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The Truth About Natural Gas:

A Wellspring for the U.S. and Global Energy Future

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A Wellspring for the U.S. and Global Energy Future

By Timothy G. Nash, Dale Matcheck, Jason Hayes, Joshua Antonini, and Andrew Reder

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Executive Summary

Americans are waking up to the fact that anti-energy policies are spiking prices and limiting access to energy. At the same time, the world is discovering that energy independence plays a critical role in ensuring nations can control their own destinies.

Energy disruptions and runaway prices are hindering investment and development at the state level. Michigan, Texas, California, and many other states have aging and increasingly fragile energy infrastructures that have come dangerously close to failure, or have experienced significant outages in the recent past. The nation is experiencing systemic pressures that are stressing the abilities of states to create and deliver reliable and affordable energy to residents and businesses.

Energy security strengthens a nation's status and stature as a reliable energy producer and exporter and promotes both national security and quality of life. The opportunity to return to energy independence is currently facing the Unites States: natural gas is a wellspring of wealth and security for America and a foundation for the world's energy future.

At the core of the issues discussed in this paper is a cautionary tale: if a nation cannot control its energy supplies, life can quickly become very difficult. With projections for significantly higher U.S. energy bills expected this winter, Americans have—and will continue to share in—the pain of flawed energy policies. Moving forward, the United States must rebalance energy sources and rebuild or repair aging infrastructure to meet growing energy demand here and abroad. Without a realistic and reliable strategy that focuses on the safety, reliability, and energy density provided by fossil fuels and nuclear, the United States will struggle to meet every day needs.

Section One: The History of Natural Gas Usage

Energy production is crucial to every civilization's development, security, and overall well-being. Available sources of energy signify what kind of civilization humans can build and maintain. Generally, if an abundant supply of inexpensive and reliable energy is available, the standard of living improves quickly.

It should be no surprise that the move toward the most efficient forms of energy has trended towards the denser, naturally stored fuels like fossil fuels. Energy density allows for more efficiency and reduced demand for associated resources. Improving efficiency is crucial to powering modern life from transportation to medicine, heating to construction, manufacturing to water purification. All are dependent on inexpensive, reliable energy.

In the United States, wood remained the dominant source of energy until as late as 1885 when coal surpassed it. Coal would hold on to its status as the number one energy source until right after World War II when the growing consumer demand for gasoline-powered cars would push petroleum to the front as the largest energy source in the U.S. Natural gas, meanwhile, enjoyed a massive rise in usage throughout the latter half of the 20th century, fluctuating in its share of the energy profile but overall quadrupling in usage and rising from around 17% of U.S. primary energy consumption in 1950 to 24% in 2000. Since the Shale Revolution when new techniques like hydraulic fracturing and horizontal drilling were implemented, the U.S. has turned into a top oil and gas producer and leading exporter.

The rise of fossil fuels and the subsequent powering of American civilization are not the result of government industrial policy. Rather, the surge in oil and gas production seen across the U.S. is a result of the competitive free market and the entrepreneurship it fosters. Discoveries of shale deposits and breakthroughs in technology have unlocked decades worth of resources to power the United States' ever-increasing energy needs all while reducing costs—both economic and environmental.

Section Two: Current Inventory and Usage in the United States

Natural gas has been a key driver in the developed world's rapidly improving standard of living, as well as the measured improvement in environmental conditions. The increased use of gas has reduced the overall cost of energy and increased energy reliability, both of which led to direct improvements in human health and well-being. Furthermore, as increasingly strict government regulation has restricted the use of coal for electricity generation, low-cost natural gas—a result of the Shale Revolution—has been available to pick up much of that lost energy production capacity. That increased production moved the United States into position as the world's largest producer of oil and natural gas, ahead of both Russia and Saudi Arabia.

As coal use in the electric industry declined, natural gas use has expanded dramatically. By the end of 2021, coal was providing only 22% of U.S. electricity supply (or 11% of primary energy consumption), while natural gas had moved up to 38% of electricity supply (or 32% of overall primary energy consumption). While total energy use had increased, the ability to fuel-switch from older coal-burning facilities to newer and more efficient natural gas facilities played a significant role in the continued reduction of air pollutants.

The Shale Revolution and the expansion of horizontal drilling and hydraulic fracturing has been a primary driver of rapidly increasing natural gas production in the United States. U.S. Energy Information Administration notes that annual natural gas production in the U.S. increased by 79% from 2007-2021. EIA also points out that increases in accessible reserves are sufficient to power the nation for another 98 years, despite continuous growth in annual natural gas consumption since 2001.

The American Petroleum Institute reports that the primary use for natural gas in America is generating electrical power. API cites EIA data showing that by 2035, 46% of new generating capacity would be derived from natural gas. At the same time, as gas use increases for electricity generation it is also seeing increased use in home heating. API reports that about half of American families use natural gas to heat their home, water, and food.

With these innovations, natural gas has taken over as a primary source of the energy needed to power highly industrialized economies.

Section Three: Natural Gas—Essential to Modern Life

Natural gas is an increasingly important aspect of modern life that enables lower cost and with reduced emissions. It can be shipped directly to households and businesses for use in heating, cooking and industrial processes. Its low cost allows consumers to save money or to spend it in other areas that greatly benefit their own lives and the economy.

Natural gas is also a key input to the manufacture of fertilizers that are used to feed billions of people around the planet. It is an essential component in the plastics that help to protect, preserve, and make modern society possible. Natural gas also plays a growing role in transportation and in providing geopolitical stability.

Reducing or ceasing natural gas production and consumption without taking these benefits into account would be deeply shortsighted. Instead, the U.S. should build on these benefits to promote economic security and a return to energy independence. Around the world today, that security is increasingly made possible as a result of inventions and innovations in natural gas technologies.

Section Four: The Environmental Benefits of Using Natural Gas

One of the reasons Western economies have been able to grow so rapidly is the presence of affordable, reliable supplies of energy. That energy and improving economic well-being has also played a direct role in the ability to direct so much attention to cleaning up the natural environment and, as an extension, improving and lengthening human lives. Energy experts have demonstrated that the energy provided by fossil fuels frees humans to focus on innovation and helps to ensure a safer, more fulfilling existence. The freedom to innovate encourages the development of new, more dense and efficient forms of energy, which reduces impacts on the environment.

Fuel-switching from coal to natural gas has allowed the U.S. to lead the developed world in reductions of greenhouse gas emissions. Using natural gas to produce energy generates about half of the CO_2 emissions produced by using coal for the same amount of energy. The EPA reports that American "greenhouse gas emissions in 2020 (after accounting for sequestration from the land sector) were 21% below 2005 levels." Increasingly efficient energy sources have also rapidly improved the nation's air quality. EPA data demonstrates that, from 1970 to 2021, combined emissions of the six criteria air pollutants tracked by the federal agency — particulate matter (2.5 and 10 microns), oxides of sulfur, oxides of nitrogen, volatile organic compounds, carbon monoxide, and lead — had dropped by 78%.

Although it may be counter-intuitive, natural gas has also played an important role in wildlife conservation. Contrary to popular belief, climate change is not the primary threat to wildlife; it is loss of habitat. The *Journal of Conservation Science and Practice* recently examined the impact of climate change, pollution, invasive species, and other potential causes of extinction. It concluded "habitat destruction threatens more species than all other categories combined, climate change the fewest." A primary cause of habitat loss is agricultural land use, but the use of synthetic fertilizers has reduced pressure to convert undeveloped land to farmland. The reduced need for land means a portion of previously cleared lands can return to a more natural state.

Section Five: Lessons from North America

North American industry is far more efficient than many of its international competitors. The International Energy Agency publishes a global methane tracker tool that demonstrates Russian natural gas production emits 30% more methane per unit of energy produced than American production. Despite that demonstrated efficiency, American oil and gas producers have still publicly committed to further reducing fugitive emissions. Their history shows they can meet these commitments.

While some green campaigners have been reluctantly willing to recognize natural gas as a temporary transition fuel, they have also made it clear that they will continue their work to stop its use. Progressive green groups like the Sierra Club lump natural gas and coal together in their anti-energy campaigns. They demand that North America stop the use of reliable and affordable domestic energy resources by "moving beyond coal and gas." But the dangers associated with meeting those demands, as well as their ever-tightening climate targets, by forcing the closure of reliable electricity generation facilities, are beginning to become obvious. As reliable fossil and nuclear plants are shut down, electricity and energy systems across the nation are showing signs of growing instability.

A growing list of examples paints a stark picture, this paper discusses three. Michigan's grid reliability issues in the winter of 2019 (as a result of a compressor station explosion and a growing reliance on weather-dependent solar and wind facilities). California's now habitual summer energy restrictions and blackouts, as well as their unrealistic demands that state residents stop using electricity at peak times. The overwhelming blackout disaster in Texas during February 2021. Each of these examples demonstrates how unprepared the nation is to manage energy needs without natural gas.

Rather than placing reliable energy as the top priority to prevent these grid failures, executives and officials are doubling down on anti-fossil fuel policies through their advocacy for

“Environmental, Social, and Governance,” or ESG, criteria. ESG aims to hasten a net-zero energy transition by encouraging investment in unreliable renewable energy while discouraging reliable fossil fuel development.

Similar to California, Texas, and Michigan, many European nations have prioritized drastic reductions in greenhouse gas emissions over energy security. Countries across Europe—notably Germany—have closed coal plants, continue to target nuclear plants for closure, and have reduced their domestic production of natural gas. As a result, European Union countries have been forced to increase their imports of Russian natural gas and are considering reopening coal plants to maintain reliable energy and electricity supplies.

Conclusion

With natural gas production outpacing the growth in domestic consumption, the United States is now a net exporter of natural gas on an average annual basis, a status achieved in 2017. The growth of U.S. LNG exports continues to be a major force in the development of more liquid and globally integrated gas markets. It also supports further opportunities to transform electric and heating supply mixes, supplement industrial and transportation fuel mixes, improve energy security, address aid in meeting emissions reductions targets, provide better energy access in developing economies, and create new economic opportunities in the global economy. Gas still faces obstacles in many markets, however, and turning this new potential for more abundant and available supply into strategic opportunities is not without its challenges.

While natural gas production and consumption has exhibited rapid levels of growth in the United States in recent years, the outlook going forward for further levels of growth is linked to and will be highly dependent on prices and environmental policies. If allowed to progress, rapidly increasing levels of gas exports could bring a range of strategic, economic, and security advantages to the United States.

In today’s energy climate, the best option for fast, affordable, and easily permittable growth is natural gas. Diversity of supply is essential and it is imperative that legislatures at the local, state, and national levels fully understand the benefits of natural gas to America and the global economy. Ignoring these benefits will cause America’s standard of living to decline, global economic and political freedom to be harmed, and environmental impacts associated with energy development to expand rather than contract in the decades to come.

Introduction: Current Situation — It Can Happen Here

As price increases continue to pressure their pocketbooks, Americans are feeling the impacts of a growing number of anti-energy policies. When politicians who are either ignorant of the impacts of restrictive energy policies or who may be misleading the public for political gain are put in charge of energy policy, essential fuel supplies are restricted and get far more expensive.

These difficulties are often driven by divisive and damaging state and federal policies that target the early closure of generation facilities. These harmful policies also restrict energy production and the development of pipeline infrastructure that could deliver oil, gas, and natural gas liquids to refineries, businesses, or homes. Additional financial pressures are being placed on the industry through the imposition of ESG goals that limit investment dollars normally used to finance drilling and infrastructure development.

As nations around the world are now discovering, energy security is increasingly important to developing and maintaining a society that can control its own destiny, can function at peak levels, and can supply citizens with safe and reliable energy at affordable prices. Secure supplies of reliable, and typically domestically produced, energy strengthens the status and stature of the United States. They help establish the nation as a reliable energy exporter and promote both national security and quality of life.

The opportunity to return to energy independence is facing the Unites States: natural gas is a wellspring of wealth and security for America and a foundation for the world's energy future. It would be wise to make use of it.

This report provides policymakers and citizens with essential information that will improve their understanding of the value of natural gas, how it is used, and the environmental benefits of using it. Legislators and regulators can use this information to reshape energy policy into a thoughtful, multi-faceted plan that safeguards the nation's future.

Natural gas has become an essential aspect of energy systems and the importance of the consistent electricity service and heating and transportation fuel it provides cannot be understated. Reliable energy supplies, long taken for granted, are critical to the everyday life of everyone in a modern economy. Heat and air conditioning, inexpensive food, and a near unlimited suite of plug-in conveniences are among the benefits made possible by reliable energy. Essential systems use inexpensive electricity to support expert medical care, to maintain the integrity and convenience of financial systems, to ensure uninterrupted communications, a smooth supply chain, consistent education, and more.

But the United States is now in the midst of a growing energy crisis and suffering inflation rates not seen in over forty years. The Biden administration has repeatedly asserted that higher prices in general, and energy costs in particular, are the result of the war in Ukraine, or are the fault of a greedy and uncooperative American energy sector. But domestic producers are actually a model for the world in the safe, clean, and efficient production of oil and natural gas. Furthermore, inflation in the U.S. was already at 7.5% before Russia invaded Ukraine.[1] It may not make for flattering headlines, but energy costs were already well on their way up before the war in Ukraine began.

Upon taking office, the Biden administration undertook a series of policy actions targeting fossil fuels: gas, oil, and coal. Therefore, it is understandable for business leaders in the energy industry to hesitate before investing when the current administration is threatening to actively work against them.

At the core of this situation is a cautionary tale: if a nation can, it must rely on other nations to power its economy. When those other nations have conflicting political or economic goals, life can quickly become very difficult for everyone. With projections for significantly higher U.S. energy bills expected this winter, Americans have—and will continue to share in—the pain of flawed energy policies that are restricting access to reliable sources of domestically produced fossil and nuclear fuels.

But energy disruptions and runaway prices can also happen at the state level. Both Texas, and California have faced blackouts or electric system instability during periods of extreme weather. In 2019, Michigan came very close to experiencing another similar outage. These three states, among others, are experiencing systemic pressures that are stressing their abilities to create and deliver reliable and affordable energy. In Texas and California alone, millions have been inconvenienced at best and, at worst, put in grave peril when outages occur.

Moving forward, the United States must abandon its anti-fossil fuel policies to meet growing energy demand. The expected transition to electric vehicles and supporting services will exacerbate this need greatly. Without a realistic and reliable strategy that includes fossil and nuclear fuels, the United States will struggle to meet the everyday needs of American citizens.

Section One: The History of Natural Gas Usage

Energy production is crucial to every civilization's development, security, and overall well-being. Mankind is a fragile species. With comparatively little physical strength and lacking natural defenses against extreme weather, humans need food, shelter, and warmth in nearly every part of the world. Human survival requires changing the natural environment to make an often-inhospitable natural environment a safer and more livable place. Contrary to popular green notions about bringing human impacts to zero or near-zero, influencing the natural environment as a means of improving its livability is the normal response of all life on earth. But moving past the limited labor potential of human hands and the mere subsistence-level existence they provide requires tools and often complex machines. All of modern civilization depends on some form of energy to power those machines.

Available sources of energy signify what kind of civilization humans can build and maintain. Generally, if an abundant supply of inexpensive and reliable energy is available, the standard of living improves quickly. Since ancient times, wood has been a reliable source of energy. Used to cook food and heat homes, it proved adequate for mankind's survival for many thousands of years. Wood, harvested from trees, could be considered a stored form of solar energy, as well as a form of carbon capture and sequestration. The process of photosynthesis in plants is a chemical reaction that transforms light from the sun and carbon dioxide from the air into stored chemical energy (sugars) which can be combusted to create heat energy. As a byproduct of photosynthesis, trees and plants produce the oxygen we breathe. Alongside wood, humans have long used wind and hydropower to power mechanical processes. The limiting factor in the energy they provide is that these forms of energy are either collecting diffuse and typically intermittent energy in real time (as in the cases of wind, sun, or water), or have collected energy in a previous time (in the case of wood which stores the solar energy absorbed by a tree).

