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Decarbonizing the Energy Supply

Investment opportunities in the coming transformation

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Spotlight on the way forward

- **Anticipate a multidecade decarbonization of the energy supply**
- **Degree of decarbonization and the mix of technologies is highly uncertain and depends critically on future government policies**
- **Thematic investing strategies can be applied differently in an effort to meet specific investors' goals**

Economic growth and the associated investment opportunities have for centuries been inextricably tied to the use of fossil fuels. In recent decades, concerns about irreversible climate change—driven by carbon dioxide emissions—have pushed consumers, businesses, and global governments to reduce their fossil fuel consumption through a combination of public policy and voluntary action. The politics of climate change are controversial within countries and across the globe.

Without weighing in on the science or the normative question as to whether and to which degree government should seek to arrest climate change, we anticipate a multidecade decarbonization of the energy supply with far-reaching impacts on businesses, consumers, and technology.

The path forward is highly uncertain and depends critically on the degree to which global governments take action to reduce emissions. Additionally, emissions reductions can be achieved through a variety of today's technologies, and those technologies are certain to change.

Accordingly, there are scores of possible scenarios, with three main groups sketching out the possibilities. The Intergovernmental Panel on Climate Change of the United Nations focuses on the science of climate change and has more than 3,100 possible scenarios in its database. Next, the International Energy Agency (IEA) focuses on sources of energy and the investments that would be required to achieve varying levels of emissions reduction. The IEA models a baseline scenario on current policies across countries (Stated Policies Scenario, or STEPS); a second scenario based

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There is clearly significant intersection between the investment ideas discussed in this paper from a pure total return perspective and those of an ESG investment strategy.

on countries fulfilling their pledges (Announced Pledges Scenario, or APS), such as the Paris Climate Agreement (PCA); and a third scenario of what it would take to achieve net zero emissions by 2050 (Net Zero Scenario, or NZE). Finally, the Network for Greening the Financial System (NGFS) is a group of central banks and supervisors committed to the development of climate- and environment–related risk management in the financial services sector and mobilizing mainstream finance to support the transition toward a sustainable economy. In this paper, we make primary use of the IEA scenarios.

The recently passed Inflation Reduction Act by Congress, for example, moves the United States. toward, if not beyond, the pledges it had made under the PCA, potentially reducing greenhouse gas (GHG) emissions[1] to 50% below 2005 levels by 2030.[2] (Note: The IEA scenarios preceded the passage of the U.S. Inflation Reduction Act, so the impacts of that legislation are not reflected in the IEA scenarios.) While we would not want to predict the evolution of public policy in this space, there are broad statements that can guide our approach to investing around this theme:

- Global governments, consumers, and businesses are likely to accelerate efforts to reduce GHG emissions that cause climate change.
- Decarbonizing the energy supply will require a transformation of the electricity generation sector, which will likely include massive investment in wind and solar technologies.
- The inherent challenges of wind and solar to produce a reliable baseline power supply may in turn require investment in a mix of nuclear generation, stored power, and fossil fuel generation paired with carbon capture and storage.
- Demand management for fossil fuels and energy will include the proliferation of more energy-efficient buildings and electric vehicles (EV).
- We expect fossil fuels to remain an indispensable component of the national energy mix for decades even in a scenario of a massive shift to renewables.

The investment opportunities that can be drawn from the decarbonization theme transcend economic sectors. It is critical that investors assess the growth potential in conjunction with risk. Some of the investable ideas we explore are not the flashiest or the most obvious, but they are the ones we find most compelling, and therefore feature them in various places within client portfolios.

It is worth noting that the focus of this paper is not environmental, social, governance (ESG) investing, but investable ideas that we believe can offer competitive risk-adjusted returns and stand to potentially benefit from the structural pivot away from hydrocarbons. At the same time, there is clearly significant intersection between the investment ideas discussed in this paper from a pure total return perspective and those of an ESG investment strategy. For more on this overlap, see the Investing Across Strategies callout box on page 11.

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Last, as this paper focuses on the investable ideas emanating from the decarbonization theme, it is silent on the broad macroeconomic impacts of climate change, such as economic growth, inflation, productivity, and related market impacts. Those topics will be covered in future research.

State of play

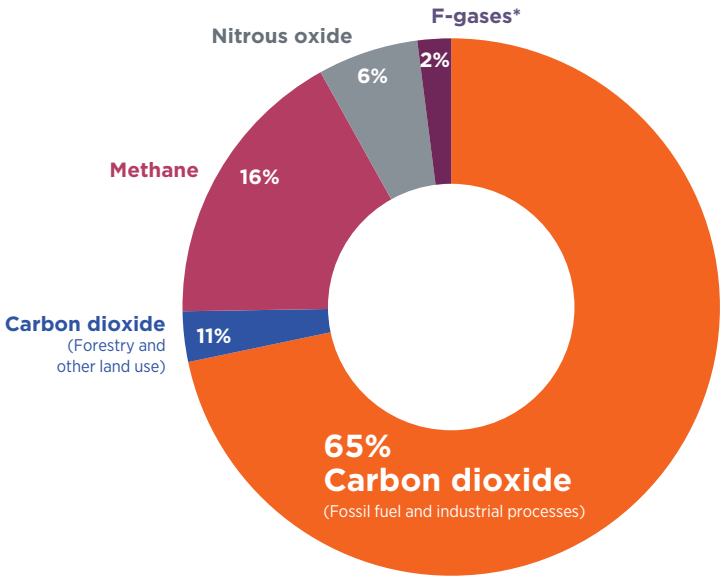
The focus is carbon dioxide from fossil fuels

There are several types of GHG that contribute to the phenomenon of climate change. Carbon dioxide (CO_2) is the most prevalent, making up 76% of the total (Figure 1), and the vast majority of that comes from the burning of fossil fuels. While there is some effort to reduce other GHG, the focus of this paper is on the global efforts to reduce CO_2 emissions by transitioning away from carbon-intensive energy sources.

