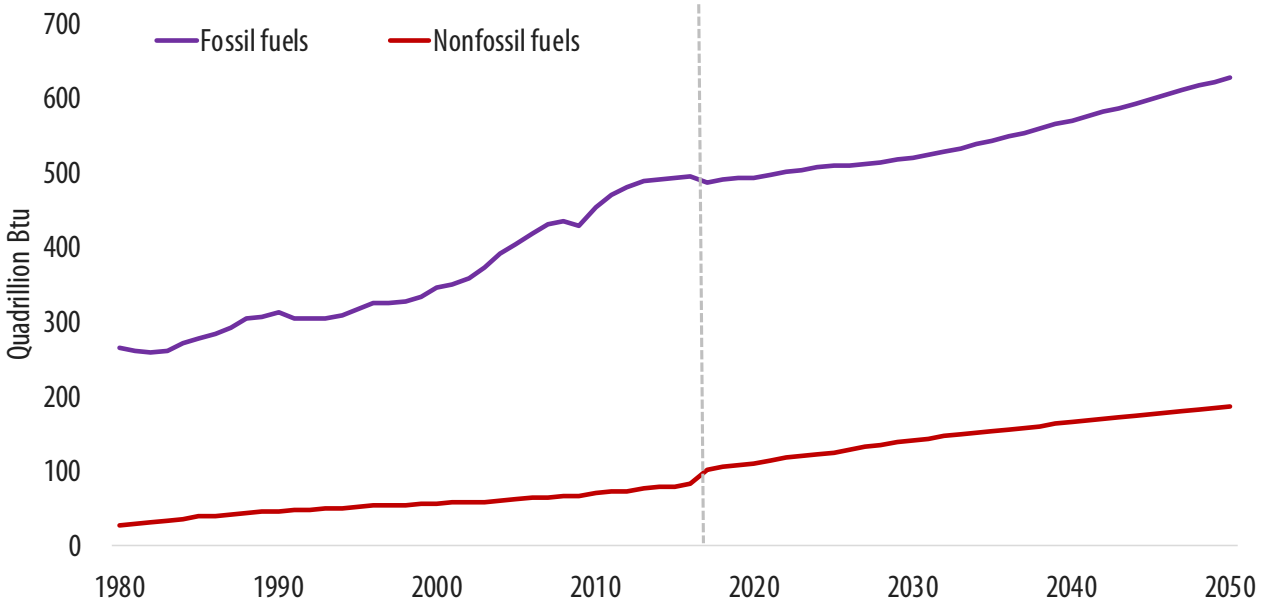
Chart 16. World energy consumption, total and per capita



Sources: U.S. Energy Information Administration (EIA), World Bank, Wells Fargo Investment Institute. Yearly data: 1980-2016.

Emerging markets, in their quest to become developed ones, likely will keep burning massive amounts of fossil fuels in coming decades, much to the chagrin of the green movement. Fossil fuels remain relatively cheap fuel sources, versus developing alternatives, for emerging countries trying to compete. To think that they would forgo such an advantage is naïve thinking. We agree with the EIA's projection that the world's fossil-fuel use should grow steadily through 2050 (purple line, Chart 17)—and expect much of the growth to come from emerging markets.

Chart 17. World energy consumption by fuel (with projections to 2050)