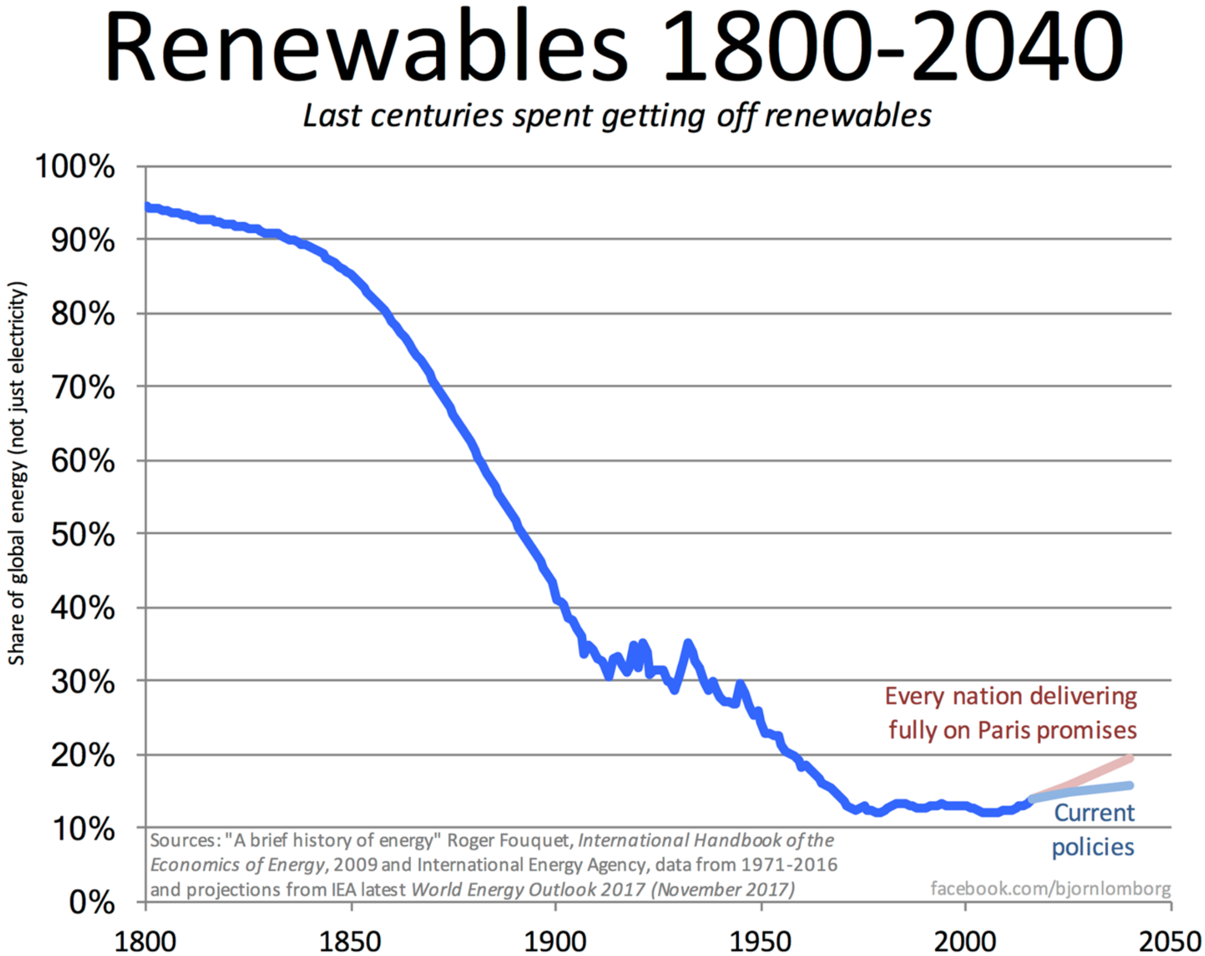
The inherent advantage of fossil fuels (such as coal, oil, and natural gas) is that they represent a massive reservoir of "energy from ancient sunlight, which was stored in plants (or in organisms that ate plants) via photosynthesis and then concentrated through natural processes (involving large amounts of heat and pressure over time)."[2] It should be no surprise that the move toward the most efficient forms of energy has trended towards more energy dense stored fuels, like fossil fuels. Energy density allows for greater efficiency, which is crucial to powering modern life from transportation to medicine, heating to construction, manufacturing to water purification. All of these activities are dependent on inexpensive, reliable energy. The move toward nuclear fuels continues that reliance on increasingly dense forms of energy.

But moving backward on that continuum limits access to energy and slows its development. Economist William Stanley Jevons noted in 19th century Britain that "[n]o possible concentration of windmills … would supply the force required in large factories or iron works."[3] On biomass, he remarked that "[w]e cannot revert to timber fuel, for 'nearly the entire surface of our island would be required to grow timber sufficient for the consumption of the iron manufacture alone.'"[4] Jevons argued that hydroelectric generation was unreliable and location dependent, for "[m]any streams and rivers only contain sufficient water half the year round, and costly reservoirs alone could keep up the summer supply. In flat countries no engineering art could procure any considerable amount of natural water power, and in very few places do we find water power free from occasional failure by drought."[5]

Jevons' critique holds true even today and is in-part bolstered by a graph created by economist and author Bjorn Lomborg. This graph demonstrates the rapid decline in the percentage of energy provided to human society by a mix of renewable energy sources over time.[*] Humans have continued to grow their use of energy but have chosen to move away from renewable sources toward more energy-dense and reliable forms—such as fossil and nuclear fuels—as quickly as they have become available.[6]

[*] This figure shows how human reliance on a mix of renewable energy sources has changed. Prior to the development of current hydroelectric, wind, and solar technology, humans relied on far smaller examples of traditional forms of water, wind power to provide mechanical power for grinding grain, pumping water, etc.

Figure 1: Renewables 1800-2040



Before the development of nuclear energy, petroleum, or natural gas, it was true that "[c]oal in truth stands not beside but entirely above all other commodities. It is the material energy of the country—the universal aid—the factor in everything we do. With coal almost any feat is possible or easy; without it we are thrown back into the laborious poverty of early times."[7] Using more modern economic terminology, "[c]oal creatively destroyed renewables as primary energy."[8] In a market system, the most efficient resource use has a way of rising to prominence.

In the United States, wood remained the dominant source of energy until as late as 1885 when coal surpassed it. Coal would retain that status until right after World War II, when growing consumer demand for gasoline-powered cars would push petroleum to the front as America's largest energy source.[9] Natural gas, meanwhile, enjoyed a massive rise in use throughout the latter half of the 20th century, fluctuating in its share of the energy profile but overall quadrupling in usage and rising from around 17% of U.S. primary energy consumption in 1950 to 24% in 2000. From 2000 to 2021, however, even more growth occurred: in 2021, natural gas supplied 32%, or about one-third, of all U.S. energy sources.[10] Over the same period of time, coal first increased dramatically and then, after 2007, began a rapid decrease. In 1950, coal supplied 36% of primary energy consumption, or 12.35 quadrillion Btus. By 2007, while coal decreased to 23% of primary energy consumption, our use had jumped to 22.75 quadrillion Btus. By 2021, coal had dropped to 11% of primary energy consumption, providing almost 11 quadrillion Btus.[11]

The initial stages of natural gas' "creative destruction" of the coal industry began in the early 20th century.[12] That process advanced as technological improvements turned what was considered a waste product of petroleum production into a vast new inexpensive and reliable type of energy. "Gas was originally flared at the wellhead to remove the hazard of explosion, but technological advances and infrastructure investment allowed gas to be collected and piped for home heating, cooking, and other uses, displacing manufactured (coal) gas. Intrastate and then interstate gas-transmission systems, one by one, brought the new fuel to markets throughout North America."[13] Today, the millions of miles of pipeline delivering natural gas provide a remarkable advantage to North American energy producers and consumers.[14]

More uses for the gas would be found over time, increasing natural gas use for electrical generation, for home heating, as a vehicle fuel, and as feedstock for fertilizer and to produce plastics. Robert Herring, former CEO of Houston Natural Gas, noted in 1970:

> "Natural gas...began to move to market through high-pressure steel pipelines. At the beginning of our growth period, natural gas was supplying less than 6% of the total energy requirements of the United States, and last year [1969], despite the amazing growth in our energy requirements in this country, the natural gas percentage increased to more than 30%."[15]

Not only would natural gas find its home in electricity generation, but it would become a valuable feedstock for the petrochemical industry as well. In 1949, the *Texas Oil Journal* remarked that a significant portion "of the gas supply for [Transcontinental Gas Pipe Line] will be 'flare gas' which will be put to useful use."[16] Herring explained that, "[a]s products became available from the refineries and liquid was stripped from natural gas, we found building blocks for the petrochemical industry. The by-product of one plant would become the feedstock of another plant."[17] The burgeoning development of uses for natural gas created and sustains a remarkable number of industries that are often taken for granted today.

In the early 1980s, the potential for producing natural gas from deep shale formations was identified by Mitchell Energy's drilling in the 8,000-foot-deep Barnett Shale in the Fort Worth Basin of North Texas. The company continued its expensive trial-and-error into the late 1990s, fracking vertical wells, punching straight down into the formation, cracking the nearby shale, and getting as much as could be gleaned from it. [18] This effort was more proof-of-concept than it was economically viable, but it proved crucial to later success. As a 2020 report by the Department of Energy's Office of Oil and Natural Gas notes, the early fracking done in the Barnett shale led to a "breakthrough concept—if a well was drilled to contact more of the shale formation and this shale formation was vigorously stimulated, the volume of reservoir being drained would be considerably greater and well performance would be several-fold higher."[19]

Additional trial and error paid off in 2002 when Devon Energy, another company drilling in the Barnett Shale, added horizontal drilling to the mix and reaped seven times the natural gas produced by conventional drilling methods.[20] The method of reaching oil and gas sequestered away in hard shale was, as one seasoned engineer noted, "just as startling as saying that ice doesn't freeze anymore."[21]

The Marcellus shale in the American Northeast experienced similarly dramatic increases in production in the early 2010s.[22] As noted in Stephen Moore and Kathleen Hartnett White's *Fueling Freedom*, "[b]y 2012 the majority of wells in the United States were horizontal, and production in the shale fields had increased dramatically."[23] Natural gas's further meteoric rise owes thanks, in no small part, to hard-earned developments such as these. In the 2000s, this combination of older and newer techniques such as hydraulic fracturing, horizontal drilling, seismic imaging, and deep-data geophysical analytics sparked what would become widely known as the Shale Revolution.[24]

But this technological development was unexpected and it overturned the conventional wisdom of "peak oil"—the concern that oil and natural gas production had reached its peak and would decline from then on—and put a stop to ever-increasing prices for energy development.

In 2006, offshore drilling company Noble Corporation's CEO James Day discussed peak oil and pricing concerns on an Australian public affairs television program. Day explained, "[t]he people that I trust and believe – geophysicists, geologists – say the days of the big fields are gone... While we can drill off West Africa, and they have significant reserves, or Brazil, or the deepwater U.S. Gulf, they're just going to be replacing what we're currently consuming. But that's just treading water."[25] Concerns were widespread: the World Energy Outlook 2010 report by the International Energy Agency warned that peak oil may have already occurred, depending on demand and the levels of aggressive climate policy being implemented by world governments.[26] However, the IEA report also noted that:

> "The amount of oil that was ever in the ground—oil originally in place, to use the industry term—certainly is a fixed quantity, but we have only a fairly vague notion of just how big that number is. But, critically, how much of that volume will eventually prove to be recoverable is also uncertain, as it depends on technology, which will certainly improve, and price, which is likely to rise: the higher the price, the more oil can be recovered profitably. An increase of just 1% in the average recovery factor at existing fields would add more than 80 billion barrels to recoverable resources."[27]

That impressive reality did not stop many, from *National Geographic*[28] to environmentalist blogs,[29] from taking away only one message: peak oil has (likely) been reached.

Nevertheless, the market, complete with its inherent incentive mechanisms, provided. "Before the onset of the shale revolution," notes an October 2017 report by the Center for Strategic & International Studies, "the forecasts at the time indicated that U.S. natural gas imports from Canada and Mexico via pipeline and other countries by way of LNG [liquefied natural gas] would continue to rise, because of growing levels of consumption and diminishing volumes of domestic production... However, this high-price environment for natural gas coupled with low interest rates incentivized the industry to explore and produce previously untapped shale gas resources through the combination of horizontal drilling and hydraulic fracturing."[30] The IEA report remained correct: technology certainly did improve and U.S. proved reserves increased dramatically along with it.[31]

The Shale Revolution turned the U.S. into a top oil and gas producer and a leading exporter. Dr. Fatih Birol, executive director of the International Energy Agency, even called the U.S. "a cornerstone of global energy security" as result of the record production.[32] The Federal Reserve Bank of Dallas released a 2020 report finding that "oil prices in 2018 would have been roughly 36% higher had the shale revolution not occurred and that the shale revolution implies a reduction in current oil price volatility around 25% and a decline in long-run volatility of over 50%."[33]

As explained later in this report, the Shale Revolution even helped to improve environmental quality. Natural gas emits far less particulate matter and CO_2 than coal or diesel fuels, so access to inexpensive natural gas has played a direct role in the country's falling CO_2 emissions levels and rapidly improving air quality.[34]

The rise of fossil fuels and the subsequent powering of American civilization are not the result of government industrial policy. Rather, the rapid advances in oil and gas production seen across the U.S. are a result of the competitive free market and the entrepreneurship it fosters. In mid-19th century Michigan, pioneers staked their livelihoods on finding oil and hitting it rich, which many successfully did.[35] The spirit of these pioneers and of speculating Texans who found Spindletop in 1901, drilled until they ran out of money, then drilled some more endures in the 21st century.[36] Entrepreneurial speculators continue to tap massive shale deposits around the country. [37] Their discoveries span from the Marcellus shale in the Northeast to the Fayetteville and Haynesville shales in the South, the Bakken shale in the Dakotas, the Barnett, Permian and Eagle Ford Shale in Texas, and back north to the Green River shale in Wyoming. These discoveries and breakthroughs have unlocked decades worth of resources to power the United States' ever-increasing energy needs all while reducing costs—both economic and environmental.

Section Two: Current Inventory and Usage in the United States

Natural gas has been a key driver in the developed world's rapidly improving standard of living, and environmental conditions. The increased use of gas has reduced the overall cost of energy and increased energy reliability, both of which led to direct improvements in human health and well-being. Furthermore, as increasingly strict government regulation has targeted the use of coal for electricity generation, low-cost natural gas—a result of the Shale Revolution—has been available to pick up much of that lost energy production capacity.

Compare U.S. primary energy consumption by energy source in 2021[38] with similar data collected 15 years prior in 2006:[39]

Figure 2: U.S. primary energy consumption by energy source, 2021

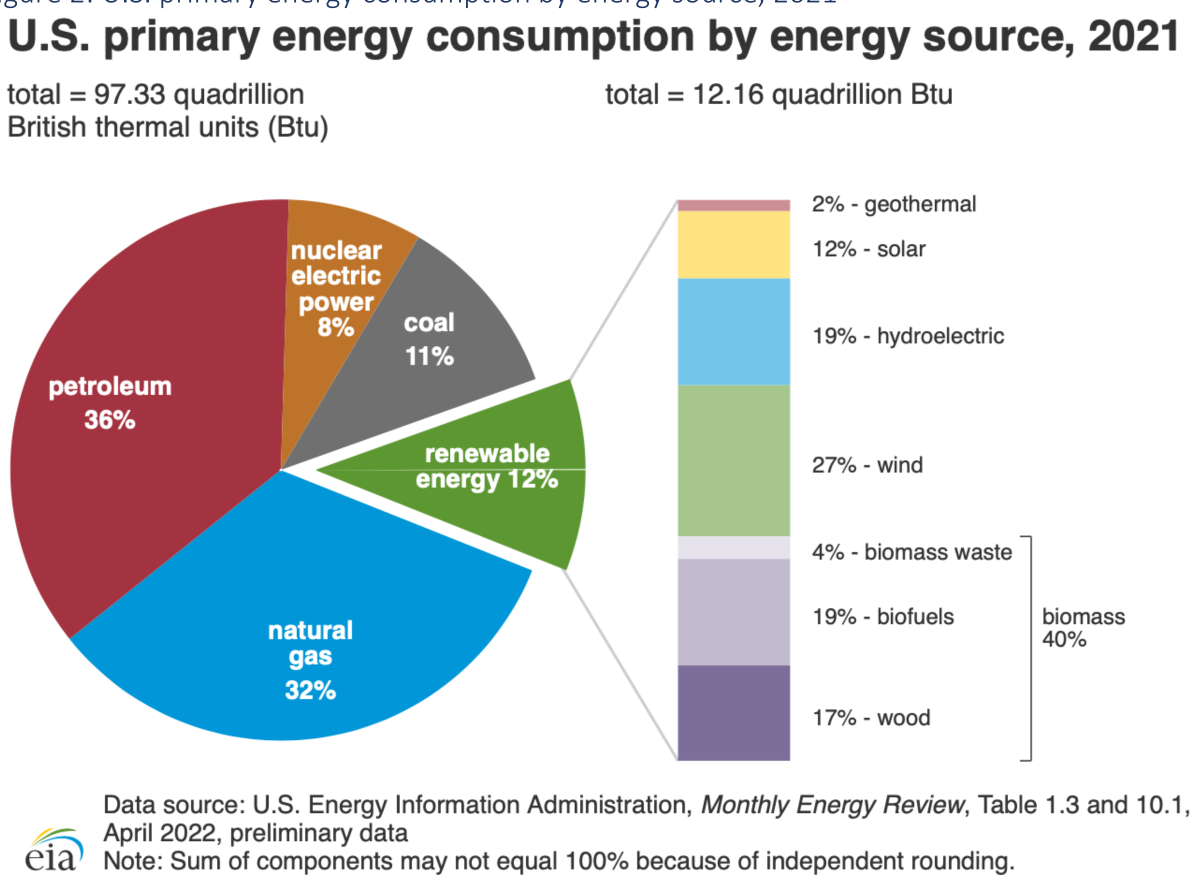
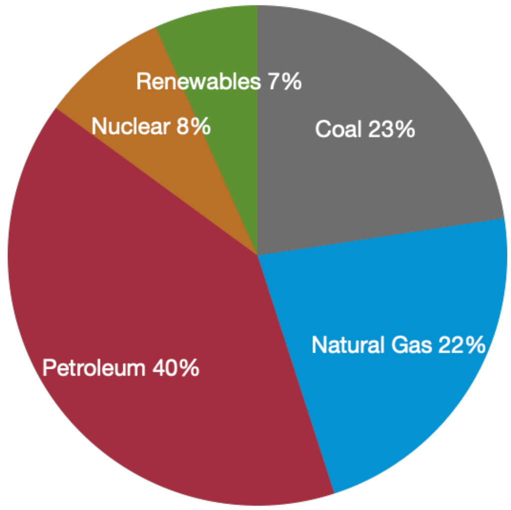