Efforts to reduce carbon emissions with current and expected technologies are most likely in our view to take aim at coal and petroleum, and to be concentrated in the sectors that consume the most. Globally, annual CO_2 emissions came primarily from the use of coal (44%), petroleum (34%), and natural gas (22%) in 2019. In the U.S., the biggest opportunities are clear, with 90% of coal demand coming from power generation and 68% of petroleum from transportation (Figure 2).

Figure 1

Global greenhouse gas emissions by type



Source: Intergovernmental Panel on Climate Change 2014.

* Fluorinated, or F-gases, are man-made and used in a range of industrial applications. For more detail on the gases in the chart, see the Appendix.

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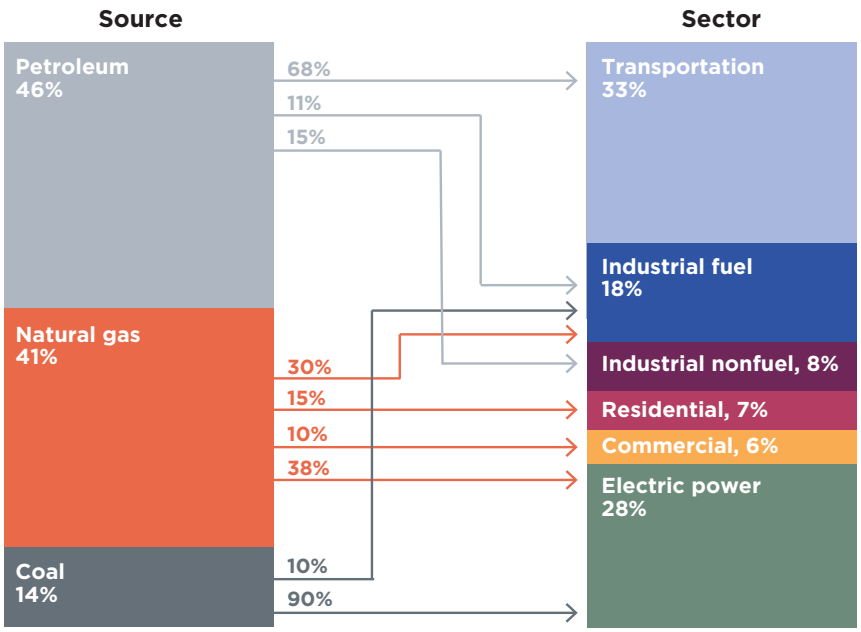
Figure 2

U.S. fossil fuel consumption by source and sector



Source: U.S. Energy Information Administration, Monthly Energy Review, May 25, 2022.

Solar and wind are unlikely to be sufficient to completely satisfy demand even with battery storage.

Policy will be key

Any reader would be forgiven if overwhelmed by myriad supranational organizations at play in the realm of climate change and policy. As aforementioned, the three leaders at the forefront are the Intergovernmental Panel on Climate Change of the United Nations, the International Energy Agency, and the Network for Greening of the Financial System. Each relies on scenario analysis, starting with a status quo baseline and then building assumptions of increasing effort to restrict GHG emissions. We refer to the scenarios laid out by the IEA.[3] Figure 3 shows the expected trajectory of CO_2 emissions in each scenario.

Path to decarbonization

Electricity generation

The biggest prize of reducing emissions is electricity generation. That sector is the largest source of CO_2 emissions and uses the most coal.[4] Moreover, reducing emissions from vehicles and heating of buildings will place a higher burden on electricity production and delivery. On the positive side, wind and solar power are proven technologies whose cost efficiency has already surpassed many fossil fuel options.[5] However, solar and wind are unlikely to be sufficient to completely satisfy long-term demand even with battery storage, as electricity is needed at night and wind is intermittent.

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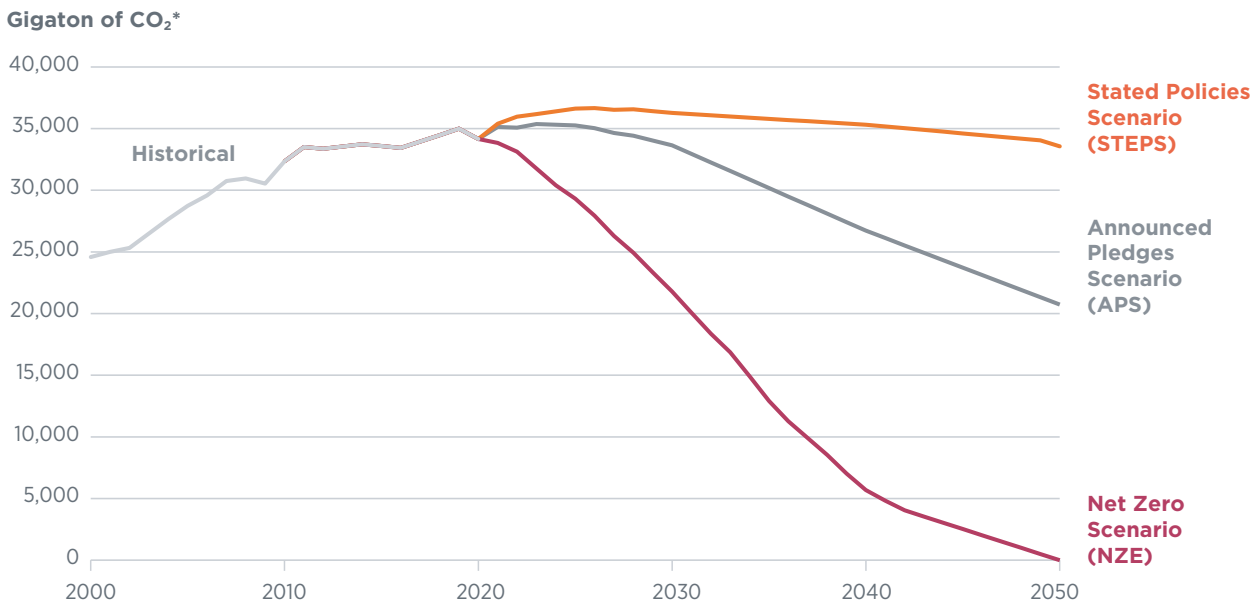
Figure 3

World Energy Outlook 2021 scenarios, 2010–2050



Source: IEA World Energy Outlook 2021.