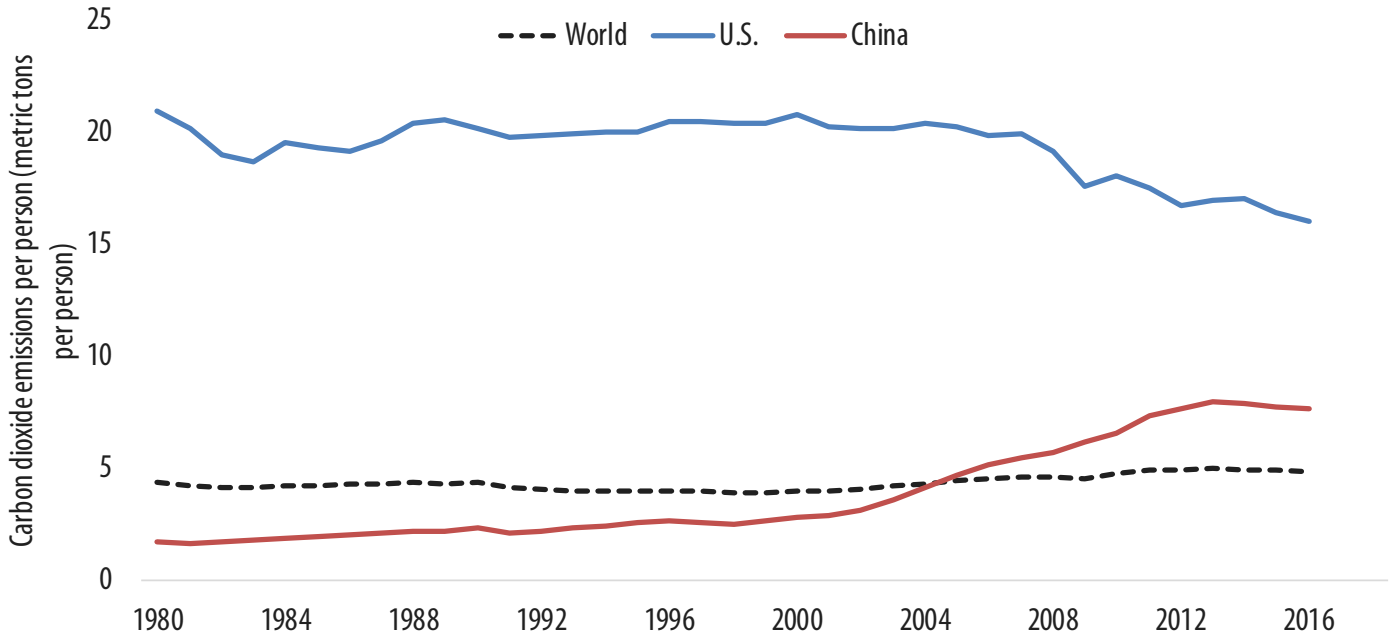


Sources: U.S. Energy Information Administration (EIA), Wells Fargo Investment Institute. Yearly data: 1980-2050. Fossil fuels include coal, natural gas, and petroleum and other liquids.

It is a scary proposition to think that emerging markets, and their massive populations, could be consuming lots more fossil fuels over the coming decades. The real nightmare, though, would be if the average emerging markets citizen consumed energy like the average American. For the planet's sake, let's hope that doesn't happen. There is room for per person energy use to grow in key emerging markets. The average person in China (red line, Chart 15 above), for example, consumes only 30% the energy of the average American (blue line, Chart 15 above).

We do believe that per-person energy use in key emerging markets, like China, will continue to rise for some time still. That said, we are hopeful that green progress should restrain emerging markets per-person energy use from ever approaching anything American-like. Another plus for the planet is that it appears that some of the key emerging markets, such as China, may have been listening when Al Gore took the stage. Chart 18 shows CO2 emissions, on a per-person basis, for the U.S. (blue line, Chart 18), China (red line, Chart 18), and the rest of the world (dashed black line, Chart 18). Notice that, since 2013, China's CO2 emissions have been dropping on a per-person basis. This is at a time when we know that China's energy use is rising.

Chart 18. C02 emissions per person: world, U.S., and China



Sources: Bloomberg, U.S. Energy Information Administration (EIA), World Bank, Wells Fargo Investment Institute. Yearly data: 1980-2016.

The Future of Fossil Fuels—The Bottom Line

The bottom line is that our lives revolve around energy use, and lots of it. Fossil fuels generate most of that energy today. Recent progress in renewables and green technology has been made, and it is the future. The green movement has investors believing that fossil fuel use will soon die. We are doubtful. It takes energy to create energy, and green technologies often require fossil fuel use too. Additionally, emerging market energy use continues to climb higher. By 2050, the planet's dominant fuel source will still likely be fossil fuels. For the planet's sake, let's hope that green progress has a higher gear still.

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