Figure 3: U.S. primary energy consumption by energy source, 2006

U.S. primary energy consumption by energy source, 2006

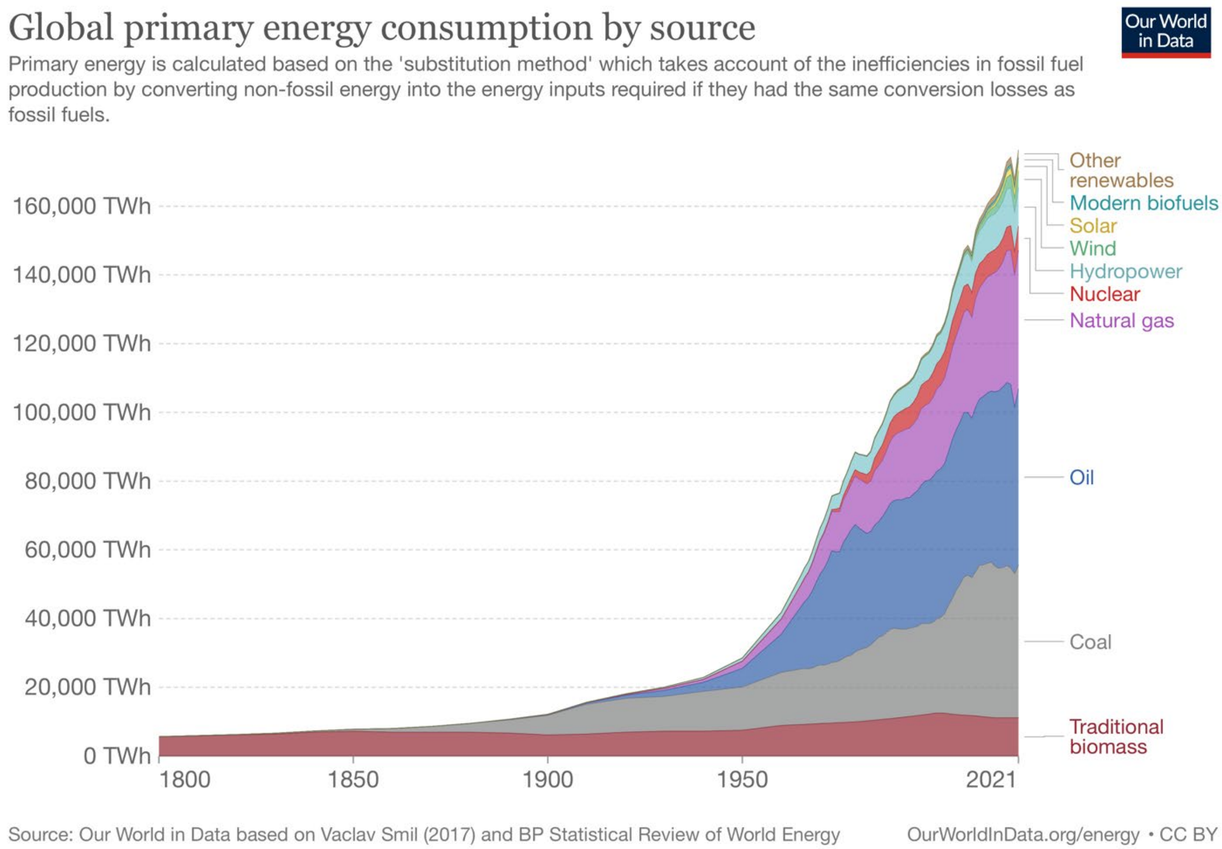


Source: U.S. Energy Information Administration

Over the past fifteen years, natural gas use has expanded from 22% of primary energy consumption to 32% to account for the decrease in use of coal. Despite the growth of renewable sources, worldwide energy consumption trends have remained relatively consistent with fossil and nuclear fuels providing the bulk of overall primary energy demand—about 90%—and renewable options[†] providing approximately 10%.

[†] *Renewable is a misnomer, as wind turbines and solar panels are neither are organic nor self-generating. Unlike wood, they don't grow, and they don't renew.*

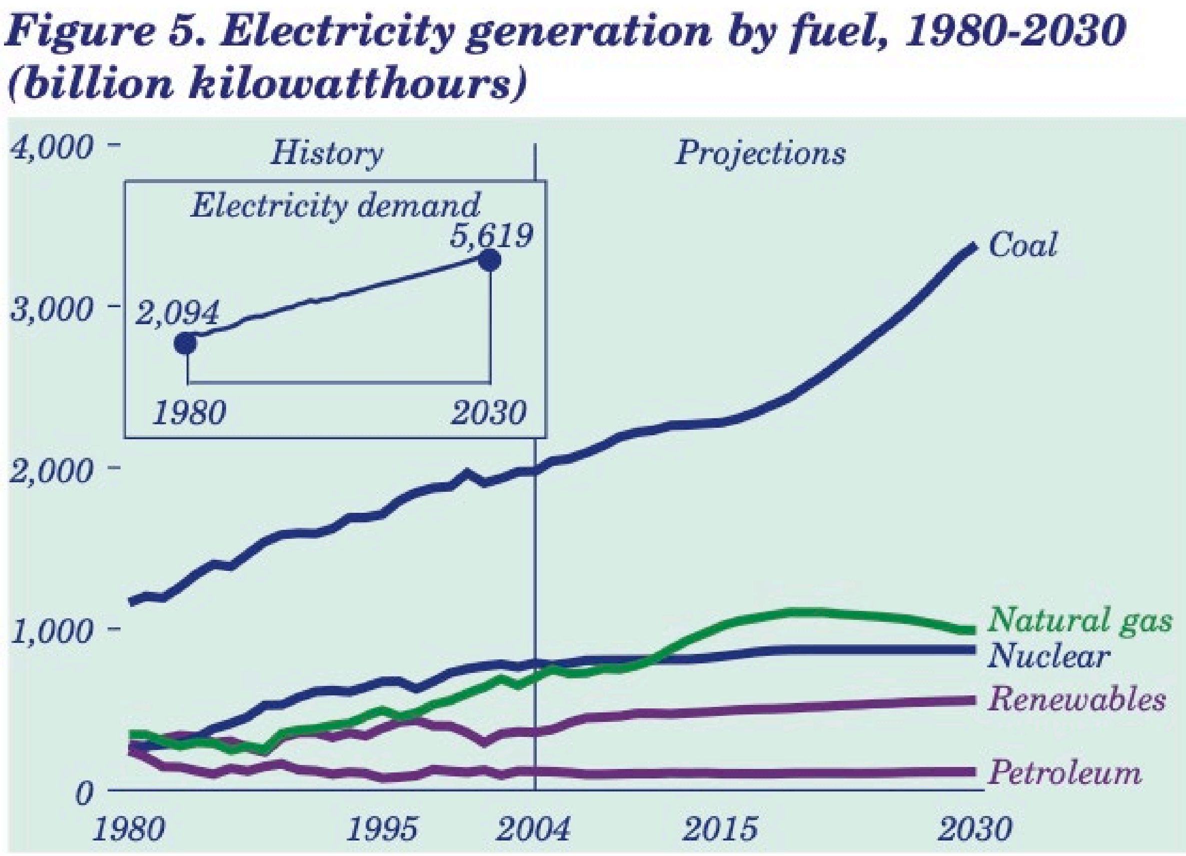
Figure 4: Global primary energy consumption by source



Innovation often disrupts expectations for energy production and can radically improve production and reduce energy costs. The discovery and production of shale gas serves as an excellent example of how improving technology improves outcomes. America's example stands as an excellent reminder of the power of technology to change energy use.

In 2006, U.S. coal production was almost at 1.2 billion tons annually, and domestic consumption of coal was at just over 1.1 billion tons.[40] At these levels, coal provided more than 50% of total U.S. electric generation and the EIA was then predicting that coal use would grow to 1.5 billion tons per year and provide 57% of electricity supply by 2030. In its 2006 Annual Energy Outlook, the EIA predicted 174 GW of new coal plants would be built between 2004 and 2030 and the nation would open several new coal-to-liquid plants to derive synthetic natural gas from coal.[41]

Figure 5: EIA predictions in 2006 forecast sustained growth in coal use

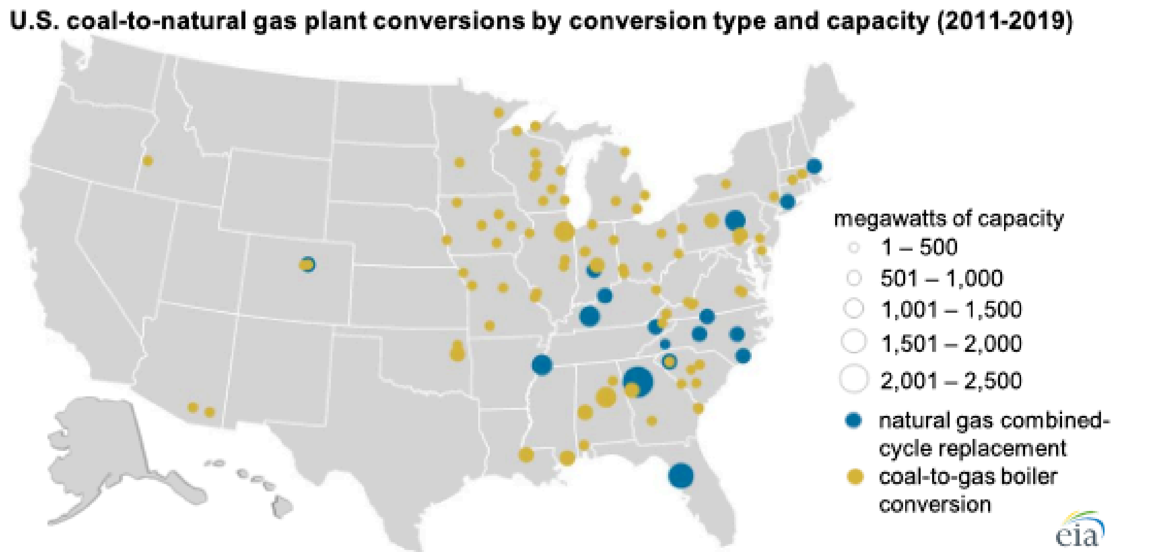


Source: 2006 EIA Annual Energy Outlook

In 2006, natural gas production was limited, and numerous plans were being proposed to build LNG import terminals, which would allow natural gas to be brought into the U.S. to meet growing demand. The EIA reported 211.1 Tcf of proved reserves of dry natural gas at year end.[42] But the Shale Revolution changed expectations for the future and the increased access to natural gas has fundamentally reworked American energy production and consumption.

An October 2019 report by the White House Council of Economic Advisors explained that, "from 2007 to 2019, innovation in shale production brought an eight-fold increase in extraction productivity for natural gas and a nineteen-fold increase for oil."[43] That increased production moved the United States into position as the world's largest producer of oil and natural gas,[44] ahead of both Russia and Saudi Arabia.[45]

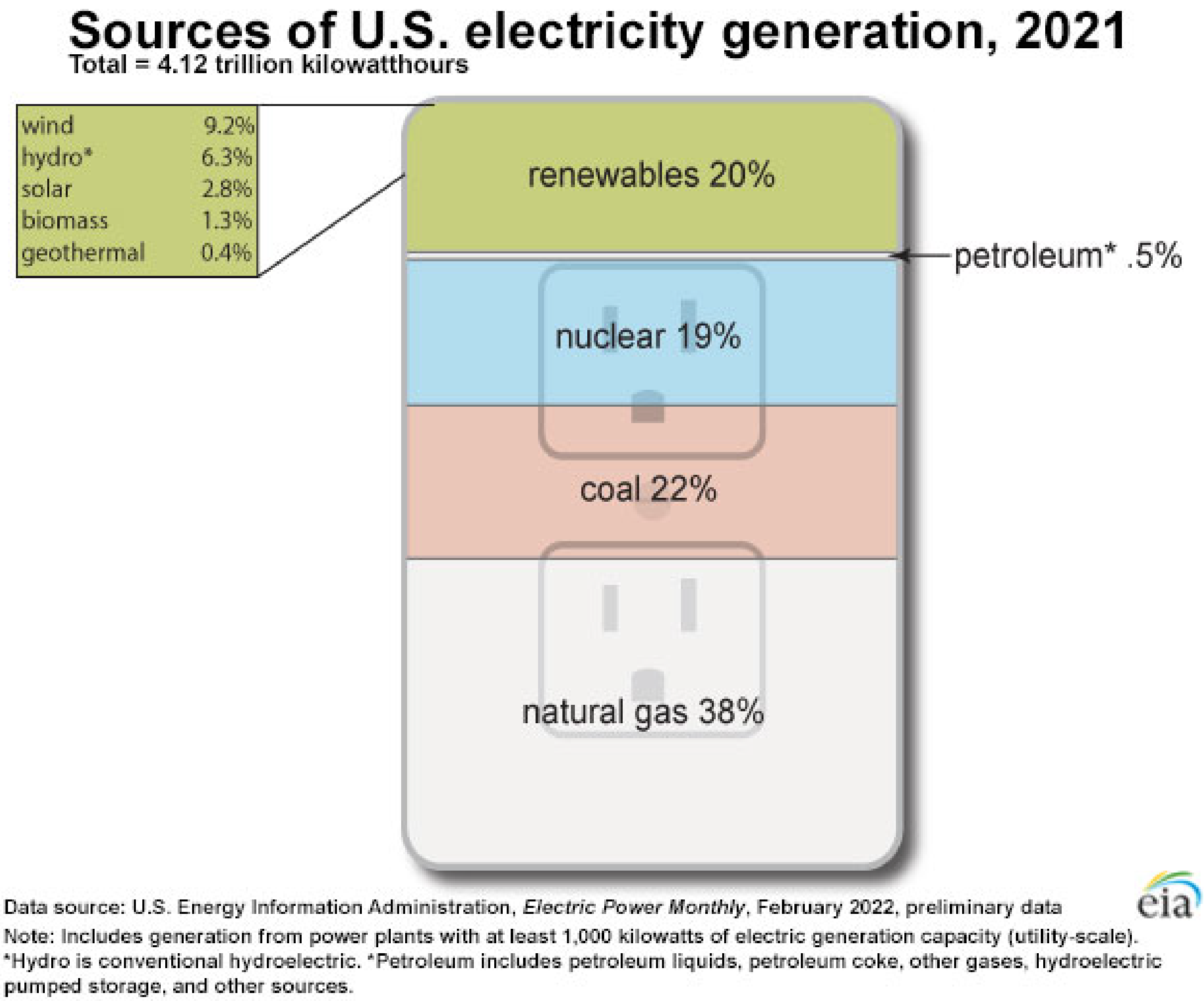
Figure 6: U.S. coal-to-natural gas plant conversions (2011-2019)



Source: U.S. Energy Information Administration, *Annual Electric Generator Report* and Preliminary Monthly Electric Generator Inventory

While natural gas use expanded rapidly, coal use in the electric industry declined dramatically. By the end of 2021, coal was providing only 22% of U.S. electricity supply (or 11% of primary energy consumption), while natural gas had moved up to 38% of electricity supply (or 32% of overall primary energy consumption). The EIA reported in August 2020 that 121 coal plants had closed or converted to natural gas since 2011. In 17 of those cases, the coal plant closed and a new natural gas combined cycle plant was constructed. In the other 104 cases, the coal-fired boiler was converted to another fuel—typically natural gas.[46]

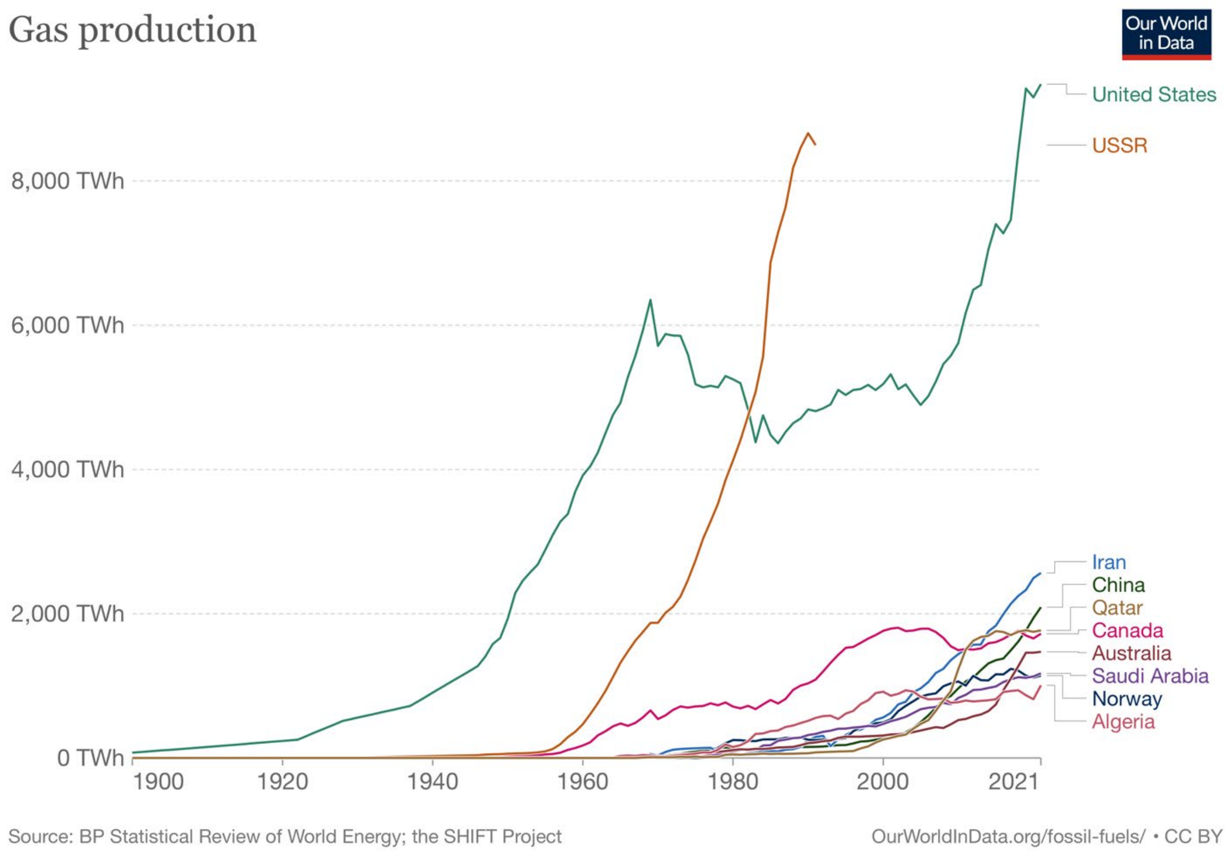
Figure 7: Sources of U.S. electricity generation, 2021