* CO_2 in gigatons (unit of power equivalent to one billion tons of TNT).

Figure 4

Global electricity demand growth from 2020 by scenario

	STEPS	APS	NZE
2030	25%	28%	39%
2040	52%	70%	111%
2050	75%	104%	166%

Source: IEA World Energy Outlook 2021.

Globally, electricity demand is expected to grow significantly in the baseline. Under current policies, the IEA projects global demand to grow by nearly 25% from 2020 to 2030,[6] and 75% by 2050—with U.S. figures much lower, at 8% and 29% for those respective timeframes.[7]

To achieve CO_2 reductions as demand spikes higher, industry must increasingly adopt non-emitting technologies while retiring and replacing existing infrastructure. Moreover, the further global governments extend CO_2 reduction requirements, the higher the demands for electricity generation as EVs are produced in lieu of gasoline and diesel vehicles, and buildings are heated with electricity instead of fossil fuels.

The IEA estimates if governments follow up on announced commitments and achieve the APS scenario, electricity demand will more than double by 2050 relative to 2020 (Figure 4). If the NZE scenario is achieved, then demand grows 166%.

It's worth noting that the IEA projects CO_2 emissions to decline mildly in its baseline scenario starting in 2025. That reflects an existing trend of a shift to renewables in developed economies, where the use of coal has steadily declined in recent decades. The baseline expectation for the U.S. is for coal to decline from supplying 24% of electric power in 2021 to just 16% in 2030 and 11% in 2050.[8]

Wind and solar

We expect significant investment in wind and solar generation in any scenario. The IEA projects a 320% increase in solar generation from 2020 to 2030 in its baseline STEPS, and a 157% increase in wind generation. For the longer horizon to 2050, those

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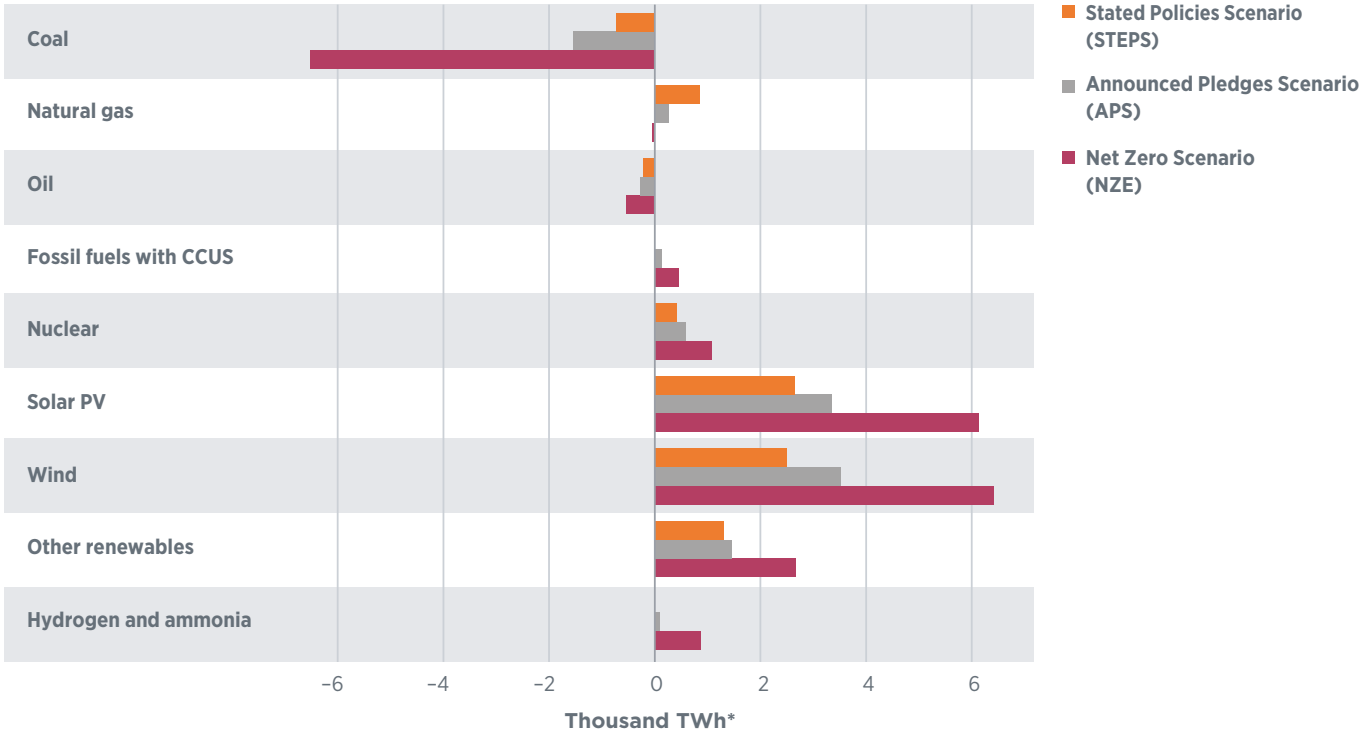
Figure 5

Change in electricity generation by source and scenario, 2020 to 2030



Source: IEA World Energy Outlook 2021.

* A terawatt-hour (TWh) is a unit of energy equal to 10 raised to the power of 12 watt-hours, or one million megawatt-hours.

figures increase elevenfold (1,000%) and 452%, respectively. The U.S. Department of Energy similarly expects strong growth in its baseline, with solar and wind generation growing 334% and 57%, respectively, to 2030. In all cases, the growth of solar and wind generation comes at the expense of fossil fuels, especially coal, which has been in decline for decades (Figure 5).

