WELLS FARGO
Investment Institute

September 2022

Bridging the gap

Challenges and opportunities of moving from fossil fuels to renewables

“What we call the beginning is often the end. And to make an end is to make a beginning. The end is where we start from.”

— T.S. Eliot

What’s inside

Preparing for a greener future

Fossil fuels have been the lifeblood of the global economy for nearly two centuries. Coal fueled the industrial revolution, oil transformed transportation, and natural gas changed the way farmers fed the world. Fossil-fuel consumption continues to rise alongside that of renewables as fossil fuels are efficient forms of energy, fit for industrial production and economic prosperity.

In recent years, some question whether the environmental trade-offs for such prosperity were too large. Today, we hear calls from policymakers and environmental activists to reduce our carbon footprint. Transitioning away from fossil fuels and reducing carbon emissions have become priorities for many countries. Europe is further along the transition to renewables than the U.S. Clean-energy aspirations are also budding in the developing world, including China.

Looking ahead, the future of energy looks green, but converting exclusively to renewable energy sources will not happen overnight. Although U.S. lawmakers' support for renewables crosses party lines, views surrounding the urgency, economic implications, and the course of direction vary widely. We see evidence that an "all of the above strategy" is developing that would rely on a combination of fossil fuels, nuclear, and renewable energy sources as the global economy transitions away from fossil fuels. Such a bridging strategy may be key to navigating a successful conversion. A transitional approach would emphasize clean natural gas and nuclear power over fossil fuels, while converting to renewables at a realistic pace. We should prepare for a green-energy future but recognize that it may take more than a decade. Even so, we believe the transition to clean energy will offer unique and appealing opportunities for investors.

Share of U.S. energy consumption

80%

Fossil fuels

Carbon-based fuel sources from the decomposition of ancient plant and animal matter over millions of years. Coal, oil, and natural gas are fossil fuels.

20%

Clean energy

Clean energy comes from sources that do not produce carbon emissions. These include not only wind and solar but also mature technologies such as nuclear, hydroelectric, biomass and geothermal.

Sources: U.S. Energy Information Administration (EIA), Wells Fargo Investment Institute, Monthly Energy Review, April 2022, prelimary data for 2021.

Key questions we consider in this report

What forces are fueling the energy transition, and why is it happening now?

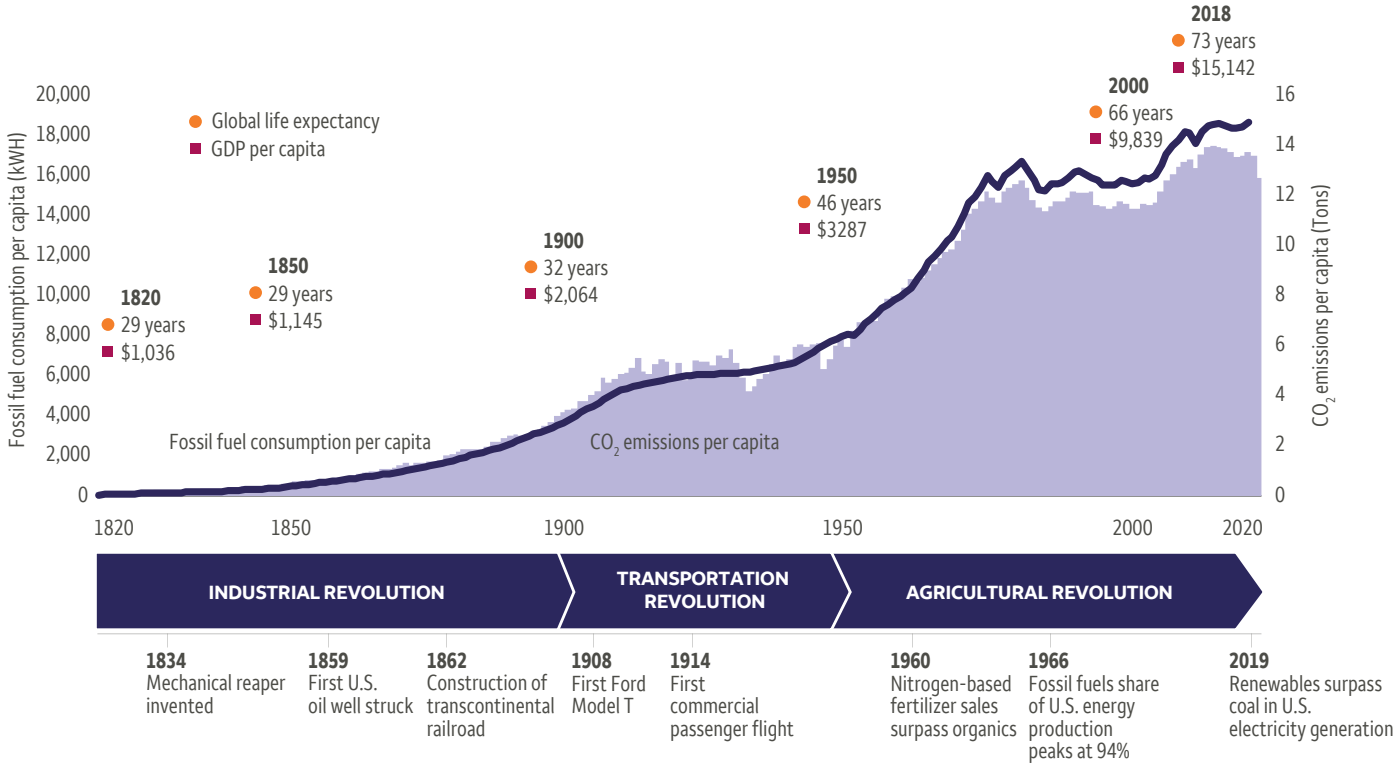
What are the key trends and challenges in shifting away from fossil fuels?