The widespread use of horizontal drilling and hydraulic fracturing technologies has deeply altered American energy production. By the end of 2020, even with rapid fuel-switching from coal to gas and rapidly increasing use, the EIA reported 473.3 Tcf of proved natural gas reserves, more than double the amount reported fifteen years earlier.[47]

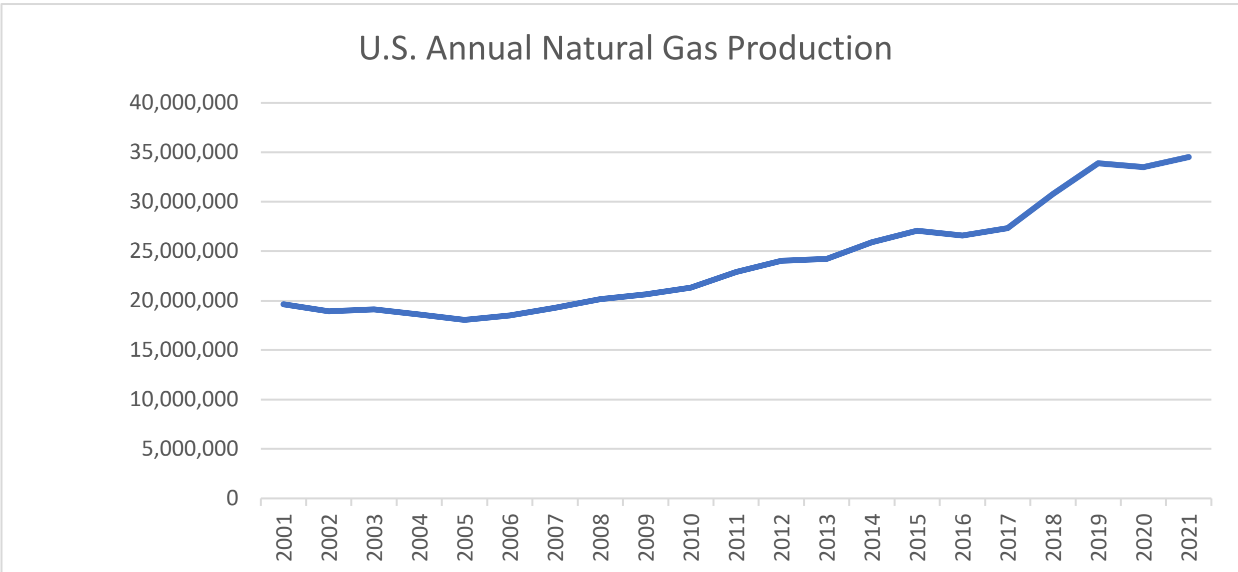
Despite the Biden administration's continued efforts to stymie production on federal lands and to stifle transportation via pipeline, production on state and private lands has kept the U.S. as a world leader in gas production.[48, 49, 50] At over 934 billion cubic meters (about 33 Tcf) annual production, America more than triples the individual production of any of the eight of the top ten natural gas producing countries in the world. The BP Statistical Review of World Energy reports that Russia, the world's second largest producer, produced just under 702 billion cubic meters, or about 24.8 Tcf, in 2021.[51]

Figure 8: Top ten natural gas producing countries in the world (TWh)



Longer-term, the Energy Information Administration reports that the expansion of horizontal drilling and hydraulic fracturing technology has allowed annual natural gas production in the U.S. to increase by more than 79% from 2007-2021.[52]

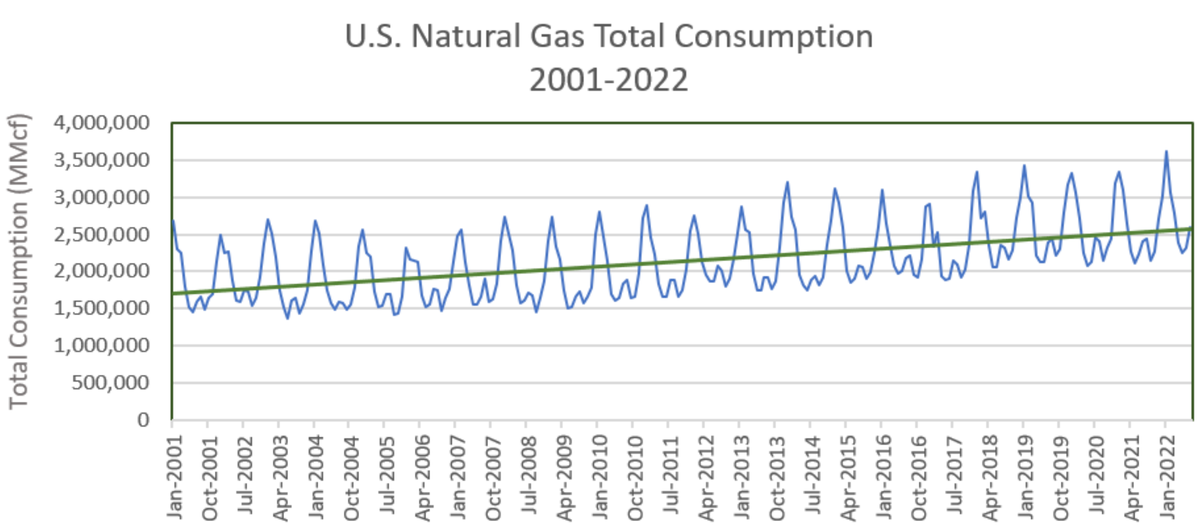
Figure 9: U.S. Annual Natural Gas Production



Source: U.S. Energy Information Administration [*https://www.eia.gov/dnav/ng/hist/n9070us2A.htm*](https://www.eia.gov/dnav/ng/hist/n9070us2A.htm)

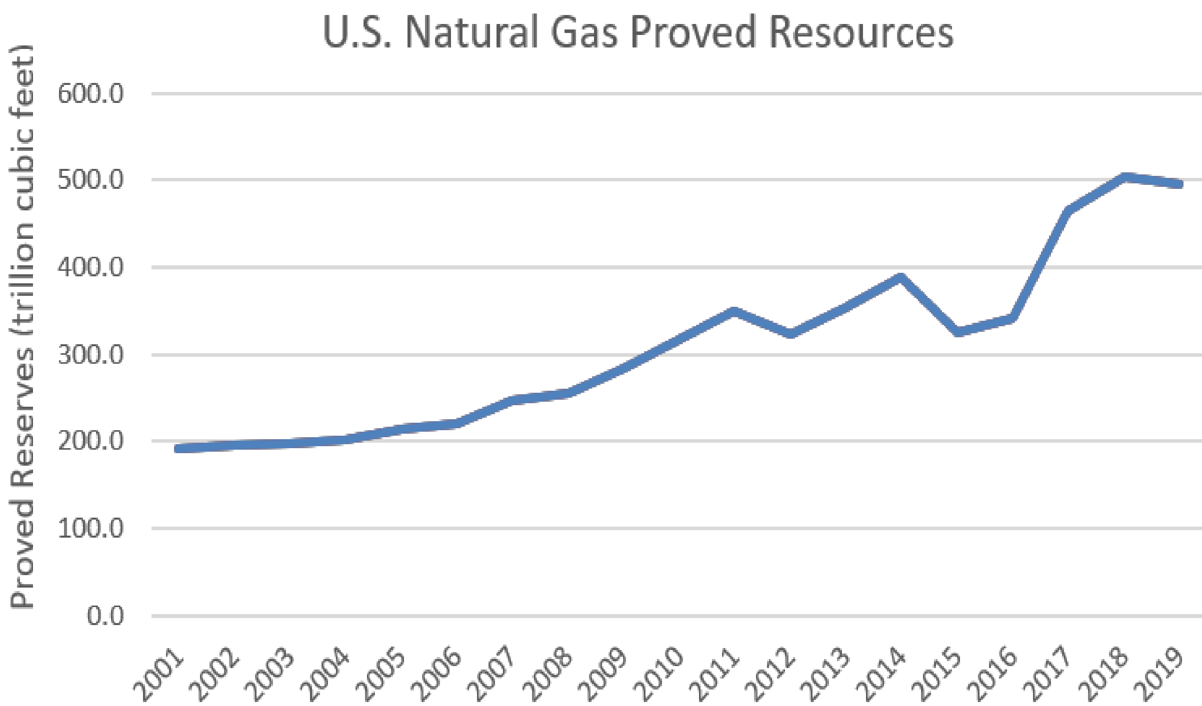
The EIA also reports that annual natural gas consumption in the U.S. has been increasing steadily since 2001.[53] But Hydraulic fracturing has allowed access to vast new reserves, sufficient to power the economy for 98 years.[54] If anti-energy policies do not slow or stop development, these technologies will likely continue to increase domestic production.

Figure 10: U.S. Natural Gas Total Consumption



Source: U.S. Energy Information Administration https://www.eia.gov/dnav/ng/hist/n9140us2m.htm

Figure 11: U.S. Natural Gas Proved Resources



Source: U.S. Energy Information Administration https://www.eia.gov/naturalgas/crudeoilreserves/

The American Petroleum Institute reports that the primary use for natural gas in America is now generating electrical power.[55] API cites EIA data showing that by 2035, 46% of new generating capacity is expected to be derived from natural gas. Even as gas use increases for electricity generation, it is also seeing increased use in home heating. API also reports that about half of American families use natural gas to heat their home, water, and food.[56]

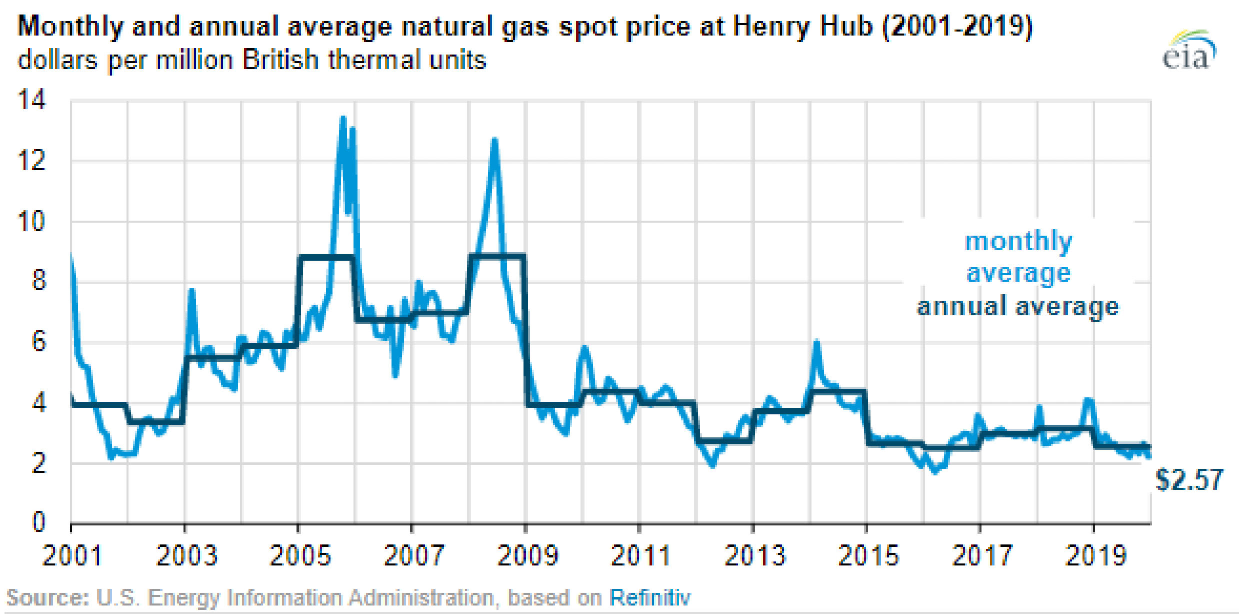
Section Three: Natural Gas—Essential to Modern Life

Natural gas is an increasingly important aspect of modern life that enables lower cost energy and reduced emissions. But gas also heats or cools homes and businesses and keeps lights, heaters, and AC units running. Natural gas is a key input to the fertilizers used daily to feed billions of people around the planet. It is an essential component in the plastics that help to protect, preserve, and make modern society possible. Natural gas also plays a growing role in transportation and in providing geopolitical stability. Reducing or ceasing natural gas production and consumption without taking these benefits into account would be deeply shortsighted.

Low-Cost Energy

Like most essential products, the price of natural gas is determined primarily by the laws of supply and demand. As the EIA graph below illustrates, the boom in U.S. shale gas led to dramatic increases in supply that allowed the price of natural gas to fall from $6.97 in 2007 to $2.57 in 2019—a decrease of 63%.[57]

Figure 12: Monthly and annual average natural gas spot price



Since households and businesses rely on natural gas for heating, cooking, and industrial processes, dropping natural gas prices meant that the cost of those applications also fell dramatically. Today, Americans pay about 40% less for electricity than the average rate for OECD‡ countries.[58] Compare that to the situation in Germany, where the government's

‡ Organisation for Economic Co-operation and Development, is a unique forum where the governments of 37 democracies with market-based economies collaborate to develop policy standards to promote sustainable economic growth.

aggressive renewables policy has resulted in one of Europe's highest electric rates. Early in 2022, the average household rate in Germany was $.44 per kWh, 2.75 times higher than the U.S. rate of $.16 per kWh.[59] The gap between German and the U.S. households is even greater when measured in terms of hours of labor required for the median worker to pay for their electricity. In 2019, the median U.S. worker needed only 1.24% of their wages to pay their electric bill. In contrast, German workers paid 4.89% of their wages, nearly 4 times as much.[60] That number would have grown much larger in 2022 if the German government had not committed to further manipulations of German energy markets. The German government spent $200 billion on emergency measures designed to shield consumers from even higher energy prices following the invasion of Ukraine. These temporary policies included suspending the surcharge for renewable sources, capping the household price on electricity, increased shipping and storage infrastructure for LNG (liquefied natural gas), and delaying the planned shutdown of two nuclear plants.[61]

The relatively low cost of energy in the U.S. not only saves consumers money, it also benefits them by indirectly raising employment and real wages. Low energy costs provide a competitive advantage for U.S. producers in an increasingly competitive global market. This advantage encourages capital investment in the U.S., which leads to higher labor productivity; higher productivity leads to higher real wages and helps to lower prices generally. [62]

The previously cited report by the White House Council of Economic Advisors estimated that the average American family of four saved approximately $2500 annually due to abundant natural gas supplies. Interestingly, these savings were progressively distributed, with poor families benefitting the most relative to their income. CEA estimated that annual energy savings amounted to nearly 7% of income for the poorest fifth of households compared to 1.3% for the richest fifth.[63]

The global economy also benefits from access to low cost, reliable energy. At present, nearly 1 billion people lack access to electricity.[64] Even more are relying on biomass sources for indoor cooking and heating which often causes dangerous levels of indoor pollution thought to contribute to more than 2 million excess deaths per year, notably among women and children.[65] In addition, lack of access to reliable electricity depresses business productivity and investment along with wages and employment. Expansion of global trade in liquefied natural gas and related infrastructure would do much to relieve energy poverty in these areas.

Food

In 1968, Stanford University biologist, Paul Ehrlich published his bestselling book, *The Population Bomb*. At that time, the world's population was slightly less than 4 billion people, but Ehrlich still famously claimed that the "battle to feed humanity is over." Of course, Ehrlich was not optimistically lauding humanity's growing productivity, made possible by improving technologies and access to affordable energy. Instead, he believed a planetary apocalypse was lurking in the wings and argued for mandated controls on human reproduction. The opening section of his book warned that, "[i]n the 1970s, the world will undergo famines. Hundreds of millions of people are going to starve to death in spite of any crash programs embarked upon now. Population control," Ehrlich predicted, "is the only answer."[66]

But the predicted apocalypse never occurred, and today, the world supports almost double the human population, with each individual consuming, on average, far more food than in the recent past. Although there are many causes for the increase in crop yields which made this possible, natural gas has played a disproportionately large and often under-appreciated role. Natural gas is the main feedstock in the production of ammonia, which is the primary source of nitrogen fertilizers.[67] The effects of these synthetic fertilizers are obvious in the experiment that recently took place in Sri Lanka.

Last spring the Sri Lankan government banned the use of synthetic fertilizers.[68] Their hope was that different techniques and natural fertilizers such as manure could be used to maintain or even increase crop yields. Unfortunately, crop yields dropped by 30% or more, devastating farmers and consumers alike. The resulting food shortages caused food prices to spike. Ultimately, the use of chemical fertilizers was reinstated.

The U.S. is the world's leading exporter of food, and access to low-cost synthetic fertilizers derived from natural gas is a key source to helping feed the world.[69] An *Our World In Data* synthesis of a study by Erisman et al. (2012) and Vaclav Smil's data in his 2004 book *Enriching the Earth* uses those sources to make the conservative estimate that "in 2015, nitrogen fertilizers supported 3.5 billion people that otherwise would have died."[70]

That is to say, half of humankind—multiple continents worth of people—are alive thanks to a single product—natural gas. As the *Our World in Data* article explains, "[i]t may be the case that the existence of every second person reading this attributes back to" the invention of nitrogen fertilizer.[71]

Plastics

Plastic is a generic term for the different types of synthetic polymers whose versatile properties have made them ubiquitous in modern life. Plastics are relatively inexpensive, moldable, lightweight, strong, and durable. They are so common in consumer products that most people hardly spend a moment of the day without coming into contact with them: appliances, tools, packaging, cleaning products, toiletries, clothing, cell phones and laptops. Less noticeable—but even more vital—are the plastics that insulate homes and electric wiring, deliver clean water, and dispose of sewage. Others promote safety and fuel efficiency in vehicles by providing a strong, but lightweight and resilient material that absorbs and redistributes the energy from collisions. More than half of what is considered rubber in automobile tires is actually a type of plastic. Even wind turbines, increasingly mandated for electricity generation, contain significant amounts of lightweight plastic.[72]

The COVID-19 pandemic also highlighted the importance of plastics to the health care industry, as personal protective equipment such as disposable gloves, masks, and face shields are all made of plastic. In addition, syringes, IV bags, and ventilator tubes all contain plastics. While stores were closed, people relied on the delivery of goods protected during shipping by plastic packaging materials. Even prior to the pandemic, heart catheters and pacemakers made from plastic have contributed for years to the decline in death rates from heart disease.