The cost reduction and efficiency of renewables is a key driver here. In the power generation sector, the "levelized cost" of both solar and wind ($29–$42/megawatt-hours, or MWh, and $26–$54/MWh, respectively) is often cheaper than gas ($44–$73/MWh).[9] Wind and solar have seen a more than 80% reduction in cost since 2010.[10] Additionally, two-thirds of the global population now lives in a location where renewables are the cheapest source of new power generation.[11]

One study of the sector concluded a 50%–60% decarbonizing of power generation over the next 20 years "can be done with little or no investment beyond that determined by purely rational behavior," achieved through new wind and solar capacity, complemented by battery storage.[12] Even an 80%–90% decarbonization could be achieved with "no new technologies."

The Inflation Reduction Act of 2022 that was recently signed into law takes a major step in implementing announced policies. A 30% tax credit for residential solar installation was extended for 10 years with step-downs to 26% in 2033 and 22% in 2034, enticing households to implement the technology. It also provides $30 billion of production tax credits for domestic production of solar, wind, batteries, and the necessary minerals.

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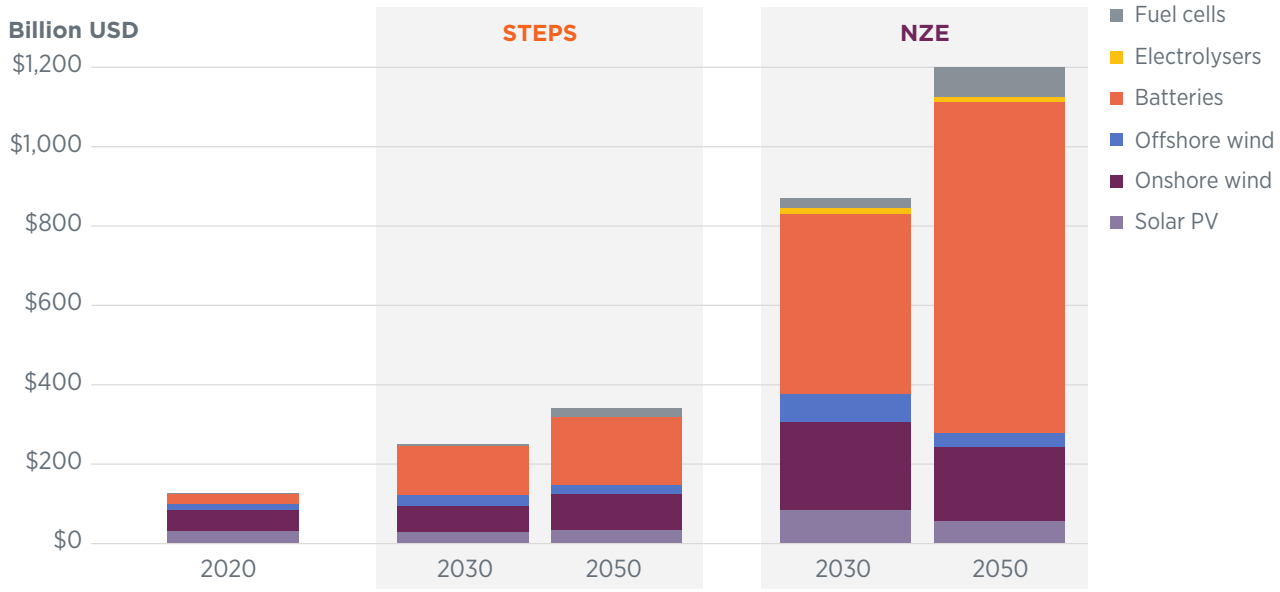
Figure 6

Estimated market size for selected clean energy technologies by technology, 2020-2050



Source: International Energy Agency.

For every step global governments take toward NZE, the greatest beneficiaries are most likely the solar and wind industries. In the NZE scenario where emerging markets move away from coal and toward renewables, solar generation grows by 8.4x over just 10 years to 2030 and by 28x to 2050. Wind generation is slated to grow fivefold to 2030 and by 15x to 2050.[13]

When the wind doesn't blow and the sun doesn't shine

A crucial element in a decarbonized electricity generation sector is how to provide a reliable, steady supply of electricity. Wind and solar are viable sources of energy when the wind is blowing and the sun is shining, but the wind doesn't always blow, and the sun sets. The only renewable energy source with such reliability is hydropower, and the number of available sites is limited. The clear benefit of fossil fuel generation is it can be relied upon day or night, though the war in Ukraine has reminded the world of the geopolitical risks that can undermine access to the resource.

To solve for wind and solar shortcomings, governments and markets will need to choose some mix of the following: battery storage, nuclear generation, and fossil fuel generation with carbon capture. The IEA scenarios rely heavily on batteries to store excess electricity that is generated by wind and solar (Figure 6). By their estimates, the market size for batteries exceeds the combined markets for wind and solar. It is certainly possible that governments and markets would follow such a path—but nuclear generation is a viable option for providing a reliable supply.

One challenge with nuclear power is public sentiment that turns negative in response to high-profile events, most recently with the Fukushima disaster of 2011. Another is the sheer cost and long lead times for construction of facilities. But recent advances

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in the design and construction of small modular reactors (SMRs) could surmount that problem. They make use of components that are built offsite and then delivered to the final location. That production, along with the standardization of reactor design, could dramatically reduce fixed costs.[14] The U.S. Nuclear Regulatory Commission (NRC) approved the first domestic SMR in mid-2022, and the builder has 18 total deals across 11 countries, possibly signaling new life for nuclear generation.[15]

Another option is for the industry to continue using fossil fuels while engaging in carbon management, which is either: a) capturing and storage of CO_2 to prevent it from entering the atmosphere; or b) putting the CO_2 to use. In the U.S., the IEA's April 2021 Technology Report says there are currently 30 such commercial facilities in operation.