How does the transition tie to attitudes toward environmental protection and climate change?

How can investors benefit from the transition to clean-energy sources?

Moving from carbon to clean energy

Human progress powered by energy comes with increased CO_2 emissions



Sources: Our World In Data, BP Statistical Review of World Energy, World Bank, Global Carbon Project, Madison Project Database 2020, Wells Fargo Investment Institute. Yearly data, 1820-2020. Per capita energy consumption is measured by taking the world energy consumption divided by the world population. GDP data is adjusted for inflation and measured in constant 2011 international dollars. The life expectancy data is the life expectancy at birth, which are the average years a newborn would live if the pattern of mortality were to stay the same throughout its life.

Thanks to fossil fuels, human progress has flourished, lifting billions from poverty, affording longer and healthier lives. Since 1900, average global life expectancy has more than doubled and today exceeds 70 years. Today, a combine harvester can reap and thresh enough wheat to produce 500,000 loaves of bread in a day, roughly a thousand times greater than an individual laborer.[1]

Yet, alongside nearly two centuries of economic prosperity since the industrial revolution, there have been trade-offs. The consumption of fossil fuels releases a cocktail of greenhouse gases into the atmosphere, which diminishes air quality and is widely believed to contribute to rising global temperatures. Transitioning away from fossil fuels and reducing the carbon footprint have become priorities for global leaders and policymakers.

The shift away from fossil fuels has been slow. To date, we have observed certain progress, particularly in the U.S and Europe. In the U.S., coal, the highest carbon dioxide (CO_2)-emitting fuel, has been reduced from 50% of electricity generation to 10% since 2007. CO_2 emissions dropped by 12% over that period. Still, many investors we talk to insist that more could be done to reduce our reliance on fossil fuels and protect the environment.

Recent U.S. polls underscore this view. In addition, record temperatures in select parts of the globe this year also are fueling the sentiment.

Some contend the answer is to expedite the transition to renewables. At first glance, this may sound like a reasonable approach; however, in our view, proceeding on a course of action before evaluating the extant data and market implications would be ill-advised. Such a trajectory would likely cause demonstrable stress on the U.S. and global economy, resulting in inflation and declines in equity and bond prices. Instead, we suggest building on lessons learned — good and bad — to develop a sound transition strategy.

Public support for climate action

69%

U.S. adults in favor of taking steps to become carbon neutral by 2050.

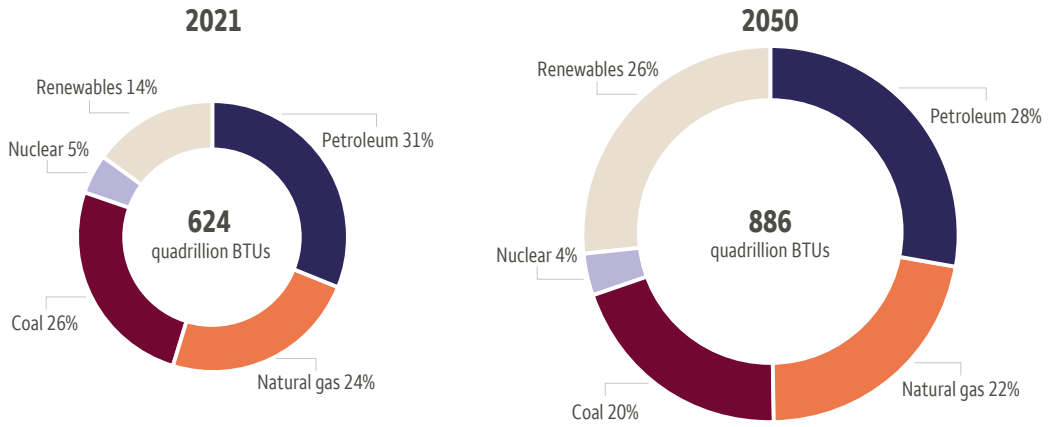
Source: Pew Research Center, April 22, 2022

Not a simple solution

Energy systems are complex. Replacing one source of energy with another is rarely a simple exchange — energy sources by nature are not created equal. Our relationship with energy is complex too. Fossil fuels are widely considered a contributor to rising global temperatures. Yet, as the chart on page 4 illustrates, fossil fuels have also helped to improve longevity and our standard of living. Rushing to replace them without comparable, reliable alternatives could have significant consequences.

Based on our assessment, we think a "bridging" strategy that embraces a mix of fossil fuel and clean energy sources may be a sensible path to take.

Global energy usage is forecast to grow with renewables becoming a larger part

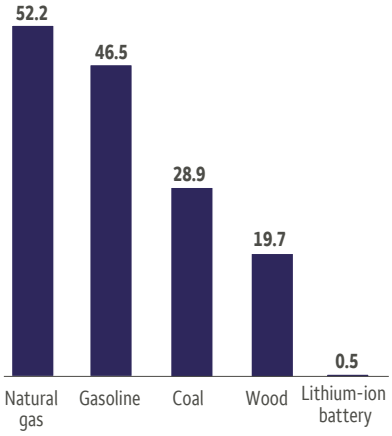


Source: U.S. Energy Information Administration, August 24, 2022

Energy sources are not created equal

Fossil fuels are energy rich

Megajoules per kilogram (MJ/kg) is a measure of energy output. Fossil fuels provide more energy per unit weight than other energy sources.