Most of the cost of plastic is determined by the price of the feedstock used in its production. There are two primary feedstocks for plastic: naphtha, a liquid hydrocarbon derived from crude oil, and ethane, which after methane is the most common component of natural gas. Both feedstocks are used to produce ethylene, which is the basic component used to produce many of the most common types of plastics and resins. Its widespread use in the manufacture of packaging materials, PVC pipes, textiles, medical devices and more have caused some to call it "the world's most important chemical."[73]

The Shale Revolution in the U.S. led to lower prices for ethane and produced a boom. From 2013 to 2021, ethane production in the U.S. almost doubled, which enabled the U.S. petrochemical industry to invest $200 billion to expand its ethylene capacity by nearly 50% during this period. [74, 75] The U.S. began to export ethane to Canada via pipelines beginning in 2014 and to the rest of the world in liquid form shortly thereafter. The U.S. is now the world's leading exporter of ethane.[76]

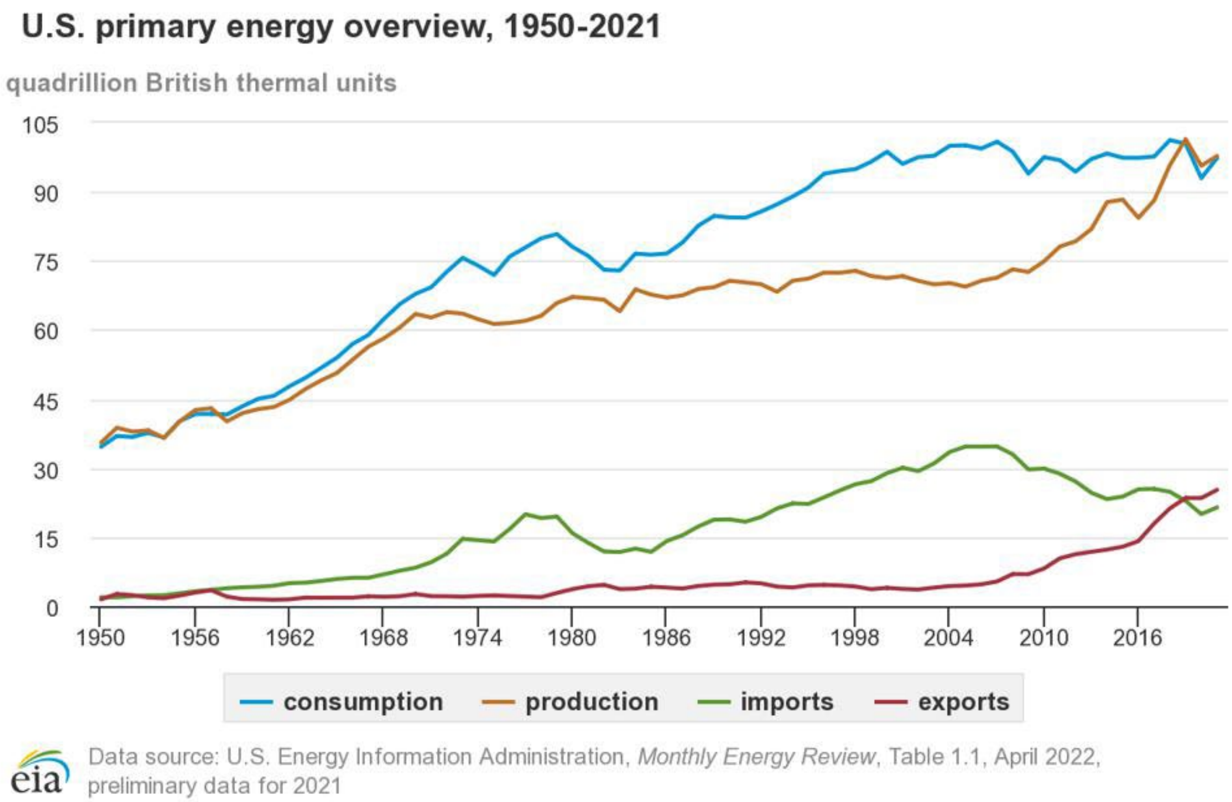
Energy Independence and Geopolitics

The combination of the 2020 COVID-19 pandemic followed by the war in Ukraine reminded many that America's dependence on foreign suppliers for many key materials such as computer chips and pharmaceuticals could become problematic.

Energy independence has been a stated goal of U.S. energy policy at least since the oil price shocks of the 1970s. The availability of abundant energy not subject to foreign control would help control inflation, provide a competitive advantage to U.S. industry, and promote national security. However, it has been an elusive goal until recently. In spite of the stated goals of energy independence, consistently expressed by both Democrat and Republican administrations, America's dependence on imported oil actually rose through the late 20th century and into the 21st century.

Throughout much of the 20th Century, American energy consumption rose more rapidly than energy production, making the nation far more reliant on production from other, often unfriendly nations. In the last decades of the century, energy independence was an explicit goal of the federal government, but no policy mix of subsidies, restrictions, or diplomacy was able to achieve it. It took investments made by the U.S. energy industry to change the national outlook. Those investments were driven by the entrepreneurial efforts of a few key individuals. The technological innovations in the oil and gas industry deployed in the last 15 years made it economically feasible to tap into unused potential reserves. After 2005, production began to accelerate and eventually caught up and surpassed consumption. In 2019, the U.S. became a net energy exporter for the first time since 1952.[77]

Figure 13: U.S. primary energy overview, 1950-2021



Today, the productive capacity of U.S. natural gas is playing a key role in the security of Europe. Although not the decisive factor, U.S. investments in natural gas shipping infrastructure will help alleviate gas shortages in Europe and maintain continuing support for Ukraine among America's European allies.

Transportation

Natural gas offers the power to reduce emissions from vehicles in one of three ways: generating efficient supplemental electricity to power electric vehicles, generating hydrogen power for fuel cell vehicles, or as a clean-burning fuel alternative.

First, electricity generated by natural gas can be used to charge plug-in electric vehicles. As government mandates and subsidies inefficiently continue to push battery-powered vehicles, the burden on existing electricity infrastructure will increase. Charging those vehicles will require a steady, predictable flow of electricity, something that intermittent, weather-dependent sources cannot deliver in sufficient or reliable quantities. Most electric vehicle owners prefer to charge their vehicles at night when the sun doesn't shine and the wind may or may not blow. This preference is not surprising since most electric vehicles are parked while owners sleep and utility companies typically offer their most favorable time-of-day rates. A recent study from Stanford University found that if this behavior continues, electric generating capacity would have to increase by 25% within the next ten years.[78]

Electricity generation powered by natural gas is the most efficient and reliable way to rapidly ramp up supplemental electricity generation during peak load periods, using technologies like simple cycle gas turbines or reciprocating internal combustion engines. Compared to other energy sources, these natural-gas-powered technologies can be brought online or taken offline relatively quickly, although doing so reduces their efficiency and raises both emission rates and costs compared to continuous operations.[79]

Second, natural gas can be used to generate hydrogen to power fuel cell electric vehicles. Hydrogen fuel cells emit nothing but water vapor. Unlike batteries which have relatively high weight to energy capacity and relatively long charging times (making them unlikely candidates for heavy duty and continuous use), the fuel cell is relatively light and can be refilled quickly. But even though hydrogen is plentiful, it must be separated from other molecules to be useful. Hydrogen can be isolated from water but doing so takes massive amounts of electricity which makes that technique economically infeasible using current technology. It uses much less energy to produce hydrogen using the "steam-methane reforming" process in which super-heated steam is used to extract the hydrogen from natural gas. Today, 95% of hydrogen in the U.S. is produced using this method.[80]

Third, as a gas, natural gas has a relatively low energy density compared to diesel fuel, so it must be liquified or compressed to be useful directly as a fuel for vehicles. Compared to diesel, compressed natural gas is a relatively inexpensive, clean burning fossil fuel.[81] CNG vehicles produce about 30% lower carbon emissions and 20% to 80% less of the emissions typically associated with diesel engines. Depending on the engine design, CNGs can reduce nitrous oxide, sulfur dioxide or carbon monoxide emissions by 80% or more, and particulate matter by as much as 99%.

Because CNG engines are internal combustion engines, they rely on the same type of infrastructure and manufacturing technology that support gasoline-powered vehicles. In addition, existing gasoline vehicles can be retrofitted to use CNG. Consumers who purchase a home-filling appliance can refill their tanks overnight, similar to owners of EVs. For homeowners looking for a greener alternative to gasoline without the range anxiety of EVs, CNG offers a potential solution.

CNG has been used in vehicles since the 1970s and there are now an estimated 23 million natural gas vehicles worldwide, with the vast majority of those being passenger vehicles. China has been promoting the adoption of natural gas vehicles for more than a decade as both a way to combat urban pollution and reduce CO_2 emissions. Today China reports the use of 7 million compressed natural gas vehicles, the largest number of any country.[82] In Europe, Italy is the leading market for natural-gas-powered vehicles with nearly 900,000 produced. By comparison, there are only 175,000 compressed natural gas vehicles on the road in the United States today.[83] This is surprising considering the relatively low and stable price of natural gas compared to gasoline and diesel fuels. The bright spot in the U.S. market remains in fleet sales where it is increasingly being used as a substitute for diesel engines in heavy-duty trucking and mass transit. As of 2019 there were more than 20,000 CNG buses in the U.S., totaling about 30% of existing transit buses.[84] In addition, 35% of new buses for mass transit run on natural gas.[85] In these applications, CNG has performance and cost advantages over battery-powered vehicles.

Section Four: The Environmental Benefits of Using Natural Gas

An early stop in the education of any student of environmental or energy policy is the concept of the Environmental Kuznets Curve.[86] Developed throughout the 1950s and 1960s by Nobel Prize recipient in economics Simon Kuznets, this hypothesis suggests that as nations increase in economic activity and wealth, their developing economies will tend to decrease economic inequality. This theory was extended to address environmental quality as well, noting that the pollution associated with industrial growth will first increase along with the growth of industry but then decrease as increasing wealth allows citizens to prioritize spending on environmental protection and conservation. The theory suggests that wealthy countries tend to have very clean environments.[§]

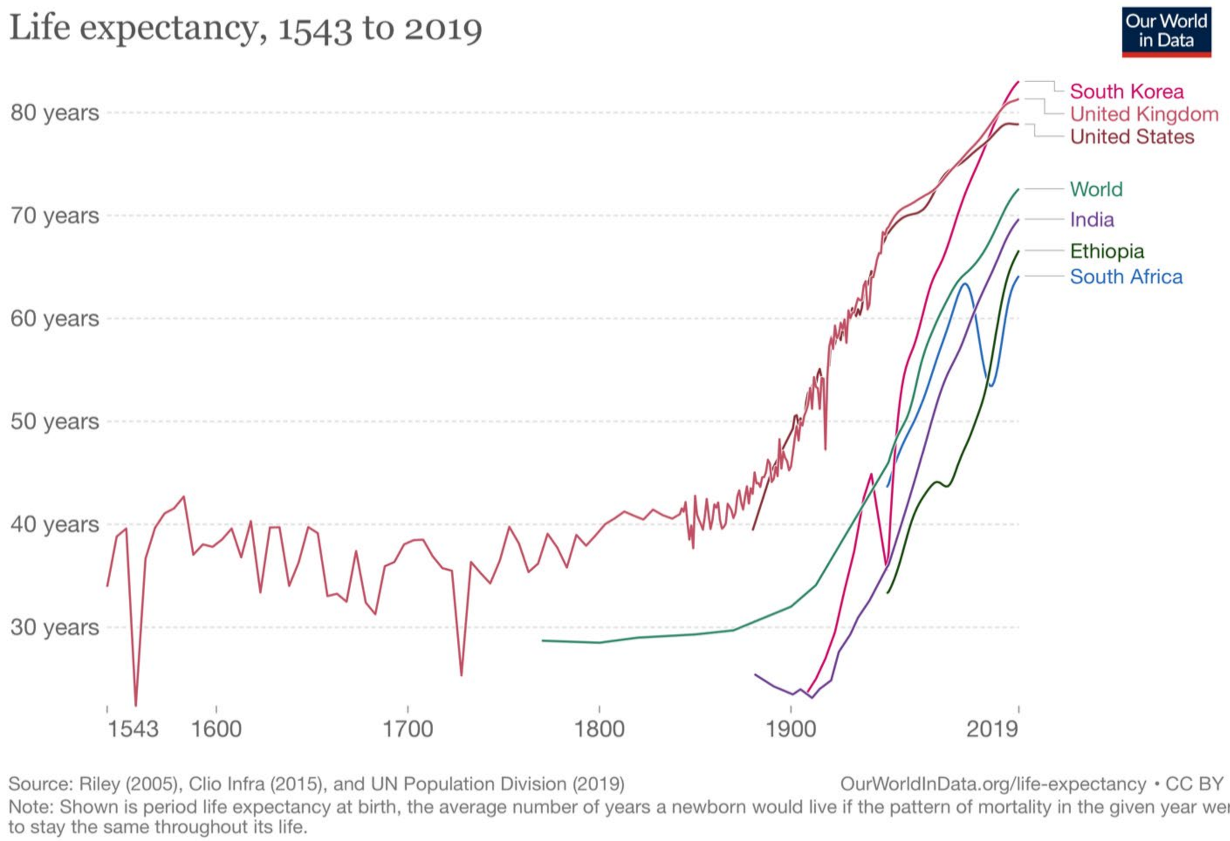
As noted previously in this paper, one of the key reasons western economies have been able to grow so rapidly and efficiently is due to the presence of affordable, reliable supplies of energy. That energy and improving economic well-being has played a direct role in the ability to focus so much attention to cleaning up the natural environment and, as an extension, improving human lives.

Increasing Life Expectancy

Data collected by *Our World in Data* indicates that, in the aftermath of The Industrial Revolution, human life expectancy has doubled across the planet. "In all world regions life expectancy was well below 40 years" until the late 1800's. However, rapid advances in dealing with infectious diseases, childhood mortality, improving medicines, and public health measures, as well as rapid increases in food production (among other reasons) have led to a rapid increase in life expectancy.[87]

[§] Empirical work has verified the logic of the Kuznets curve for local environmental quality but some critics push back against its application to global CO_2 emissions. They claim the graph is "N-shaped," rather than V-shaped, in this case as CO_2 emissions may decrease initially, but then will grow again. While they do make this argument, the examples of Western nations described in this paper argue against the N-shaped curve idea. This is because developed economies are closing older and less efficient coal plants and opening more efficient forms of energy generation, including HELE coal, natural gas, and nuclear. However, those arguing in favor of a N-shaped curve also tend to demand wind and solar over fossil fuels and nuclear. In doing this, they ensure increased CO_2 emissions as they force less-efficient uses of natural gas for rapidly ramping single cycle gas turbines and RICE systems over more efficient combined-cycle turbines. Many greens, such as the Sierra Club, also actively campaign against the use of nuclear energy sources. However, by closing nuclear and forcing less-efficient uses of natural gas, green groups and compliant governments actually ensure higher overall emissions.