The most mature existing technology is to capture emissions post combustion. These can be retrofitted to most existing plants. An earlier-stage technology is to remove CO_2 before combustion and only applies to new integrated gasification combined cycle plants. Last, the "oxyfuel" method burns the fuels with oxygen (or a mixture of oxygen and recirculated flue gas, instead of air) making the capture of CO_2 easier. This is also early stage, presently expensive, and not eligible for retrofitting with current technologies.

CO_2 captured from industrial processes is stored (injected) deep into rock formations. Capacity is not known with precision but is believed to be sufficient. Making use of captured CO_2 is already being done by many firms. It is injected into working oil wells to boost yield and improve profitability and production.

Demand management

Electric vehicles

Moving from fossil fuel-powered cars and trucks to EVs is a crucial component of decarbonization. Passenger vehicles in the U.S. consumed approximately 40% of domestic petroleum in 2021.[16] Ongoing improvements in EVs have helped to level the playing field, and EV sales are soaring. That success has relied in part on government support. Future gains and full adoption will require an adequate charging network and likely demands continued public support.

Initial reporting indicates global EV sales in June 2022 were up 54% compared to a year earlier, reaching 16% of total that month.[17] That continued growth adds to stunning surges in sales for all of 2021 when sales of 6.6 million vehicles doubled the total from 2020. Using a longer lens, in 2012, only 120,000 EVs were sold across the world, and nine years later that was exceeded each week. Explosive sales growth pushed the total number of EVs on the road to 16.5 million by the end of 2021 (Figure 7).

A recent survey shows how dramatically consumer preferences have shifted since the start of the pandemic in 2020. For the first time, more than half (52%) who intend to purchase a new automobile say they will choose an EV or hybrid.[18] The surge in fuel prices in 2022 no doubt played a role, but respondents also cited an aversion to public transportation and ride-sharing apps, likely a scar from the pandemic.

52%

of consumers who intend to purchase a new automobile say they will choose an EV or hybrid.

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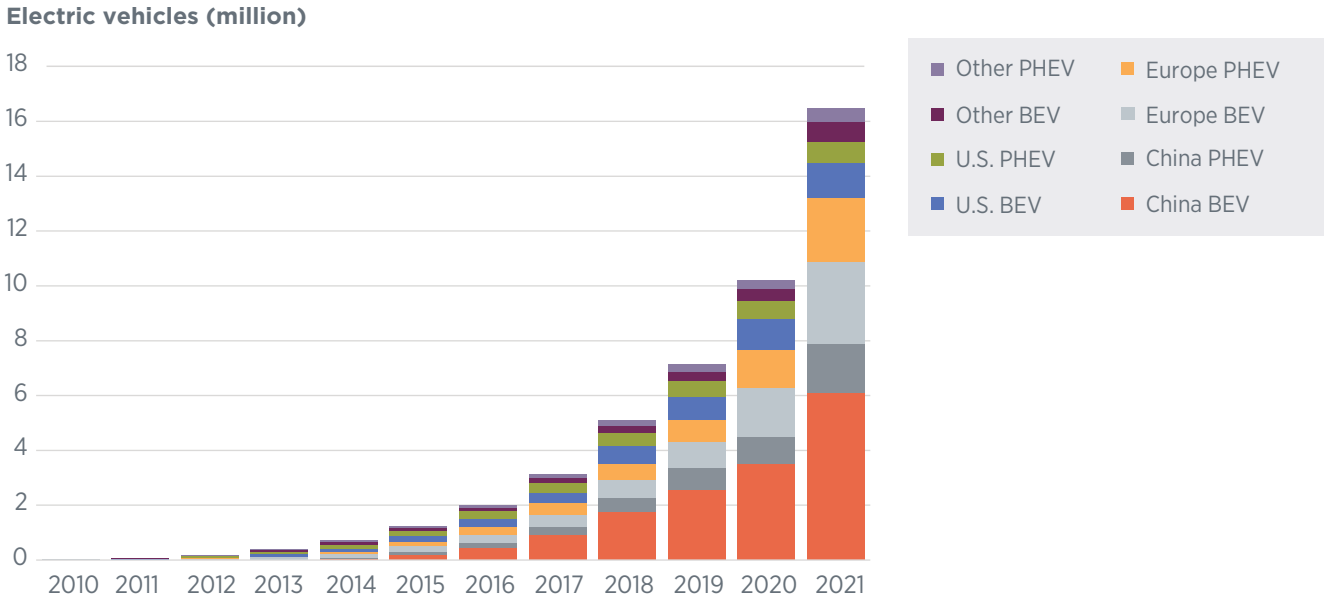
Figure 7

Global EV stock: plug-in hybrid electric vehicle (PHEV) and battery electric vehicle (BEV)



Source: IEA Global EV Outlook 2022. "Other" includes Australia, Brazil, Canada, Chile, India, Japan, Korea, Malaysia, Mexico, New Zealand, South Africa, and Thailand. Europe in this figure includes the EU27, Norway, Iceland, Switzerland, and United Kingdom.

While EVs have certainly captured consumers' imaginations, government subsidies have been a key driver of the success. Public spending to support the industry nearly doubled in 2021 to a global total of $30 billion. China's government has a goal for EV sales within their borders to be 20% market share by 2025. In 2021, just more than half of global sales were in China. Combined sales across Europe were 2.3 million, and about 630,000 EVs were sold in the U.S.[19]

On the supply side, automakers have played their part, boosting development of EVs in response to anticipated legislation as well as consumer demand. In 2021, there were 450 EV models available worldwide—twice as many as in 2018 and five times more than in 2015, according to the IEA's Global EV Outlook 2022. Traditional carmakers have explicit goals for some or all of their sales to be EVs in the next or succeeding decades.