Sources: The Engineering Tool Box, Epec Engineered Solutions, September 2022

A convergence of economic, technological, political, and societal forces are driving the transition to clean energy. Renewables are making technological strides, but currently most present no match for the efficiency of fossil fuels. Below we discuss key differences between fossil fuels and renewable energy sources.

Density (power)

Density, or power, is probably the greatest difference, and most important gap, between the two energy sources. Fossil fuels provide an effective bang for the energy buck. Energy in carbon-based compounds is densely packed, and in a relatively small space. This makes fossil fuels cost effective for a wide range of applications. The graphic to the left shows the energy density of different fossil fuels versus a lithium battery.

Affordability

Renewable energy sources have made the most progress in terms of affordability. Renewables, such as wind and solar, are most often used to create electricity. The chart below shows a common metric comparing the costs to generate electricity with different sources called the levelized cost of electricity (LCOE). Renewables look comparatively reasonable versus most fossil-fueled generation capacity. Keep in mind, however, that LCOE cannot take every comparative cost into account, and without heavy subsidies for renewables, the cost differential would not be this close.

Comparing costs of energy sources to create electricity

Estimated capacity-weighted LCOE for new resources entering service in 2027.

Sources: U.S. Energy Information Administration, Annual Energy Outlook 2022.
Notes: Levelized costs include tax credits. LCOE figures represent costs before passage of Inflation Reduction Act which includes incentives that should lower the costs for renewables.

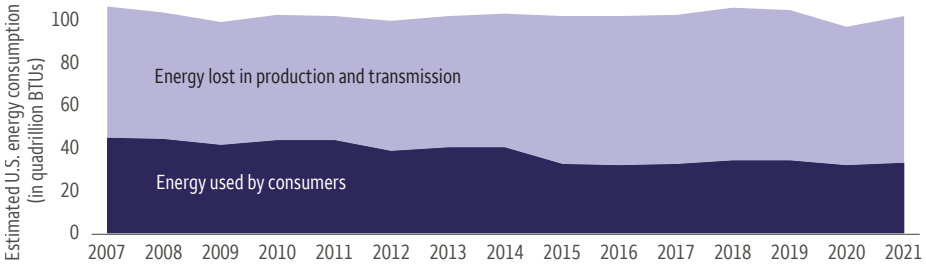
Versatility

Versatility is another area in which renewables need more time to mature. Fossil fuels can power everything that renewables can, but they also power planes, ships, and combines. To compete in this category, renewables will need storage technologies to advance.

The average utility can store roughly 10 minutes per day of electric generation. This means the majority of renewables generation goes unused and, unfortunately, is wasted. Once storage technologies mature, however, renewables could become ultra-competitive, if not downright unbeatable.

U.S. energy wasted

Today, 67% of all energy produced by the U.S. energy sector is discarded and never makes it to a consumer. Looking ahead, long-duration battery storage technology could reduce waste and improve the efficiency.



Source: Lawrence Livermore National Laboratory, 2007–2021, March 2022

Capturing and repurposing CO_2 to mine bitcoin

Bitcoin miners get a bad rap for their energy use, even though the electricity they use is arguably the greenest of any industry on the planet. Most importantly, however, bitcoin miners have potentially found ways to turn two of fossil fuels' greatest negatives — CO_2 emissions and wasted energy — into environmental positives.

One can barely drive a few miles in east Texas without seeing natural gas flares on the horizon. Natural gas is a regular byproduct of oil drilling.

Some enterprising bitcoin miners have recently discovered how to cap natural gas flares to run bitcoin mining machines. In the process, they have helped cut gas emissions from entering the atmosphere.

Vehicle electrification could help renewables scale

Vehicles on the road (worldwide)

Electric vehicles

2021	2040
12 million	530 million

Gas vehicles

2021	2040
1.1 billion	1.2 billion

Sources: Bloomberg New Energy Finance, Wells Fargo Investment Institute. Year-end data: 2021, actual; 2040 estimate.

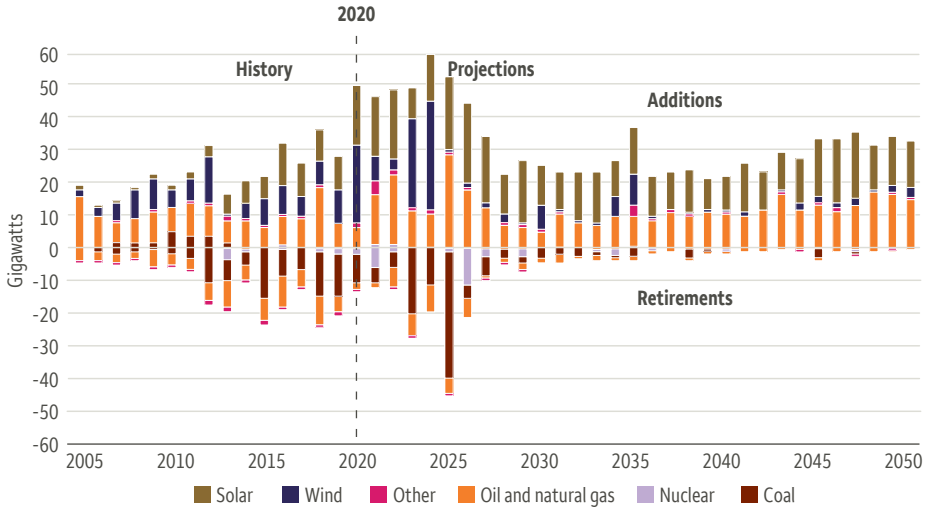
Scalability

Scalability is about how many places can produce and use renewables cost effectively. Many areas of the U.S. do not have weather conditions to make renewables cost effective. The graphic below is a map of 2021 electric-capacity additions. Note that the new wind additions cluster in the middle of the country while solar additions are largely situated along the coastlines of the south and east.