Figure 14: Life expectancy 1543 to 2019



Fossil fuels have been a key factor in driving both improved human health and environmental outcomes. While many environmental groups will argue the health and potential climate impacts associated with fossil fuels lead to an overall net negative impact, arguments by energy experts like Alex Epstein in his book, *Fossil Future*, demonstrate the flaws in that thinking. Epstein describes how fossil fuels produce "ultra-cost-effective machine labor, enormous amounts of freed-up mental labor, and materials that radically increase humanity's productive ability."[88] He explains that the use of fossil fuels allows humans to transform "our naturally deficient, dangerous, low-opportunity, stagnant planet into an unnaturally nourishing, safe, opportunity-filled, progressing world."[**]

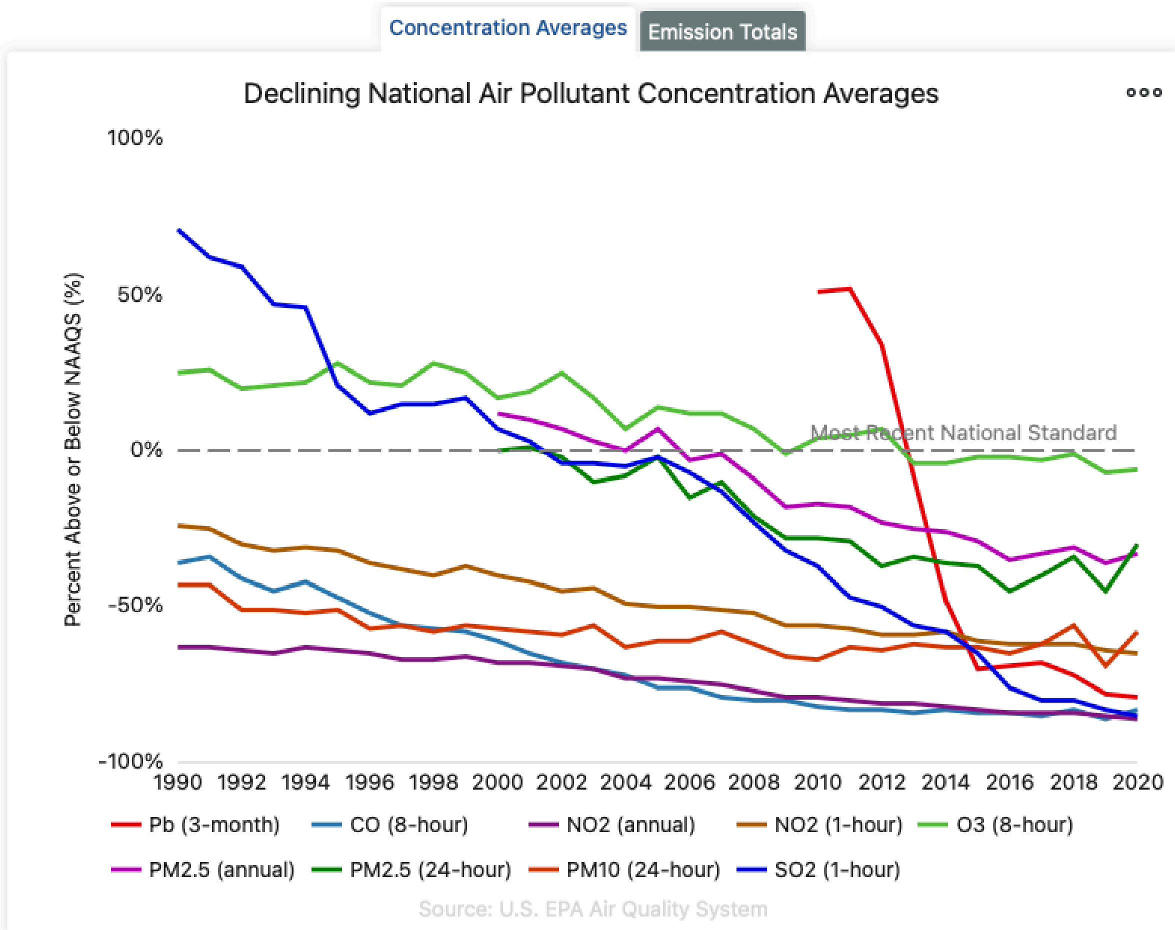
As productive capacity has increased, demand for energy has kept pace. During this phase of energy growth, the ability to fuel-switch from older coal-burning facilities to newer and more efficient natural gas facilities has played a significant role in the continued reduction of air pollutants. American efforts in that area have been extremely effective.

[**] Epstein does not deny that there are environmental impacts associated with using fossil fuels, but he points out how fossil fuels so expand the human capacity to do worthwhile work that the benefits of using them easily outweighs the potential harms they might cause.

Air Quality Trends

EPA data demonstrates that, from 1970 to 2020, combined emissions of the six criteria air pollutants tracked by the federal agency — particulate matter (2.5 and 10 microns), oxides of sulfur, oxides of nitrogen, volatile organic compounds, carbon monoxide, and lead — had dropped by 78%.[89]

Figure 15: EPA Declining National Air Pollutant Concentration Averages



Many will still argue that natural gas is a fossil fuel and that using it releases CO_2 into the atmosphere. However, fuel-switching from coal to natural gas has allowed the U.S. to lead the developed world in reductions of greenhouse gas emissions. This is because using natural gas to produce energy generates about half of the CO_2 emissions produced by using coal for the same amount of energy. The EIA notes, "about 117 pounds of CO_2 are produced per million British thermal units equivalent of natural gas compared with more than 200 pounds of CO_2 per MMBtu of coal and more than 160 pounds per MMBtu of distillate fuel oil."[90]

Methane

Opponents may argue that because methane is a more powerful greenhouse gas than carbon dioxide, even small amounts of leakage from its production, delivery, and combustion could offset the benefits of reduced carbon dioxide emissions on climate. However, while methane is considered to be more potent of a greenhouse gas, it has a far shorter residence time in the atmosphere than CO_2: 9-12 years vs. centuries for CO_2.[91]

Additionally, the North American oil and gas industry is far more efficient than many of its international competitors. The International Energy Agency publishes a global methane tracker that demonstrates Russian natural gas production emits 30% more methane per unit of energy produced than American producers.[92] The tracker suggests that "almost all national inventories have been underreporting emissions" and that "emissions from the energy sector are about 70% greater than the sum of estimates submitted by national governments." The IEA also notes that many areas across the globe are not open to satellite observation and specifically points out "the main Russian oil and gas producing areas" are off limits to measurement. It is likely, therefore, that Russian emissions are higher than being reported. The tracker also claims that "large leaks from oil and gas operations were detected by satellite in fifteen countries in 2021, with significant emissions from the Permian basin in Texas and very large leaks in parts of Central Asia."[93]

But National Oceanic and Atmospheric Administration research published in 2017 indicates that, while global methane emissions have increased, fugitive emissions from natural gas production may not be the culprit. NOAA researchers point out that "air samples collected at different latitudes around the world show that the amount of methane carrying carbon-13 — a rare isotope of carbon — has dropped significantly since 2007."[94] That "chemical fingerprint" is key because carbon-13 is associated with the production of fossil fuels. Instead, the researchers "point toward agricultural and wetland emissions from the tropics" as the source of rising methane levels, not fossil fuels.

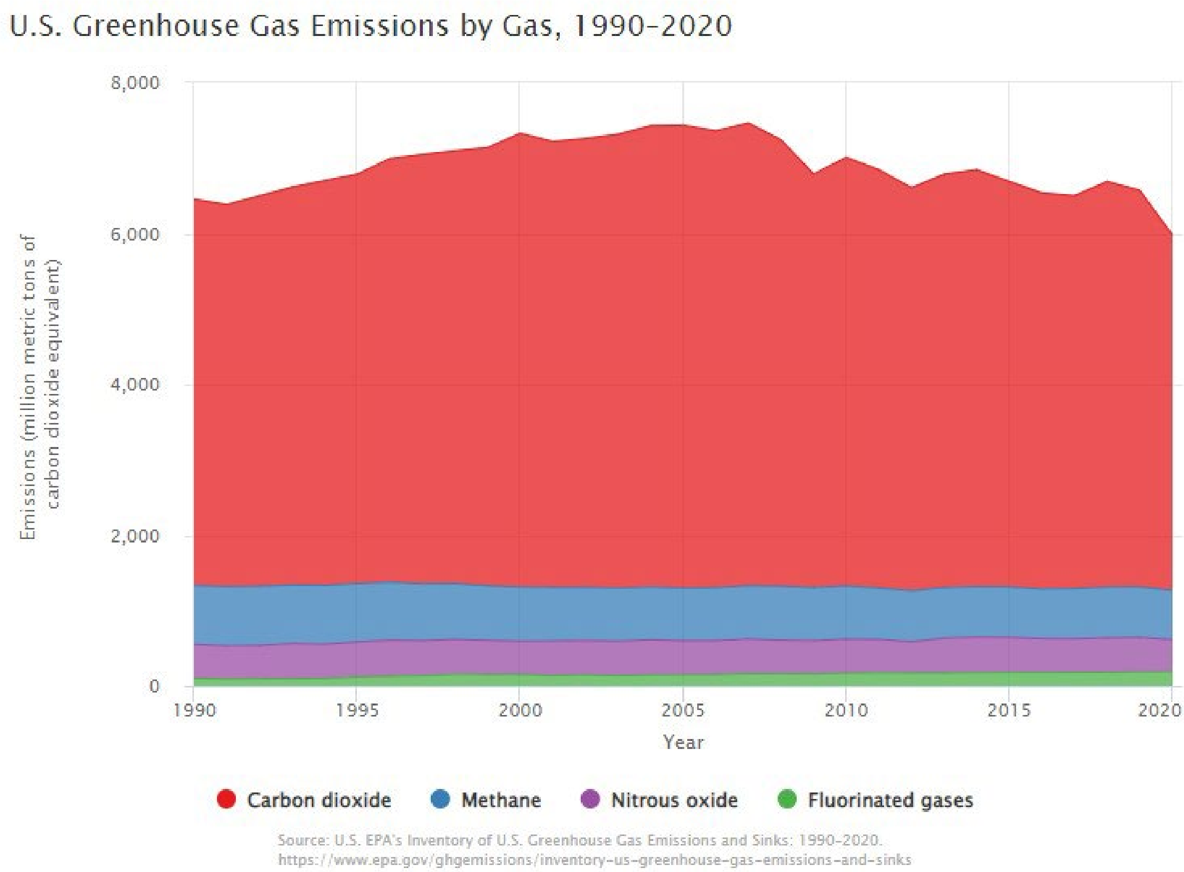
Despite this news, American oil and gas producers have still publicly committed to further reductions in fugitive emissions. Their history shows they can meet these commitments. The Independent Petroleum Association of America (IPAA) correctly argues that producers "have every incentive to capture and sell as much of this product as possible to American consumers, rather than letting it escape into the atmosphere."[95] An IPAA report, "Energy In Depth," states that, while American producers have increased oil and natural gas production by 80% and 51% respectively, they have reduced methane emissions by 14%. These operators understand that pollution is wasteful and stiff competition amongst oil and gas producers forces them to maximize efficiency.[††]

[††] While free market solutions are already addressing pollution issues, government regulators have also imposed additional regulatory pressure and legal liabilities on the industry by mandating further reductions. While ideological visioning documents published by government typically fail to meet their grand visions, the White House "U.S. Methane Emissions Reduction Action Plan," which was released in November 2021, claims the emissions reductions it proposes "would reduce by approximately 75% emissions from the sources, equipment, and operations that the proposal covers." The plan expects that 41 million cumulative tons of methane reductions

Carbon Dioxide

The EPA reports that American "greenhouse gas emissions in 2020 (after accounting for sequestration from the land sector) were 21% below 2005 levels."[96] Green groups and progressive special interests decried efforts to remove the U.S. from the Paris agreement during the Trump administration's tenure. However, reducing CO_2 emissions 21% below 2005 levels brought the United States significantly below the Obama administration's initial "2020 target of net economy-wide emissions reductions in the range of 17 percent below 2005 levels."[97]

Figure 16: EPA - U.S. Greenhouse Gas Emissions by Gas, 1990-2020



While emission levels continued to drop during the COVID-19 lockdowns, rebounding economic activity slowed reductions and the Global Carbon Project's Global Carbon Budget 2021 projected emissions for the United States would remain 4.5% below its 2019 levels.[98] In the U.S.

will occur between 2023 and 2035 and it directs "the EPA to issue regulations under the Clean Air Act to reduce the oil and gas industry's methane emissions."

Government's submission to the United Nations Climate Change Nationally Determined Contributions Registry, the Biden administration points out that the U.S. is "broadly on track to achieve 26-28 percent emissions reductions below 2005 levels in 2025." However, it has set far more aggressive and costly goals of 50%-52% reductions below 2005 in 2030.[99, 100] While not officially established as the nationally determined contribution, the Biden administration has stated a clear goal of "driv[ing] toward net zero global emissions no later than 2050."[101] This administration has also signed an executive order committing the nation to achieve "a carbon pollution-free electricity sector by 2035 and net-zero emissions economy-wide by no later than 2050."[102]

It's worth reiterating that, up to 2020, significant reductions were achieved despite the fact that the U.S. was exiting the Paris Agreement and the use of natural gas was increasing. It's clear that these international mandates are not required to address environmental concerns. Environmental successes and greenhouse gas reductions that have happened as a result of fuel-switching in the U.S. are likely to be even more important elsewhere in the world, particularly in China. China is estimated to have even more shale gas than the U.S., although, at this point they have not exploited it.[103] EIA data indicates that China generates almost ten times as much of its electricity from coal as from natural gas[104] and its recent increases in coal generating capacity are equivalent to building "more than one large plant every week."[105] China has announced plans to use natural gas as a bridge fuel in its stated aims of achieving carbon neutrality by 2060.[106] While there are significant reasons to question their commitment to greenhouse gas reduction targets, if China follows through, their plan could result in a significant reduction of carbon dioxide and other emissions associated with energy generation.

Increased use of low-cost natural gas following the Shale Revolution led to substantial improvements in air quality in the U.S. Reduced emissions of pollutants associated with electricity generation is tied to reductions in respiratory illnesses, especially in the heavily populated areas in the northeast.[107] If similar transitions occurred in developing nations—natural gas substituting for biomass for heating and cooking—improvements in indoor air quality would save thousands of lives annually.

Wildlife Conservation

Although it may initially appear counter-intuitive, natural gas has also played an important role in wildlife conservation. Contrary to popular belief, the biggest threat to wildlife isn't climate change; it is loss of habitat. A recent study published in the *Journal of Conservation Science and Practice* examined the impact of climate change, pollution, invasive species, and other potential causes of extinction. It concluded "habitat destruction threatens more species than all other categories combined, **climate change the fewest**."[108, ‡‡] This is significant because a primary cause of habitat loss is agricultural land use. By dramatically increasing the productivity of existing farms, synthetic fertilizers have reduced pressure to convert undeveloped land to

[‡‡] Emphasis added

farmland. The reduced need for land means some previously cleared agricultural lands can return to a more natural state. Dr. Indur Goklany of the CO_2 Coalition estimates that without fossil fuel-based technologies, the amount of farmland required to feed humanity would increase from 12% of global land area to 32%, an increase that would devastate wildlife conservation. In addition, he points out that the land footprint of electric utilities powered by natural gas is only about one-third those relying on renewable sources.[109]

Section Five: Lessons from North America

Green Groups Push to Halt the Use of Natural Gas

The oil and gas industry has already played a direct role in reducing North American emissions and has committed to further emissions reductions. Despite this, green campaigners still push to halt the use of this important fuel. While these groups have been willing to temporarily recognize natural gas as a "transition fuel," they have made it clear that they will work to stop its use.

In their anti-energy campaigns, progressive green groups like the Sierra Club now attempt to paint efficient new combined-cycle natural gas developments with the same brush they use to attack much older pulverized coal technologies that were designed and have been in operation for many decades.[§§] They demand that North America stop the use of reliable and affordable domestic energy resources by "moving beyond coal and gas." On its website, the Sierra Club demands that the nation "close all US coal plants," "stop all new gas infrastructure," and "stop the expansion of fracked gas."[110]

Unfortunately, many policy makers listen to these dangerous demands and implement policies aimed at restricting oil and gas exploration, development, and transportation. But when this happens, the investments in energy and infrastructure that have made so many improvements in energy supply, reliability, and pricing, as well as human health and well-being possible face serious political uncertainty. Energy policy, like American politics today, has become much more polarized. Investments in energy are capital intensive and take many years to complete. An inconsistent policy environment will discourage investments in domestic energy supplies, and the energy industry has been subjected to a great deal of political uncertainty in recent years.[111]

There are manifest dangers posed to human health and well-being when essential sources of energy are simply "left in the ground." When green groups and elected officials demand ever-tightening climate targets and force the closure of reliable electricity generation facilities, they directly endanger human health and life. As reliable fossil and nuclear plants are shut down, electricity and energy systems across the nation are showing signs of growing instability and fragility. Clear examples include Michigan's near-system wide failure during the January 2019 Polar Vortex event, the now frequent grid instability issues experienced in California during normal summer conditions, and the state-wide blackout that struck Texas in February 2021. The push by ESG-guided financial interests to limit investment in reliable energy sources and

[§§] This type of attack is akin to ranking the most recently released model of hybrid electric automobile as being similar to a 1960's era family sedan because they both run on gasoline. The two were designed using very different levels of technology to achieve very different goals. They have very different levels of efficiency making the attempt an apples vs. oranges comparison.

the building energy crisis in Europe in the run up to the winter of 2022-23 stands as equally pressing concerns.

Michigan electricity grid reliability

In late January 2019, Michigan (and much of the American Midwest) was in the grips of a Polar Vortex event plunging temperatures to as low -20°F /-29°C. Even winterized wind turbines throughout the region effectively froze in place as a result of the extreme cold and solar produced little, if any, additional energy. Together, wind and solar made up less than 5% of the regional fuel mix, while natural gas, coal, and nuclear supplied the bulk of demand. While utilities were already strained to meet high demand for both natural gas and electric services, Consumers Energy's Ray Compressor Station suffered a fire and explosion, immediately restricting over 60% of the natural gas going through the utility's infrastructure.[112] The incident exacerbated a bad situation and starkly illustrated that the region's electric grid would be extremely hard-pressed to keep up with customer demand without natural gas.

Figure 17: Screenshot of text message sent to Michigan residents on January 30, 2019

Residents across the state received a rushed-out text message from the state's emergency warning system that instructed people to immediately turn their thermostats to 65°F or less to avoid system-wide instability. For most residents that discomfort and uncertainty during a period of high demand represented an introduction to big utility plans to impose "demand response" programs as a means of maintaining grid reliability.

Rather than ensuring utilities have sufficient reliable generating capacity—as they did in the past—they are now focusing heavily on climate mitigation policies and prioritizing the rapid closure of larger, baseload generation facilities that use fossil and nuclear fuels. In their place, utilities intend to rely on the construction of weather-dependent renewable energy sources. But when weather conditions are not amenable to producing electricity and wind or solar facilities fail, utilities inform their customers that they must restrict their use as a means of reducing demand on the electric grid—demand response in a nutshell. For the average person, these programs equate to restricted access to electricity as a new preferred method of avoiding blackouts.[113]

Demand response programs are being implemented by many large electric utilities across the nation. For example, two of Michigan's major utilities, DTE Energy and Consumers Energy Company, plan to meet net zero CO_2 emissions targets, DTE by 2050 and Consumers by 2040. Both utilities have had long-term integrated resource plans, or IRPs committing them to emissions reductions that have been approved by state regulators, the Michigan Public Service Commission.