The success of the push will depend on numerous factors, especially continued subsidies, the development of a charging network, and the availability of necessary commodities and components at non-prohibitive costs. The IEA's Outlook estimates the global market value of electricity for EV charging will grow twentyfold in the APS scenario, reaching $190 billion by 2030. Most charging is likely to occur at home and work, but publicly available infrastructure will be needed.

The amount of charging infrastructure planned thus far is likely insufficient for the anticipated number of vehicles. By 2030, the IEA estimates public charging units must grow ninefold to 15 million units to support the number of vehicles expected in the APS scenario. To reach NZE, the required build-out would be substantially larger to 40 million stations, requiring annual investment of nearly $90 billion.[20]

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Investment opportunities

The shift from hydrocarbons unveils a new landscape of investment opportunities across industries. As with any investment opportunity, there are risks, and market participants should be mindful of the following:

Time horizon

The move away from hydrocarbons will take time, and investors need to be patient. The IEA's scenarios use 2050 as a reference point for emissions goals, which is well beyond the time scope of most active managers (who typically look at investing in a company with a three- to five-year—or possibly even a decade-long—time horizon). For reference, it has taken electric vehicles 25 years to amass their roughly 5% share of U.S. light-duty vehicle registrations, according to the U.S. Department of Energy.[21]

It has taken electric vehicles **25** years to amass their roughly **5%** share of U.S. light-duty vehicle registrations

Policy risk

As previously mentioned and reiterated, the path to decarbonization is very policy dependent, and therefore so too are the potential winning and losing investment opportunities. Policymakers will likely increase their use of both carrots and sticks to incentivize changes in business investment and consumer demand. With Democratic and Republican approaches to this issue varying greatly and leadership changing so frequently, investors should prepare for a range of scenarios and consider seeking out companies that are diversified when it comes to business model and policy risk.

Shiny objects

There are many companies working on exciting technological developments to enable the electrification of our world. However, many of these companies are small and early stage, with a long way to go to prove the profit assumptions baked into valuations. Others are higher profile but with extremely elevated valuations. Sometimes the shiny, flashy, or "obvious" investment is not the best for an investor with a moderate risk tolerance.

With these principles in mind, we explore some investable ideas related to the decarbonization theme that we find compelling, and which are included in various ways in our client portfolios.

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Investing across strategies

One of the exciting things about thematic investing is that it can be applied in different ways to work toward meeting specific investors' goals. As it relates to investing in the structural trend of decarbonization, there are two types of strategies where this theme intersects significantly: environmental, social, and governmental (ESG) and high-growth equity strategies.

ESG*

This is an investment discipline that considers ESG criteria, in addition to traditional investment factors, to achieve financial objectives. Unlike other values-based investment strategies, ESG is focused on achieving risk-adjusted returns, while investing in companies across industries and sectors with a comprehensive, dynamic approach. Environmental factors like emissions intensity and carbon production discussed earlier are common metrics on which companies are screened but are just one slice of the ESG pie. This space also includes other environmental metrics like water waste and renewable usage, as well as social metrics tied to goals of all stakeholders and governance guideposts targeting accountability, fairness, and transparency. ESG investment options across asset classes have grown dramatically in recent years.

High-growth equity strategies

Plans to transition from hydrocarbons rely heavily on continued investment in and development of technologies, and these technologies may be exciting investment opportunities for those looking to take on a bit more risk, in return for potentially greater long-term reward. Companies developing or utilizing decarbonization technologies extend beyond sectors and may appear as part of a broader equity investment strategy known as high growth. This is a style of equity investing that focuses on investment opportunities offering high potential earnings growth. These stocks may not have strong earnings or offer profits today, but investors allocate capital with the expectation that the company will deliver above-average earnings growth in the future. A high-growth equity strategy may hold higher allocations to technology-related companies across sectors, sometimes trading at above-market multiples.

For more detail on these and other investment strategies, please consult your investment advisor.

HVACs

Autos

HVACs vs. autos

Automobiles, and specifically EV manufacturers, are arguably the most obvious—but, in our view, not the best—way to invest in the electrification theme. The auto industry is very cyclical, and profit margins for traditional automobile manufacturers are slim compared to the broader S&P 500. Traditional auto manufacturers pay a valuation penalty for their cyclicality, when compared to the overall equity index. Yet investors have bid up the valuations of EV manufacturers on lofty profit growth projections, leaving little room for error. Every part of the auto business model—from service to payment[22]—could be disrupted by EVs.

We contrast that with an industry that is less conspicuous but likely to be more impactful to both carbon emission reduction and investor returns—heating, ventilation, and air conditioning (HVAC). The construction and day-to-day operation of buildings (e.g., lighting, heating, cooling) account for a whopping 36% of global energy use and 39% of energy-related carbon dioxide emissions annually.[23] In recent years, HVAC systems have become more efficient, but established companies and startups alike are investing in ways to make this $20 billion market even more economical, from an energy perspective.[24] Building developers and operators are

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* There is no guarantee that integrating environmental, social, or governance (ESG) analysis will provide improved risk-adjusted returns over any specific time period. The evaluation of ESG factors will affect the strategy's exposure to certain issuers, industries, sectors, regions, and countries and may impact the relative financial performance of the strategy depending on whether such investments are in or out of favor.

incentivized to build or renovate with the latest smart-building technology because of the potential to reap tax credits in the short term and save on costs over time.

Less than 1% of buildings globally were qualified as net zero carbon in 2019;[25] the Paris Climate Agreement calls for all buildings to be net zero by 2050.[26] An estimated 82% of commercial buildings in the U.S. were built before 2000, some or all of which would need to be retrofitted to meet more stringent emission standards. The combination of aging infrastructure in the developed world and increased demand for construction and temperature control in developing economies makes the HVAC industry ripe for investment. One area of technology we are monitoring closely for its investment prospects is hydrogen, with hydrogen furnaces offering just one application. While not yet operating at scale, hydrogen furnaces present a clean home-heating solution with potentially lower maintenance costs. We will be further exploring hydrogen-based technology in our 2023 Capital Markets Forecast.