Even for areas with favorable weather conditions, new energy infrastructure needs to be constructed, so profitability could remain highly variable. That said, time may be a great equalizer for renewables scalability. As renewable technology continues to improve and costs drop further, centralized renewables generation location may not be necessary. We may one day generate and store the energy we need directly from our personal property.

Clean technologies are expected to provide majority of new electricity production

As coal and nuclear electricity generating capacity retires, new capacity additions will come from natural gas and renewable technologies.



Source: U.S. Energy Information Administration; Annual Energy Outlook 2021 (AEO2021) Reference case and July 2020 Form EIA-880M, March 3, 2022

Reliability

Renewables have the most catching-up to do in terms of reliability. The wind does not always blow and the sun does not always shine. One consequence of this is that electrical grids — purchasing electricity from wind and solar farms — need to plan for the worst. This, in turn, requires more investment in back-up systems. Increasing the number of wind turbines and solar panels may help somewhat but does not solve the worst-case scenarios, as Texans observed this past July.

Keeping things cool when the wind doesn't blow

Texas is not only the largest producer of oil and natural gas in the U.S., it is also the largest producer of electricity from wind and solar, and its electrical grid is built for Texas only. The state is transitioning from fossil fuels to renewables, too, so it is a good case study.

During a scorching heatwave this past July, when Texas residents needed electricity the most, the wind stopped blowing. On one particularly hot day, only 3% of the state's massive wind power was moving. The result was that the state had to turn to fossil fuel back-ups.

Reliability, making sure a country has ample supply to meet demand, is likely to become a bigger issue in coming years. The reason is that heavy renewables incentives have turned utilities against fossil-fuel generation, even if only for profit-driven reasons. Ironically, the more that governments subsidize renewables, the more unreliable electrical grids could become.

Number of operating U.S. nuclear power plants

1990	2021
112	93

Source: U.S. Energy Information Administration, 2022

Forces driving the push to clean energy

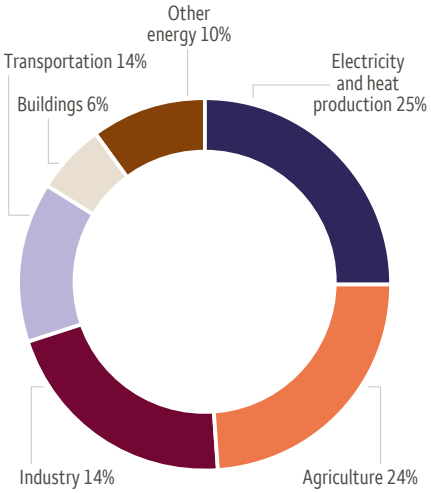
The U.S.'s energy transition principally started 15 years ago following the release of the documentary, "An Inconvenient Truth." The film acted as a call-to-arms of sorts for climate awareness. A year later in 2007, U.S. CO_2 emissions peaked and have declined nearly every year since. The drop in CO_2 intensity has largely come from the electric power industry. Coal, specifically, was the prime victim. Under presidential pressure, utilities were politely "asked" to shift from coal to natural gas (which releases roughly half the CO_2 that coal does), and with the use of tax breaks as an incentive, utilities were "asked" to add wind and solar electric generation.

What about the nuclear option?

Nuclear energy may be one viable solution to protect energy security and an integral component of a bridging strategy for energy transition. By 1990, nuclear energy provided 19% of electricity in the U.S. Since then, nuclear used in generating electricity has remained stagnant. Although the public has leaned away from nuclear energy, citing safety concerns, nuclear energy is a potent energy source. It has been in use for decades and is one of the oldest sources of non-CO_2-emitting energy. In 2020, the Nuclear Energy Institute stated that by using nuclear energy, more than 471 million metric tons of CO_2 emissions were avoided. As the U.S. pushes toward lowering carbon emissions, nuclear energy will likely be included in the conversation.

The politics of clean energy

Global greenhouse gas emissions by economic sector



Source: Climate Change 2014: Mitigation of Climate Change. Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change, Cambridge University Press, Cambridge, United Kingdom and New York, NY

Transitioning from our dependency on fossil fuels to renewables will not only involve corporate and technology leadership but also political leadership. The Biden administration has expressed commitment to renewable energy and has mobilized policy actions to support that endeavor.

On his first day in office, President Biden rejoined the Paris climate accord. In November 2021, he attended the COP26 and signed the Glasgow Pact. In June, he authorized the use of the defense production act (DPA) to expand manufacturing in key clean-energy technologies. The Inflation Reduction Act of 2022 includes provisions that support Biden's executive actions.