In its 2022 IRP filing, DTE has indicated an intention to close its coal-fueled generation plants by 2035. By 2042, the utility expects that natural gas will supply 20% of customer demand, 62% will come from renewable sources—wind and solar primarily, 12% from nuclear, and 6% is expected from battery and pumped hydro storage.[114] In contrast, Consumers Energy has proposed a more radical vision. They intend to cease all coal generation by 2025. Then, by 2040, then intend to meet 63% of customer demand with renewables, 15% with customer efficiency programs/ demand response, 12% with battery and pumped hydro storage, and 10% with natural gas.[115] Consumers Energy has also worked with Entergy, the owner and operator of the utility's single nuclear plant, to hurry the closure of that plant in the summer of 2022,[116] nine years before its operating license expired.[117]

But as utilities get these net-zero CO_2 plans published and approved, regional, and national electrical grid managers have begun sounding warning bells. They are warning that utility plans to restrict and close supplies of reliable fossil and/or nuclear generation in favor of intermittent and weather-dependent renewable energy sources is dangerous. In the lead up to higher summer demand for electricity in 2021, the North American Reliability Corporation published their 2021 Summer Reliability Assessment, which warned that the North American electricity grid was at an "elevated or high risk of energy shortfalls."[118]

NERC repeated that warning again in May 2022, noting there was a "high risk of energy emergencies during peak summer conditions." NERC's CEO, Jim Robb, noted the increased risk of outages was caused by a mix of high heat and drought in western states, as well as the ongoing transition toward "low-carbon resources" of electricity generation, and the "disorderly retirement of older generation." Robb noted these retirements are "happening too quickly."[119] He explained that, to remain reliable, an electric grid must "balance reliability, affordability, and its environmental impact." But he also noted that, "we get in trouble...when we overemphasize one of those three dimensions." Additional studies, completed by NERC in 2022 indicated that planned battery backups for wind and solar would prove insufficient and that "additional investment in natural gas infrastructure" would be needed to maintain the reliability of the electric grid.[120]

At the regional level, the Midcontinent Independent System Operator, which is responsible for overseeing grid reliability for 15 U.S. states and the Canadian province of Manitoba, published the results of its 2022/2023 Planning Resource Auction in April 2022. The PRA results demonstrated that "accredited capacity"—generation facilities that can be relied on to produce electricity on demand as opposed to when weather conditions cooperate—"has decreased due to thermal retirements and the increasing transition to renewables." The PRA noted that, as a result of the rushed transition to renewables, significant portions of the region "have increased risk of needing to implement temporary controlled load sheds"—service limitations or rolling blackouts.

The solution to maintaining reliable electricity services is to maintain existing facilities and add new generation capacity based on fossil fuels, like natural gas, or nuclear.[121] In fact, a July 2022 report, published by Goldman Sachs Asset Management, explained that "quadrupling U.S. LNG capacity to 55 Bcf/d by 2030 to replace international coal use" use would "reduce international CO2 emissions by an additional 1.1 billion metric tons per year."[***, 122]

Attacks on Line 5

At the same time as the region is experiencing growing electric system instability, there is a strong push to reduce the availability of the midstream infrastructure used to transport crude oil, natural gas, and natural gas liquids. In one example, over the past four years, there has been a targeted campaign by Michigan's Governor Gretchen Whitmer to force the closure of the Line 5 pipeline, especially the section of the pipeline that crosses the Straits of Mackinac between Michigan's Upper and Lower peninsulas.[123]

"Enbridge's Line 5 pipeline consists of dual 20-inch pipes that daily transfer 540,000 barrels of light crude oil and natural gas liquids through the Straits of Mackinac to refineries in Canada and across the American Midwest."[124]

Citing concerns about a possible oil spill in the Great Lakes, the governor and Michigan's Attorney General have employed a string of legal tactics intended to close the pipeline permanently. This is unfortunate as the pipeline daily supplies the entire Midwest region and the Canadian provinces of Ontario and Quebec with an essential mix of transportation and heating fuels: propane, gasoline, diesel, and jet fuel.[125]

The loss of this essential piece of energy infrastructure would hit low-income and middle-class families that rely on the energy it provides the hardest. The plan to close the pipeline is also wholly unnecessary as Enbridge, the company that operates the pipeline, has agreed to build a

[***] The Goldman Sachs report accepts at face value the notion that wind, solar, and EV use will reduce CO2 emissions and makes the claim that quadrupling American LNG production would have the same emissions reduction impact as electrifying all U.S. vehicles, powering every American home with solar and battery backup, and adding 54,000 industrial-scale wind turbines (doubling U.S. wind capacity) all combined. In reality, this list of three has questionable ability to actually reduce overall CO2 emissions as the intermittency of wind and solar force inefficient use of natural gas facilities for load following and peaking capacity. See: David Stevenson. "No Emission Reduction Gained from Increasing Wind & Solar," (Caesar Rodney Institute, June 20, 2022). https://perma.cc/YX9P-S3S7.

EVs add in the issue of the embedded CO2 emissions associated with their manufacture, as well improving or decreasing in their actual emissions profile depending on the make up of the grid on which they depend for their charging. See: Bjorn Lomborg. "Policies Pushing Electric Vehicles Show Why Few People Want One" (Wall Street Journal, September 9, 2022).

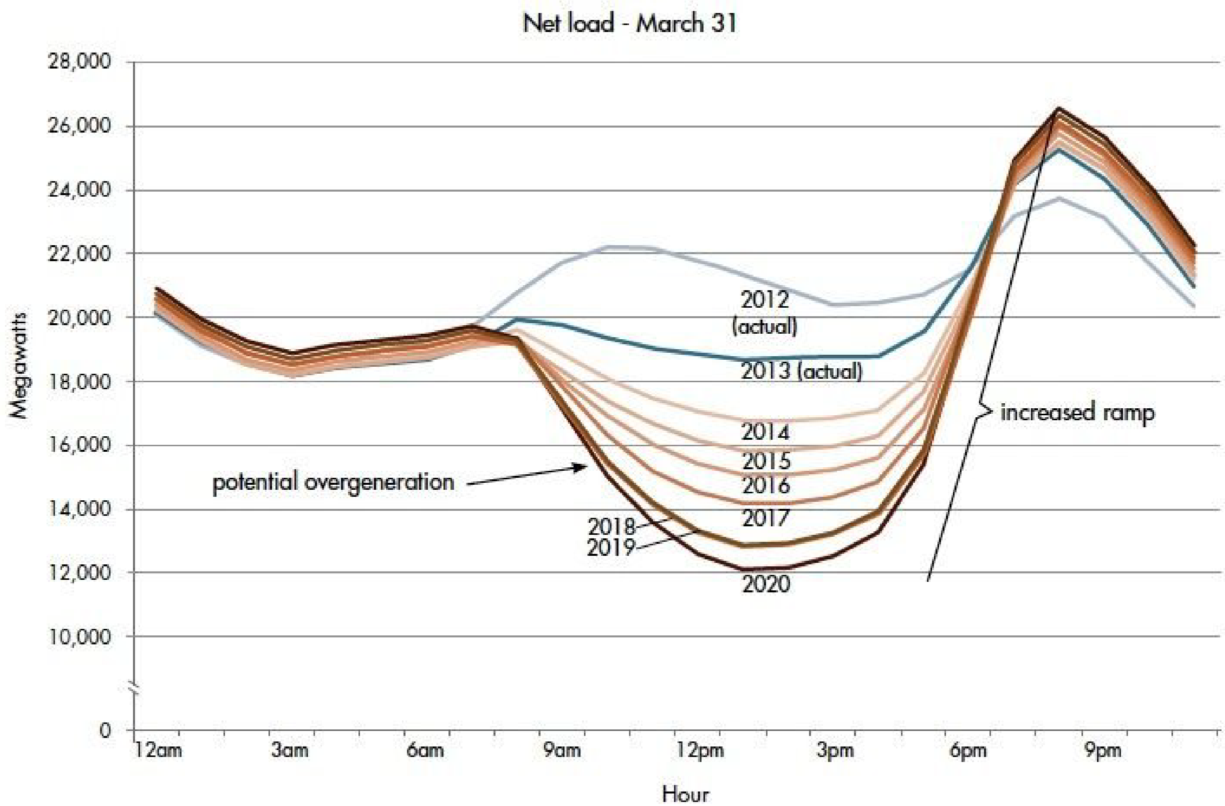
concrete-lined tunnel, one hundred feet below the bed of the lakes and to relocate the section of the pipeline that crosses the Great Lakes to that tunnel.[126] Allowing this tunnel project to go forward would protect the natural environment by removing the pipeline from the waters of the lakes. Research by the Consumer Energy Alliance also indicates that building the tunnel would protect nearly 34,000 jobs and over $20 billion in economic activity across the Midwest, among many other benefits.[127]

California's now habitual summer blackouts

The state of California has long styled itself as the prime representative of the nation's environmental conscience. However, that belief has also positioned the state as the progenitor of the nation's growing energy crisis.

Much like the above-noted utilities in Michigan, California has implemented a policy of shuttering large reliable generation facilities—both fossil and nuclear—while rapidly expanding its reliance on solar generation. But overbuilding solar generation ensures that the state is oversupplied with electricity during the middle of the day, when the sun is shining. Then, as the sun begins to descend in the early afternoon, the state finds itself in need of an energy source that can rapidly ramp up to meet demand. At this time of day, people are returning home from work and turning on home appliances: stoves and ovens, air conditioners, etc. These rapid changes in demand, paired with the sudden daily drop off of solar generation, challenge California's utilities to meet net demand, causing a situation known as the duck curve. [128]

Figure 18: California net load curve / Duck Curve
Source: Energy.gov



Inevitably, as the state encounters high heat days during summer months, utilities struggle to provide customers with reliable electricity services.[129] State regulators respond by imposing alerts that warn residents to stop using electricity and demand they avoid charging electric vehicles from between 4-9 pm.[130] Not surprisingly, when solar fails to provide sufficient electricity for residents, the state has sought to avoid blackouts by appealing to federal regulators for approval of emergency orders allowing expanded use of natural gas.[131]

Despite the growing stability issues with their grid, California continues to require every new home to have solar panels installed before they can be sold.[132] In addition, in 2021 the state restated its commitment to require "that renewable and zero-carbon energy resources supply 100 percent of electric retail sales to customers," as well as the need to build a "carbon-free grid."”[133] Together with this growing instability, high electricity rates brought on by the state’s heavy reliance on renewable sources, are likely to harm efforts to further electrification.[134] These difficulties are compounded by other mandates and regulations, such as those requiring residents to transition to so-called zero-emission electric vehicles and banning the sale of new internal combustion engine vehicles by 2035,[135] or those regulations that will significantly limit, or effectively ban, the sale of all small, off-road engines by 2024.[136, 137]

Texas's statewide blackouts – February 2021

In February 2021, Texas experienced an unusual, but not unprecedented, cold snap.[138] Surging demand for electricity and natural gas for heating stressed the state's grid beyond the ability of utilities to increase supplies. Several insufficiently winterized generation facilities froze or ran out of fuel and wind turbines across the state ground to a halt. As the state's second largest source of electric power, wind had supplied 42% of the state's electricity demand only a few days earlier. But with a cold front advancing across the state, it dropped to less than 8%.[139] According to ERCOT data, reported by JP Morgan, of over 25 GW of available wind generation facilities, only 0.6 GW of wind, or 2.4% of installed capacity, remained online during the cold snap (see Figure 18).

Figure 19: ERCOT seasonal adequacy assessment

ERCOT seasonal resource adequacy assessment: winter worst case, gigawatts

	Coal	Nuclear	Gas	Wind
Total capacity	13.6	5.2	48.4	25.0
Expected offline	2.8	1.1	10.0	23.2
Expected online	10.8	4.1	38.3	1.8
Minimum during crisis (Feb. 15)	7.6	3.8	27.5	0.6
Underperformance	**3.2**	**0.3**	**10.8**	**1.1**

Source: ERCOT 2020 SARA report, EIA, JPMAM. 2021.

Defenders of renewable energy were quick to shift the blame toward unweatherized fossil and nuclear plants. Figure 18, which was taken from a JPMorgan annual energy report, attempted to claim natural gas had "underperformed" while it defended wind by claiming turbines were not even expected to be online during a crisis situation.[140] One *New York Times* editorial attempted a similar defense for failing wind generators, pointing out that wind is "reliably unreliable" and that ERCOT, or the Electric Reliability Council of Texas, the state agency in charge of regulating the electric grid, never expected wind to work during this period of high demand.[141]

Interestingly, the JPMorgan report does recognize that shortages in natural gas supply were compounded by a "critical loop" problem. The report's author explains that many "natural gas production sites, compression facilities and hubs are electrified instead of using natural gas to power their operations. As a result, if their electricity is cut it creates a downward spiral since these facilities can no longer supply natural gas to power plants, creating the need for even greater outages that affect more natural gas operators." This is hardly an effective critique of natural gas as a fuel source. It is, however, a profound statement on the lack of planning by state regulatory officials who had not confirmed that essential energy infrastructure, needed to transport natural gas to electricity generation facilities, was recognized as an essential service prior to ordering blackouts.

Contrary to the critiques of fossil fuel options, the coal and natural gas plants that continued to operate increased output by 47% and 450% respectively, but even that incredible feat was insufficient to meet growing demand during the extreme cold.[142] ERCOT imposed rolling blackouts to avoid a far more damaging systemwide failure. According to the office of the Texas Comptroller, 69% of the state's population—approximately 20 million people—"lost power at some point during Feb. 14-20" and "at least 210" people died as a result of exposure to cold or other factors brought on by the cold or energy outages.[143]

Multiple sources of energy were incapable of producing sufficient electricity for such a large population. However, Texas' long-term effort to switch reliable fossil fuel plants with heavily subsidized and weather-dependent wind, mixed with a lack of preparedness for extreme cold weather, and combined with poor planning by the state's regulators were the real reasons behind the blackouts.[144]

In July 2022, Texas Public Policy Foundation's Life: Powered Initiative elaborated on the state's larger problem with electric grid stability:

> "Texas has made significant progress in preventing our energy grid from experiencing another crisis like it did during winter storm Uri last year. Despite several close calls and requests by ERCOT to conserve power, the energy grid has met demand and we expect it do so the remainder of this year. However, unless Texas adds more dispatchable capacity over the next few years, the risk of continued crises will only deepen. The Texas economy continues to grow and requires a robust electric grid to support it. Identifying the problem is easy: the Texas market encourages dependence on federally subsidized variable, intermittent, and weather-dependent sources of energy, like wind and solar, that produce only a small fraction of the energy Texans need at critical times."[145]

The threat ESG poses to natural gas investment

Another tool of the anti-fossil fuel movement is the ever-increasing use of "Environmental, Social, and Governance," or ESG, criteria for investment. The end goal of the Environmental portion of ESG is a "net zero economy"—that is, net zero carbon emissions by 2050, as per the Paris Climate Accords.[146]

Net zero as a goal represents a significant threat to the oil and gas industry, and thus stable energy policy. Net zero hypothetically permits the use of some carbon-emitting sources of energy, so long as that use is balanced out by carbon sequestration. However, in no net zero scenario are fossil fuels as prominent as at present. The United Nations' plans for net zero explicitly mention "[r]eplacing polluting coal, gas and oil-fired power with energy from renewable sources, such as wind or solar."[147]

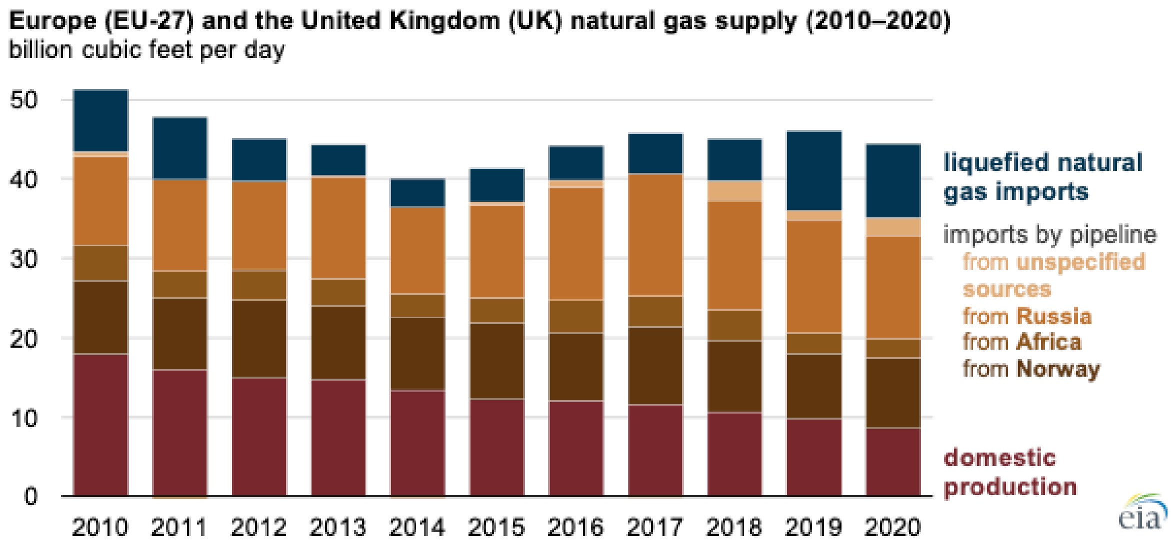
The case of BlackRock and its CEO Larry Fink is a representative example of the attitude present in the institutional investment and financial intermediary spheres. BlackRock, the world's largest asset management corporation, is one of the more prominent advocates for ESG, and its CEO, Larry Fink, heads that advocacy. While Fink says that BlackRock "does not pursue divestment from oil and gas companies as a policy," he nevertheless advocates for a world in which oil and gas' role has been thoroughly gutted—a world with net zero carbon emissions.[148] BlackRock is only one of many institutional investors to advocate for ESG; from banks to ratings agencies to even the SEC, the use of ESG criteria for judging companies' worth is certainly prominent on Wall Street and in DC.[149]

How the advocates intend to both give rise to the "net zero transition" while avoiding divesting from oil and gas has yet to be demonstrated.[150] However, when faced with the dissonance between the plethora of public commitments to net zero and the Paris Agreement versus the occasional promise to keep investing in drilling, holding out hope for oil and gas' continued support would not seem to be a wise bet. As a result, ESG should be seen as another arm of the anti-fossil fuel movement, at least in the long term. Promises to not divest from oil and gas in following years ring hollow.