Battery commodities

Battery producers

Battery commodities vs. battery producers

A world less reliant on hydrocarbons will dramatically increase use of batteries for energy portability and storage. One projection of global battery demand estimates a tenfold increase in gigawatt hours between 2020 and 2030, with 86% of the projected end-use demand in 2030 going to transportation.[27] This growth trajectory will create new entrants and investment opportunities along each step of the value chain: raw materials, manufacturing, distribution, integration, and recycling.

Investing in much of the battery space is likely to be a high-risk high-reward endeavor for two main reasons: 1) the pace of innovation, and 2) industry concentration. For battery designers and producers, research and development of technologies is resource intensive and rapidly evolving, making it very challenging to project which companies will produce the winning technology and then be able to maintain that research edge while growing and protecting market share.

The competitive landscape for battery production is also bifurcated between early-stage companies—which tend to be higher risk and more often better suited for private markets strategies—and a few large, established Asia-based players. China's dominance in battery production cannot be ignored. In 2021, China was responsible for 79% of global lithium-ion battery production; this is expected to shrink to only 65% by 2025 as countries like Germany and Poland gain modest share.[28] China-based Contemporary Amperex Technology (CATL) was the world's leading lithium-ion battery maker in 2021 with an estimated 32% market share. The three largest battery producers control approximately 70% of the global market.[29]

Whereas battery technology is rapidly evolving, the suite of commodity inputs needed to produce batteries is generally more predictable, and we are seeing that opportunities may be found earlier in the value chain within the mining and chemical manufacturing industries. Commodities are notoriously cyclical, but in the case of battery inputs, the structural trend is likely to support demand even in a cyclical slowdown.

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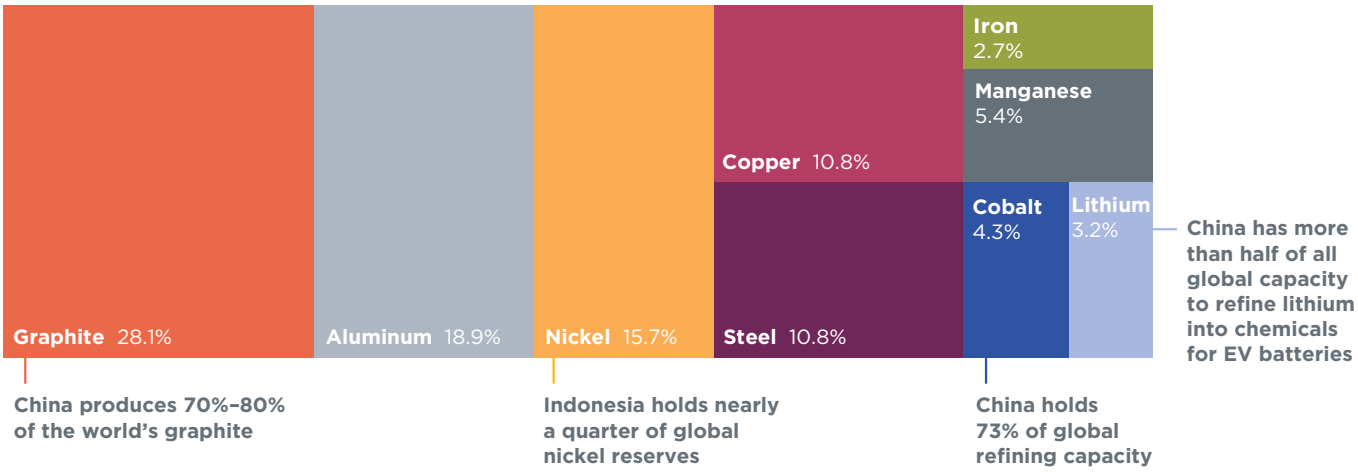
Figure 8

Key minerals in an EV battery



Sources: Bloomberg News; U.S. Geological Survey, Mineral Commodity Summaries, January 2020; Brookings Institution; Northern Graphite Corporation.

The growth trajectory of batteries will require a significant increase in mining of key minerals like lithium, nickel, cobalt, and graphite (Figure 8), even as next-generation batteries are developed. Miners and chemical companies may offer reasonable valuations and stable cash flows, supported by long-term contracts. For example, efforts to manage supply-chain risk have incentivized companies like Ford and General Motors to contract deals directly with raw material suppliers.[30] These resources are fairly concentrated geographically, often in regions with a high geopolitical risk rating, so it may be preferential to rely on larger suppliers that have proven success in navigating foreign jurisdictions and a diversified commodity exposure.

Bioplastics

Packaging

Bioplastics vs. packaging

The effort to reduce carbon is a puzzle, and every piece is important. One piece of that puzzle is an old environmental strategy—recycling—that is getting a new twist in the form of bioplastics. Globally, governments are cracking down on the use of traditional, oil-based polyethylene terephthalate (PET) plastics, in part because of the carbon emitted in the production and transportation of these plastics, as well as the carbon utilized by the waste management industry to dispose of or recycle PET plastics. Consider the following:[31]

- Approximately 480 billion plastic bottles were consumed in 2018 with an estimated CO_2 footprint of between 67 billion and 192 billion kg of CO_2.
- That equates to the annual CO_2 output of 5–74 million cars or up to one-third of the entire aviation industry.

This has sparked investment in bioplastics, which are "plastic" made from renewable resources like plants or sugars. Depending on the type of bioplastic, there can be as much as an 80% reduction in the carbon footprint over its lifetime compared to traditional, oil-based PET plastics.[32] This might sound simple, but it has proven challenging to produce plant-based plastics that compete with traditional plastics in terms of weight, strength, look, and ability to keep their contents fresh.