Glasgow Climate Pact: Commitment to a cleaner future

In November 2021, 120 world leaders and policymakers and over 40,000 participants convened the UN Climate Change Conference (COP26) in Glasgow, Scotland. The key themes of COP26 were:

- Expanding greenhouse gas emission reduction targets
- Financing the energy transition of the poorest countries
- Reducing methane emissions

COP26 main objectives

- Achieving carbon neutrality by 2050
- Protecting locales most threatened by climate change
- Mobilizing at least $100 billion a year to achieve the first two goals
- Working together to achieve carbon neutrality

Outcomes since COP26 related to energy transition

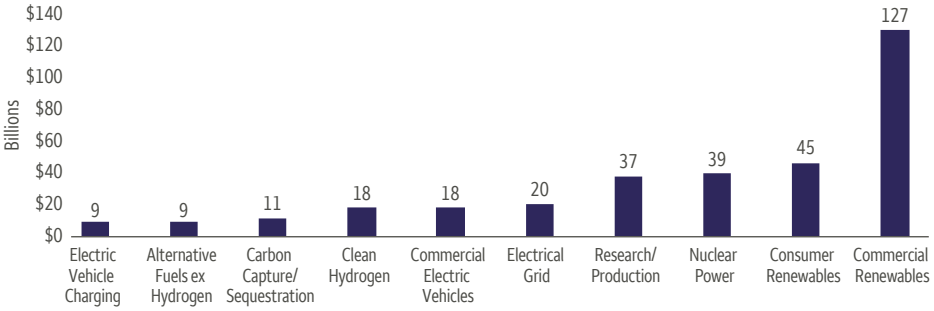
- *Great methane pledge* — promises to cut methane emissions by 30% from today's levels by 2030.
- *Move away from coal power* — 40-plus nations pledged to shift from coal power to renewables
- *Financial support for emerging nations* — A collective pledge of $10.5 billion to help the poorest countries transition to clean energy.

Inflation Reduction Act offers support

Certain energy-related provisions of the Inflation Reduction Act (IRA) are likely to accelerate the transition to clean energy. Over the past decade, the general view is that clean-energy-related legislation and executive actions have had incremental impacts on the energy sector. The IRA appears far more ambitious. The lengthy duration of proposed tax credits coupled with new tax credits for energy storage and clean hydrogen are potential game changers for the transition that would accelerate the pace of renewables adoption as well as jump-start the clean hydrogen economy.

U.S. energy investment over the next decade

Fiscal spending directed toward alternative energy the Infrastructure Investment and Jobs Act and Inflation Reduction Act has increased significantly.



Sources: The White House, Congressional Budget Office, Senate Democratic Leadership, Wells Fargo Advisors estimates

The Department of Energy estimates funding related to energy across the two bills approximates $430 billion ramping up over the next five to 10 years.

China's balancing act

At the COP26, the world's second-largest economy committed to net-zero emissions by 2060 along with ambitious climate plans. China continues to require more energy to achieve its goals of economic growth and meet energy demands of 1.4 billion people. Indeed, China faces certain hurdles to achieving emissions targets, including:

- *Coal reliance* — Coal powers 56% of the country's industry-heavy economy, a major reason China accounts for more than 25% of the planet's carbon emissions. Coal mining also supports local economies of some of its poorest regions, providing millions of jobs.
- *Capital expenditures* — To achieve a 2060 net-zero emissions target, China will require investments of as much as $22 trillion through 2060 across carbon-heavy industries.[2]
- *Slowing economic growth* — China abandoned its 5.5% real gross domestic product (GDP) target, for growth within "a reasonable range." Beijing is prioritizing its stated policy to grow the middle class, emphasizing services over construction, pollution abatement over new factories, and technology.

Finding the right rate of change

Many countries have ambitions to decarbonize and achieve net-zero emissions. Yet, eliminating fossil fuels will likely have indelible impacts on the global economy and our daily lives. If history is a guide, a rising quality of life will require more energy use, not less. As the global population grows, and demand for goods and services grows, so will demand for energy. Quitting fossil fuels "cold turkey" could pose catastrophic consequences for the global economy and individual livelihoods. Sri Lanka and Germany are recent cases in point.

Sri Lanka's fertilizer ban

With aims to be the first country to grow only organic foods, the country banned natural gas fertilizer in April 2021. The consequence of poor harvests was predictable and immediate.

Sri Lanka moved too quickly on its transition to organic farming, leaving the country vulnerable to the external shocks of COVID-19 and the war in Ukraine. The pandemic had shattered its tourism industry, an economic centerpiece and provider of foreign exchange. Hikes in energy costs from Russia's invasion of Ukraine further battered the economy, which relies mostly on imported crude oil.

In addition, last year the government forced two million farmers to switch to organic farming, banning synthetic fertilizers and pesticides. Consequently, rice production fell by 20% in the first 180 days of the ban. Exports of tea, Sri Lanka's main cash crop, fell to their lowest level in nearly a quarter-century. Whether from outrage over the new laws or an inability to go organic, farmers left one-third of all farmland fallow.

The result? Food prices soared, and Sri Lankans went hungry. So extensive was the damage that President Rajapaksa had to reverse the diktat by November 2021. Eventually Rajapaksa fled Sri Lanka amid protests over the resulting economic crisis.

Germany's rush to achieve emission goals

Germany has also experienced energy shortages due to aggressive energy policies and the war in Ukraine. Germany's aggressive transition toward sustainable energy has made fossil fuels more uncertain and Europe's largest economic power susceptible to unpredictable and aggressive actions by Russia.

Natural gas was deemed a safe and reliable fuel that would complement growing supplies of renewable power during the energy transition. But the rush to achieve emission goals has severely hampered the main source of energy, fossil fuels. Europe is under pressure as Russia cuts off natural gas supplies, but no country is more at risk than Germany, where nearly half of homes rely on fuel for heating. The Kremlin is likely to limit gas flows to Europe as long as the war in Ukraine continues.