Europe's rapidly growing energy costs and the early winter 2022 energy crisis

Similar to California, Texas, and Michigan, many European nations have prioritized drastic reductions in greenhouse gas emissions over energy security. Countries across Europe—notably Germany—are closing coal and nuclear plants. Many have reduced their domestic production of natural gas. These European Union countries have been forced to make up lost domestic natural gas production with imports of Russian natural gas to maintain reliable energy and electricity supplies.[151]

Figure 20: EU and UK natural gas supply (2010-2020)



Source: Graph created by the U.S. Energy Information Administration, based on data from Eurostat and the International Group of Liquefied Natural Gas Importers (GIIGNL) annual liquefied natural gas trade reports
Note: Due to reporting requirements, some volumes of pipeline-imported natural gas are not attributed to a source country.

European energy policies, like Germany's *Energiewende*, have obligated these nations to expand their supplies of renewable generation, specifically wind and solar. These policies have instigated the outlay of enormous sums of money but have achieved emissions reductions that are similar to the reductions that were achieved by the United States for far less.[152] However, just as they have in Michigan, Texas, and California, wind and solar have often and repeatedly left European electrical grids short of supply.[153] Across the European continent predictions are for a 6% to 8% decrease in average wind speeds by 2050. In 2021, the entire continent experienced a "wind drought" that saw the "the load factor—that is, the ratio of actual output to the theoretical maximum—[drop] by 13% in Germany and the UK and by 15% to 16% in Ireland and the Czech Republic."[154]

That intermittent and weather-dependent service then forces these nations to rely even more heavily on natural gas to supply fast-ramping electricity during the majority of time where wind and solar produce nothing. But as Western Europe reduces domestic production of natural gas, it increases its demand for Russian gas. With ongoing Russian aggression in Ukraine and the apparent willingness of the Russian government to use natural gas as a transcontinental political weapon, these countries are finding themselves in an increasingly precarious position.

Russian President Vladimir Putin critiques the claims that Russia has weaponized energy supplies as "politically motivated tittle-tattle."[155] However, Kremlin spokesperson Dmitri Peskov blamed the "collective west" for energy shortages and stated that Russia would not resume shipments of natural gas to Europe via the then-functional Nordstream 1 pipeline until Western sanctions targeting Moscow were lifted.[156] In a conference call described by Reuters, the Russian representative claimed western nations were trying to shift the blame for energy shortages and warned “Russia would retaliate over a G7 proposal to impose a price cap on Russian oil.”[157]

Facing politically motivated actions like this, Germany, Austria, the Netherlands, the Czech Republic, and the United Kingdom have seriously considered reopening shuttered coal plants. Dutch, German, and Austrian officials have cautioned their citizens to reduce the use of natural gas in the months leading up to winter and are removing regulatory barriers to open coal plants. Czech ambassador at-large for energy security Vaclav Bartuška bluntly stated his country would “burn anything we can to keep our people warm and to make electricity” if faced with a natural gas shortage.[158]

Conclusion

Concerns over the direction of U.S. energy policy have heightened since January 2021. Climate-first energy policies being implemented by Washington, D.C. have brought U.S. energy independence and therefore our nation's economic health and security into question. These green energy policies have reduced the world's supply of oil and natural gas, which brings higher global prices and tends to benefit economies that are often unfriendly to America and its allies. In addition to higher prices for Americans, current energy policy has cost the U.S. economy tens of thousands of jobs, along with millions if not billions of dollars in lost wages and tax revenue.

While these policies have been targeted toward addressing environmental and climate concerns, pushing oil and gas development to these other nations has actually resulted in increasing CO_2 emissions. "Dirtier" sources of oil and gas from these often unfriendly nations slow environmental progress because hydrocarbon fuels that are produced in North America are among the cleanest and most environmentally friendly in the world.

The future will become more bleak if President Biden's remarks at a November 4, 2022 campaign stop come to fruition. At this event, the president stated, "We're now changing the nature of the life of a battery. Folks, it is now cheaper to generate electricity from wind and solar than it is from coal and oil; literally cheaper. We're going to be shutting these plants down all across America and having wind and solar. So, it's going to become a wind generation. And all they're doing is - is going to save them a hell of a lot of money."

But on Saturday, November 5, 2022, Senator Joe Manchin (D-WV) took exception with the President's declaration. Manchin harshly critiqued the president's words noting, "President Biden's comments are not only outrageous and divorced from reality they ignore the severe economic pain the American people are feeling because of rising energy costs. Comments like these are the reason the American people are losing trust in President Biden and instead believe he does not understand the need to have an all-in energy policy that would keep our nation totally energy independent and secure."

If iconic Democrats such as President Biden and Senator Manchin cannot agree on current U.S. energy policy, it suggests that an open review of the current state of the U.S. energy economy is needed. A thorough review would speak to a multi-prong U.S. energy future with natural gas playing an ever-growing and prominent role in an ever-greener America, and as a trusted energy supplier to its allies.

This review becomes even more essential in light of rapidly evolving natural gas markets. The Shale Revolution, made possible by the economically viable extraction of large natural gas (and oil) deposits trapped in geologic formations, has allowed natural gas production in the United States increase by nearly 50% over the past ten years. The United States is producing and consuming natural gas at record levels, bringing with it an array of economic and strategic advantages in improving U.S. trade and industrial competitiveness while altering the electric power mix and thus providing for environmental benefits.

With natural gas production growth outpacing the growth in domestic consumption, the United States is now a net exporter of natural gas on an average annual basis, a status achieved in 2017.[159] The rapid growth in U.S. exports of natural gas is being made possible by the major advancements seen in the LNG industry, allowing gas to be shipped over long distances at increasingly competitive rates. This challenges the long-established dependence on pipelines for gas trade and in turn tests traditional gas business and pricing models. Facilitated by these developments, U.S. natural gas exports are expected to more than double over the next five years, making the United States the largest exporter of liquefied natural gas in the world.[160]

The growth of U.S. natural gas exports continues to be a major force in the development of more liquid and globally integrated gas markets, supporting further opportunities for natural gas to transform electric and heating supply mixes, supplement industrial and transportation fuel mixes, improve energy security, address environmental concerns, provide better energy access in developing economies, and create new economic opportunities in the global economy.

Despite its promise, gas still faces obstacles in many markets, however, and turning this new potential for more abundant and available supply into strategic opportunities is not without its challenges. When asked by Congresswoman Rashida Tlaib (MI-13) in a hearing at the U.S. House Committee on Financial Services if his bank would commit to a policy that would prohibit additional funding for new oil and gas projects, JPMorgan Chase & Co CEO Jamie Dimon responded, “Absolutely not and that would be the road to hell for America.”[161]

Environmental policies, especially those aimed at mitigating perceived climate change threats, have the potential to undo much of the rapid growth of natural gas production and consumption. Continued growth in production of American natural gas resources, along with corresponding increases in midstream/pipeline infrastructure, represents a growing potential for domestically produced gas to supply increasing worldwide demand. This growth would provide “a range of strategic, economic, and security advantages to the United States,” so long as production levels can be maintained and prices remain competitive.[162]

The examples of Michigan, Texas, California, and Europe demonstrate that a world without natural gas is a dangerous and miserable world indeed. With nuclear and coal both heavily restricted by the weight of regulation, policy-based limits on natural gas supplies threaten a pre-industrial dystopia where survival depends on finding sources of energy available when there is no wind, no sunshine, and no wood left to burn.

For that reason, it is reasonable to question whether plans to shut down and curtail exploration and production of natural gas and petroleum are safe. Furthermore, it is reasonable to query whether it is realistic to expect weather-dependent electricity generation from wind and solar to replace reliable energy sources like natural gas and nuclear. It is frightening to imagine a world without the benefits provided by natural gas: low-cost electricity, plastics, manufacturing processes, fertilizer and readily available heating and cooking fuel, all of which offer so many benefits to so many people. Even those who embrace the notion that human activity is the driving force behind dangerous global warming, should also accept the reality that human ingenuity has the potential to solve that problem. A world without natural gas-derived plastics, fertilizer, or large machinery (including ships, airplanes, automobiles, trucks, and trains) is difficult and dangerous to human health and well-being.

In today's energy climate, the best option for fast, affordable, and easily permittable growth is natural gas. Diversity of supply is essential and it is imperative that legislatures at the local, state, and national levels fully understand benefits of natural gas to America and the global economy. Ignoring these benefits will ensure that Americas standard of living will decline, global economic and political freedom will be harmed, and environmental impacts associated with energy development will expand rather than contract in the decades to come.

About the Authors

Dr. Timothy G. Nash is vice president emeritus of Northwood University and the director of the university's McNair Center for the Advancement of Free Enterprise and Entrepreneurship. Nash also holds the school's McNair chair in free market economics. Nash's travels and research have taken him to over 30 countries from Mexico and China to Switzerland and France. Nash led the efforts to develop the center's highly regarded *Michigan Economic Competitiveness Study* for the Michigan Chamber of Commerce in 2012, comparing Michigan's economy to the remaining 49 states. The study has been duplicated for Illinois and West Virginia. Nash is the co-author and co-editor of four books, including *When We Are Free* with foreword by Milton Friedman. Nash's articles and interviews have appeared in publications ranging from *Townhall, National Review, and The Wall Street Journal's Market Watch* to *Automotive News, The Detroit News,* and Harvard's *Better, Faster, Cheaper.*

Jason Hayes is the director of Environmental Policy for the Mackinac Center for Public Policy in Midland, Michigan. Hayes is also a research fellow at the McNair Center for the Advancement of Free Enterprise and Entrepreneurship at Northwood University, and has served as an adjunct instructor at Northwood, teaching environmental science and environmental policy, since 2018. Jason has spent the past three decades focused on energy and environmental policy. He has worked as a forester and park ranger in the backcountry of British Columbia and has co-authored research on national parks and grizzly bear management for The Fraser Institute. He spent fifteen years researching and communicating energy and environmental policy in the North American energy industry, before moving to Michigan. He has published numerous research papers and policy guides focusing on forest management, wildfire reduction, energy policy, electricity regulation, and private conservation. His comment and analysis are often featured in a mix of radio and podcast programs, as well as the *Fox Business Channel*, *The Wall Street Journal, USA Today, The Hill, National Review, The Detroit News*, and many other media sources. Jason holds an undergraduate diploma in Wildland Recreation from Selkirk College, a Bachelor of Science from the University of British Columbia, and a Masters of Environmental Design (Environmental Science) from the University of Calgary.

Dr. Dale Matcheck is chair of the economics department at Northwood University and holds a David E. Fry chair in free market economics. Matcheck holds a degree in economics from the University of Michigan (1984) and a PhD. in economics from Cornell University (1993). Dr. Matcheck is a research fellow at the McNair Center for the Advancement of Free Enterprise and Entrepreneurship at Northwood University. His research interests are in the fields of public policy and the economics of the environment. In 2019 and 2020, he was the recipient of the Sam Marotta Faculty ethics award. He is the co-editor of *When We Are Free*, an anthology of essays on Limited Government and the Free Enterprise System, and the academic director of the Northwood University Freedom Seminar. Prior to coming to Northwood University, he was an assistant professor at the University of Michigan - Flint

Joshua Antonini is an Environmental Policy intern for the Mackinac Center for Public Policy in Midland, Michigan. Joshua researches and writes on energy and environmental policy for the Mackinac Center's blog and Michigan Capitol Confidential. Antonini is also a research scholar on environmental and public policy issues for the McNair Center for the Advancement of Free Enterprise and Entrepreneurship at Northwood University. He graduated from Hillsdale College in 2022 with a Bachelor of Arts degree in Economics.

Andrew Reder is student research scholar with the McNair Center for the Advancement of Free Enterprise and Entrepreneurship at Northwood University. He is currently an honors student at Northwood University where he studies economics and management. Andrew's homeschool background contributed to his interest in free enterprise economic philosophy which has been a defining characteristic of his success at the McNair Center and Northwood University. Andrew is the author or coauthor of several articles which have been published through the McNair Center, FEE.org, and the Mackinac Center for Public Policy. He is also the editor of Students in Defense of Freedom which is a collection of essays authored by Northwood students who wish to express their views on current issues in American society.

About the Editors

David J. Nash is a Partner at Growth Concepts. Dave is an award-winning writer and business consultant who has collaborated on numerous projects within the automotive, travel, healthcare, and retail sectors including business development, performance improvement, marketing strategy, branding, promotions, communications, and media outreach. A graduate of the University of Michigan with a BA in Communications and Journalism, Mr. Nash has also supported many Northwood University position papers and other endeavors. A partner at Growth Concepts since 2005, Mr. Nash also served as Executive Vice President of Creatives Services at Utechniques, and National Marketing Manager for American Express Group & Incentive Services.

Bob Thomas has over 25 years of experience working with researchers on economic and policy studies including the Michigan Chamber Foundation Economic Competitiveness Studies in partnership with Northwood University and education gap analyses with the Michigan Business Leaders for Education Excellence. As Executive Director for the Michigan Chamber Foundation, he is responsible for strategic program development in the areas of leadership; diversity, equity and inclusion (DEI); and economic competitiveness. He graduated from Grand Valley State University with a bachelor's degree in Advertising and Public Relations and is faculty for the US Chamber of Commerce Institute for Organization Management.

Jonathan Williams is the Chief Economist and Executive Vice President of Tax Policy at the American Legislative Exchange Council (ALEC), where he works with state policymakers, congressional leaders, and members of the private sector to develop fiscal policy solutions for the states. Williams founded the ALEC Center for State Fiscal Reform in 2011 and co-authors *Rich States, Poor States: ALEC-Laffer Economic State Competitiveness Index*. Williams' work has appeared in many publications, including *The Wall Street Journal*, *Forbes, The Financial Times, Toronto Star* and *Investor's Business Daily*. Williams also serves on the Advisory Board of the State Financial Officers Foundation (SFOF) and as an adjunct fellow at the Kansas Policy Institute. He has written for the Ash Center at Harvard's Kennedy School of Government. His work has been featured at the federal level by The White House, the Congressional Joint Economic Committee and the U.S. House Committee on Ways and Means.

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The McNair Center was founded in 2015 at Northwood University in Midland, Michigan. The Center is a leading university think tank focused on the advocacy and expansion of free market economics, and the creation and cultivation of entrepreneurs. The McNair Center was made possible by a generous gift from The Robert and Janice McNair Foundation whose founders are examples of how entrepreneurship and the free enterprise system generates jobs, changes lives, and literally charts a new course for individuals, families, and entire communities. The McNair Center is dedicated to carrying out the McNair's vision for awakening a new generation of entrepreneurs while defending the moral and ethical underpinnings of the American competitive free enterprise system.

The McNair Center is part of Northwood University, a highly regarded private university located in Midland, Michigan, offering undergraduate, masters and doctoral degrees in subjects ranging from accounting and finance to economics and computer science at the undergraduate level to a doctorate in Business Administration.

Northwood University is led by President Kent MacDonald and is guided by The Northwood Idea, twelve educational outcomes and a Code of Ethics which drive Northwood's educational philosophy. An understanding of the American tradition of freedom and the essential value of free enterprise are at the foundation of a Northwood University education. Business courses are taught by industry leaders—men and women who are successful executives and entrepreneurs. They know the market realities and educate students; they make them specialists who understand and can steer change in various economic environments. The core curriculum is taught by faculty with the expertise and passion needed to provide the cross-discipline knowledge necessary for success in today's world.

Our curriculum is current and relevant. Students engage in real-world case studies through small, interactive classes. They learn the complexities of global business, qualities of leadership, how to solve problems through critical thinking, and how to motivate others.

Our students understand how business works. They actively participate in university-wide signature events. Northwood University is famous for its student-produced Outdoor Auto Shows, outstanding Style Shows, Honors Symposia, world class banquets such as the Annual Stafford Dinner, and more. Each event is unique in that it is produced as a business. Profits are expected.

By providing an education that spans classrooms, board rooms, and borders, Northwood graduates emerge as leaders, managers, and entrepreneurs ready to succeed in a global marketplace. Employers of Northwood University graduates are unanimous in their praise. For more information, visit northwood.edu.

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The **Mackinac Center for Public Policy** is dedicated to improving the understanding of economic and political principles among citizens, public officials, policy makers and opinion leaders. The Center, located in Midland, Michigan, has emerged as one of the largest and most prolific of the more than 50 state-based free-market "think tanks" in America.

The Mackinac Center advances the principles of free markets and limited government. Through their research and education programs, the Mackinac Center challenges government overreach and advocates for free-market approaches to public policy so free people realize their potential and their dreams.

Committed to its independence, the Mackinac Center neither seeks nor accepts any government funding. The Center enjoys the support of foundations, individuals and businesses that recognize the important role of sound policy ideas. The Center is a nonprofit, tax-exempt organization. For more information, visit www.mackinac.org.

The Empowerment Alliance (TEA) was founded in 2019 to showcase the power of American ingenuity, the tenets of our free market system, and the abundance of our nation's natural gas supply to forge a realistic, rational, and effective approach to American energy consumption and environmental conservation. TEA's path to America's commonsense energy policy is a realistic alternative to extreme "Green New Deal" tax and regulatory policies being promoted across the United States and globally today. TEA believes America can enjoy affordable, secure, energy independence on our own terms without dependence on foreign resources and the strings attached.

We encourage all readers to visit the TEA website at info@EmpoweringAmerica.org.

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