Long-term opportunities for investors in clean technology

Carbon capture, utilization, and storage (CCUS) technology

A key takeaway from COP26 was the growing role of private-sector funding in addressing climate change. By joining the Glasgow Financial Alliance for Net Zero, nearly 500 global financial institutions committed $130 trillion of balance sheet assets to combat emissions and achieve 1.5°C.[3]

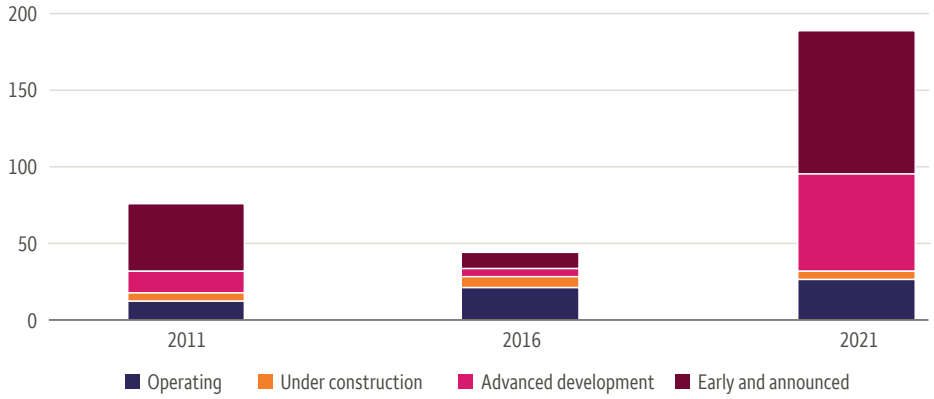
Successfully investing this capital requires a combination of technological advancement and legally binding, global climate policy, which may include government-mandated carbon taxes. While the latter is certainly challenging politically, we do not believe it precludes the private sector – including our clients – from investing in areas of technological innovation that can facilitate energy transition. One such area is CCUS technology.

Combustion engines and industrial processes emit large amounts of CO_2. CCUS technologies can serve two purposes:

- Capturing and transporting CO_2 for utilization or storage deep underground
- Removing carbon from bio-based processes and the atmosphere.[4]

We are seeing a surge in momentum, driven largely by investment incentives in CCUS technology, with nearly 100 facilities in operation, under construction, or in advanced development last year alone.

Planning and development of CCUS facilities is accelerating



Source: IEA and Global CCS Institute CCS Facilities Database, November 24, 2021

Decarbonization and energy transition

Energy decarbonization entails preventing carbon emissions from polluting the atmosphere. Carbon-capture technologies scrub CO_2 from the air with the goal of zero net emissions.

Carbon capture investment opportunities

Beyond societal and political pressures to tackle climate change, we see several key initiatives from financial regulators that will likely accelerate private capital investment.

First is a significant improvement in disclosure — primarily via the Task-Force on Climate-Related Financial Disclosures — which requires companies to disclose emissions data along with data on carbon flaring and capture.[11] Transparency into the risks and rewards of carbon projects, and their impact on climate-change objectives, can help private capital evaluate technology investments. Moreover, companies that fail to reduce CO_2 emissions could be "punished" by higher costs of capital.

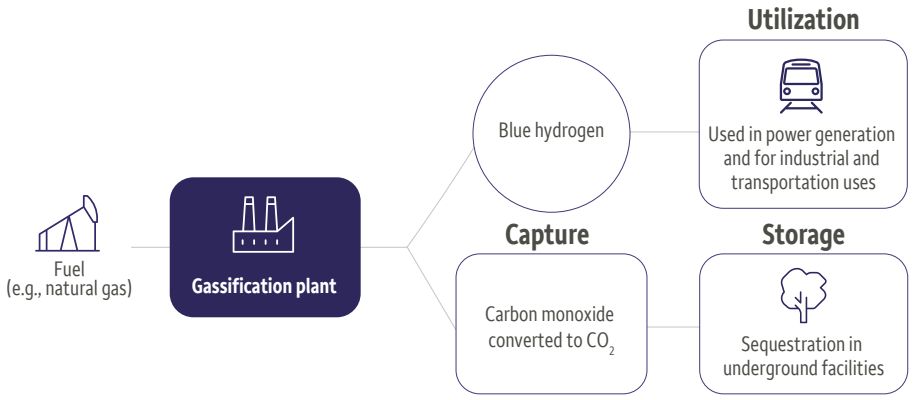
The Potential of CCUS

According to the International Energy Agency's Net Zero by 2050 study, CCUS technology will reduce our dependency on fossil fuels for power generation from 80% in 2020 to 22% in 2050.[5] Moreover, it has the potential to capture more than 90% of CO_2 emissions and achieve 14% of global greenhouse gas emissions reductions by 2050.[6]

As mentioned above, the world cannot simply flip a switch and eliminate fossil-fuel usage. CCUS acts as a critical bridge between current energy dependencies and a future state that may not require fossil fuels. The technology has garnered the attention of policymakers, with the White House Council on Environmental Quality issuing a report to Congress recommending how legislation should be used to accelerate CCUS projects.[7] More recently, the Infrastructure Investment and Jobs Act noted that "carbon capture and storage technologies are necessary for reducing hard-to-abate emissions from the industrial sector." For instance, the cement industry — which is growing rapidly especially in emerging economies — could benefit from reduced emissions due to implementing CCUS technology.

How CCUS works

CCUS technology can be broken into three key components: capture, utilization and storage. Precombustion carbon-capture technology converts fuel to a synthesis gas consisting primarily of carbon monoxide and hydrogen. Subsequently, carbon monoxide is converted to CO_2 and then a solvent separates CO_2 from the hydrogen. To generate power, an integrated gasification combined cycle power plant burns the hydrogen in a combustion turbine and uses the exhaust heat to power a steam turbine.



Source: Wells Fargo Investment Institute, September 2022

Post-combustion carbon capture, which normally involves retrofitting existing power plants, utilizes a chemical solvent to separate CO_2 out of the fossil-fuel combustion exhaust.

Once the CO_2 is captured, it not only needs to be transported — which provides investment opportunity via energy infrastructure — but it can be stored in geological formations deep underground. Such formations include oil and gas reservoirs, deep saline formations, coal beds, or basalt formations and shale basins. Within oil and gas reservoirs, injecting CO_2 can actually be used to extract additional oil.[8]

Electrification and long-duration battery storage

Electrifying the U.S. will require significant amounts of extra electricity. According to one study, about 90% more electricity will be needed by the year 2050, if the U.S. is aggressive in its transition efforts.[9] This also means significant amounts of extra infrastructure on both the supply and demand side. Supplying the extra electricity will require such things as new power plants, transmission lines, and battery and storage. New infrastructure is required on the demand side too, from cars, to buildings, to heavy industry.

Electrifying the U.S. will not be easy, or cheap, however. Conducting and storing electricity requires massive amounts of minerals, such as copper, cobalt, and zinc. Minerals are both an investment opportunity and a challenge.

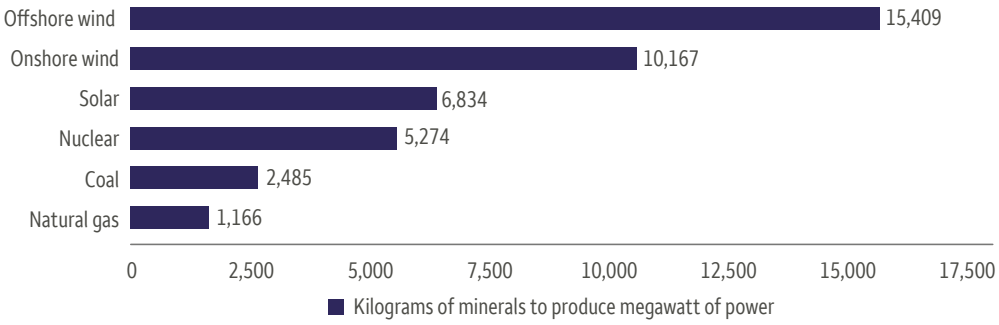
Electric vehicles, as an example, typically require three to four times more copper than conventional vehicles. Total copper demand for the electric vehicle sector is projected to rise from less than 500,000 tons in 2021 to 1.5 million tons in 2025 and to 3.3 million tons in 2030.[10] And that extra demand is only for electric vehicles. The chart below shows the amount of extra minerals used in clean energy technologies versus other power generation sources, such as coal and natural gas.

Battery storage investment opportunities

To transition from fossil fuels successfully, capacity and storage technologies, need to mature. Large battery storage in place for utilities today can hold less than 1% of total electricity generated in the U.S. With U.S. energy policies clearly favoring renewables, we see investment opportunities in the long-duration battery and storage space.

Clean energy technologies require more minerals than other power generation sources

Mineral commodities are vital to renewable energy infrastructure like solar panels, wind turbines, and batteries.



Source: International Energy Agency. Minerals used in production include copper, nickel, manganese, cobalt, chromium, molybdenum, zinc, silicon and rare earth.

Investing in the energy transition

Although a complete transition from fossil fuels to renewables will likely take decades to achieve, we do believe there are potential prospects for investors during the transition process. In our view, a bridging strategy will create a variety of investment opportunities across sectors and asset classes.

Investment opportunities in the energy transition

Renewable generation

- **Wind and solar** – According to S&P, approximately 76% of new electric generation capacity in the U.S. came from solar and wind developments in 2021. We expect strong growth to continue here and see opportunities in the Utilities, Consumer Discretionary, Industrials, and Information Technology sectors.
- **Energy transmission and battery storage** – The increasing prevalence of wind and solar generation is likely to require increased investment in transporting these energy sources from where they are generated to where they are consumed and/or storing a portion of output for later usage. We see potential opportunities in Utilities and Industrials.

Electrification

- **Passenger vehicles** – Electric vehicles (EVs) accounted for only 5% of U.S. new car sales in the first quarter of 202214. However, we expect adoption rates to continue to expand in the coming years as battery costs decline and more models become available. We see potential opportunities in Consumer Discretionary, Information Technology, Industrials, and Materials.
- **Electrical equipment/minerals** – We expect additional applications outside of passenger vehicles to see higher levels of electrification over the coming decades. We see the Industrials, Information Technology, and Materials sectors as benefitting.

Energy resilience & efficiency

- **Traditional fossil fuels** – We expect natural gas, gasoline, and other fossil fuels to remain in heavy use for several more decades. Potential disruptions in supply during this time period and/or slower than anticipated progress in key areas in the energy transition could lead to higher profit opportunities for companies exposed. Certain areas, namely liquefied natural gas, could also provide growth opportunities. We see the Energy sector as well placed in these scenarios.
- **Nuclear** – Although the prospect of new nuclear plant construction in many countries (including the U.S.) remains unlikely in the near term, public policy has recently shifted towards supporting currently operating assets in this area. We view this as supportive for select companies in the Utilities sector.

Decarbonization

- **Hydrogen, carbon capture & alternative fuels** – We believe many industrial processes (cement and steel production for example) and certain consumer services (airline flights) could prove difficult to electrify and will therefore require alternative technologies to reduce emissions and potentially decarbonize. Investment in hydrogen and other alternative fuels has recently begun to increase and we see potential opportunities in the Materials, Energy, Industrials, and Utilities sectors.

Sector	Investment opportunities
Energy	Energy sector companies are primarily involved in the production, transportation, and refining of fossil fuel energy. Yet, in recent years, we have seen many traditional Energy companies making inroads towards diversifying into alternative energy businesses. These initiatives are mostly in early stages and the companies' core businesses will remain rooted in fossil fuels for the foreseeable future. We believe that Integrated Oil Companies and Midstream Energy companies are best positioned for market share in alternative energy over time, as we view these assets as somewhat complementary to their existing business models.
Utilities	Utilities play an important role in the clean-energy transition as the sector is among the top contributors to global emissions. They are the entities that own and operate the electric generation. Since ownership of generation facilities is fragmented, the "greening" of the utilities sector will take years and opportunities will be widespread. This also implies that the "transition" will be carried out by individual utilities at varying speeds.
Industrials	The Industrials sector, particularly the Capital Goods Industry, may play both sides of the fence in the energy transition. Energy is generally capital-intensive and has been responsible for numerous large-scale projects requiring significant concentration of machinery. Meanwhile, we anticipate growing demand for electrification and lower emissions will provide opportunities for secular growth which are likely to include: auto factory re-tooling, charging station build-out, electrical grid investment, alternative fuel, and improved asset utilization via automation, controls, and software.
Materials	Within the Materials sector, the largest addressable opportunity in the energy transition is likely to be rising demand for blue and green hydrogen. We view the industrial gas sub-industry as well-positioned to benefit here as these companies are typically leaders in the existing, fossil fuel-driven, hydrogen supply chain. Although most large-scale projects for blue and green hydrogen are still several years from completion, we believe that market demand could be significant over the longer term.
Consumer Discretionary	The importance of the energy transition to this sector is mainly confined to autos. The shift toward clean-vehicle technology is being fueled through government mandated programs and from a bottom-up demand from consumers who feel motivated to be more green, but who also want a potentially cheaper total cost of ownership than is currently available with a gasoline powered automobile. While electric vehicles make up only a low-single-digit percentage of total U.S. passenger vehicles today, we believe they will take market share from traditional combustion engine vehicles at a rapid pace.
Green muni bonds	The push for a greater reliance on renewable energy in the public-power sector continues to grow as state governments look to legislate such action. Legislatures in California, Illinois, and New York, for example, aim to curb the use of fossil fuels over the coming years and dampen the environmental impact. While such actions will support the transition away from fossil fuels, the cost associated with conversion and irregularity of output from extreme weather events could extend the amount of time necessary to make these changes. For example, drought conditions in western states have caused a dip in hydroelectric generation while extreme heat in Texas has lowered the state's wind turbine output considerably. While these issues may persist, U.S. public power utilities are likely to continue converting to more renewable energy sources due to state and federal regulations or the need to diversify their fuel mix. We continue to view the sector as favorable due to the essentiality of the service provided and mostly unregulated rate-setting authority.

Power forward

Technological advances, changing societal attitudes, and supportive government policies are all contributing to an evolution in how the global economy generates and consumes energy. We believe that a transition from fossil fuels to renewables is feasible, but it should be done thoughtfully and strategically.

Tackling environmental concerns while not infringing on economic livelihoods requires multiple solutions beyond simply shifting away from fossil fuels. Energy systems are as complex as our relationship with fossil fuels. Racing to replace them without comparable and reliable alternative energy sources could have dire economic, social, and political consequences. A "bridging" strategy that draws upon a mix of fuel sources as renewables continue to mature, in our view, appears the most viable path toward a green-energy future.

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Risk considerations

Alternative investments, such as private equity funds are not appropriate for all investors and are only open to "accredited" or "qualified" investors within the meaning of U.S. securities laws.

Alternative investments, such as private equity funds, are speculative and involve a high degree of risk that is appropriate only for those investors who have the financial sophistication and expertise to evaluate the merits and risks of an investment in a fund and for which the fund does not represent a complete investment program. They entail significant risks that can include losses due to leveraging or other speculative investment practices, lack of liquidity, volatility of returns, restrictions on transferring interests in a fund, potential lack of diversification, absence and/or delay of information regarding valuations and pricing, complex tax structures and delays in tax reporting, less regulation and higher fees than mutual funds. Private equity fund investing involves other material risks including capital loss and the loss of the entire amount invested. A fund's offering documents should be carefully reviewed prior to investing.

All investing involves risks, including the possible loss of principal. There can be no assurance that any investment strategy will be successful. Investments fluctuate with changes in market and economic conditions and in different environments due to numerous factors, some of which may be unpredictable. Each asset class has its own risk and return characteristics. The level of risk associated with a particular investment or asset class generally correlates with the level of return the investment or asset class might achieve.

Equity securities are subject to market risk, which means their value may fluctuate in response to general economic and market conditions and the perception of individual issuers. Investments in equity securities are generally more volatile than other types of securities. The prices of **small-cap stocks** are generally more volatile than large company stocks. They often involve higher risks because smaller companies may lack the management expertise, financial resources, product diversification and competitive strengths to endure adverse economic conditions.

Sector investing can be more volatile than investments that are broadly diversified over numerous sectors of the economy and will increase a portfolio's vulnerability to any single economic, political, or regulatory development affecting the sector. This can result in greater price volatility.

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Definitions

Russell 2000 Index measures the performance of the 2,000 smallest companies in the Russell 3000 Index, which represents approximately 8% of the total market capitalization of the Russell 3000 Index. The Russell 3000 Index measures the performance of the 3,000 largest U.S. companies based on total market capitalization, which represents approximately 98% of the investable U.S. equity market.

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