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Let's be clear: Bioplastics are no substitute for what we were taught in elementary school about the importance of recycling. The Yale School of the Environment estimated that just 8.4% of plastic in the U.S. is actually recycled,[33] and 95% of the plastic that ends up in the ocean by way of rivers comes from just 10 waterways in Asia and Africa.[34] However, single-serve, packaging-intensive consumer products companies are increasingly allocating resources to reduce their plastic-related carbon footprint. Coca-Cola, Nestle, and Evian are just a few examples of beverage companies partnering or investing in research around bioplastics. According to Coca-Cola in October 2021, the company unveiled its first 100% plant-based plastic bottle.

Unfortunately for investors in these consumer products companies, being environmentally friendly comes at a cost. Today, bioplastics can cost as much as double that of oil-based plastics.[35] The cost differential between the two could shrink with additional investment and scale. However, margins for consumer staples are notoriously slim, so this input cost could become a headwind for investors should regulations push faster than any decline in the cost curve.

In our view, one of the best ways for investors to potentially profit from the expected 13% annual growth of the bioplastics industry[36] is through the chemicals space. The deep research and development budgets, scaled operations, and ability to partner globally with packaging companies make multinational chemical companies a likely beneficiary of increased use of bioplastics. Bioplastics are not limited to consumer products, but rather extend to electronics, transportation, building and construction, and health care.

Solar

Wind

Solar vs. wind

The anticipated increased reliance on wind and solar energy generation obviously makes these companies central to the decarbonization story. But for various reasons, we hold only a modest allocation to companies tied to these renewables. Much of the cost reduction of wind and solar versus traditional hydrocarbons is appreciated by investors and, in our assessment, priced into many of the stocks. Investors pay a risk premium because of the policy support—like the federal investment tax credit—so critical to growth of these technologies, yet so uncertain at times. Between these two renewables, we believe there may be greater opportunity in solar versus wind.

Solar offers more direct investment opportunities compared to wind. As an example, the largest producer of wind turbines is General Electric, and this business is only 11% of their portfolio.[37] Solar can be deployed at a smaller scale than wind, bringing faster adoption to residential, industrial, and office end use, as well as offering earlier potential realization of profit forecasts. In our view, opportunities can be found in companies producing microinverters, which are chips that help convert solar panel energy into a form that can be utilized by the grid.

However, investors should be mindful that the solar supply chain is complex and somewhat fragile, with a tremendous amount of policy-related risk. China's influence is felt in every stage of the solar supply chain, even despite a history of

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We would be remiss to not mention the investment opportunity in traditional oil drilling and exploration companies. This may seem to run counter to the entire thrust of this piece, but this is where time horizon becomes very important.

dumping allegations and U.S. tariffs back to before 2011. Solar stocks have seen volatility on changes to subsidies, tax credits, and tariffs, all the while valuations have climbed.

Other opportunities

There are many more ways to invest in the multidecade, structural themes of electrification and reduced hydrocarbon usage. The investment ideas we have discussed are focused on the public equity market, but the private market* offers the ability to get in on the ground level of new green technologies and startups specializing in everything from air conditioners without ozone-depleting refrigerants to recycling batteries. Most private markets strategies are also more conducive to the longer time horizon, higher risk, and potential growth of this theme.

We have not mentioned the utilities sector, but it is an important diversifier for an equity portfolio (being more defensive and less correlated with cyclical industries), and a key sector for electrification of the grid. Utilities making proactive upgrades to their grids to enable increased use of renewables like wind, solar, biomass, and hydropower—and less reliance on coal and hydrocarbons—will likely offer more stable cash flows than competitors should regulation increase in the future.

Lastly, we would be remiss to not mention the investment opportunity in traditional oil drilling and exploration companies. This may seem to run counter to the entire thrust of this piece, but this is where time horizon becomes very important. We are confident that hydrocarbons will remain an important part of energy production over the next 5–10 years. During that time, the oil market is projected to remain tight. Organization of the Petroleum Exporting Countries (OPEC) has limited spare capacity, and global oil majors are being very selective about future investment. Some call it capital discipline; others may view it as oil companies seeing the writing on the wall. Meanwhile, demand is expected to increase, driven by growth in emerging economies. ExxonMobil's 2021 Outlook for Energy projected 10% growth in global oil demand between 2019 and 2050,[38] with oil demand by non-Organisation for Economic Co-operation and Development (OECD) countries growing by an estimated 42% (compared to a projected –27% decline in OECD demand). That means investors looking out over the next few years should not neglect what could be a profitable sector, in our view. The increase in oil prices coupled with capital discipline have enabled some oil companies to net record profits in 2022.

Concluding thoughts

Ultimately, our job is to observe and predict trends occurring in the marketplace and find ways for our clients to profit from them. The pivot away from hydrocarbons will take many years, and there will be periods when progress is accelerated and other periods when it stalls. Hydrocarbons are not going away anytime soon, and any policy that forces the transition too quickly will undoubtedly pose a risk to energy security. But private markets and public policy interests are aligning to drive the transition, and there are opportunities for the investor focused on generating return while limiting risk. For clients seeking greater visibility into how these themes and investment ideas are making their way into portfolios, please reach out to your investment advisor.

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* Some investment products may be available only to certain "qualified investors"— that is, investors who meet certain income and/or investable assets thresholds. Offers of such products will be made only in connection with the delivery of the appropriate offering documents, which are available to pre-qualified persons upon request. Investments such as private funds and mutual funds which focus on alternative strategies are subject to increased risk and loss of principal and are not suitable for all investors. These types of investments may use aggressive investment strategies, which are riskier than those used by typical mutual funds and you may lose more money than if you had invested in another fund that did not invest as aggressively.

APPENDIX

ENDNOTES

1 Greenhouse gases are specific gases that trap heat within the earth's atmosphere leading to a "greenhouse effect," the cause of climate change.

2 https://repeatproject.org/docs/REPEAT_IRA_Prelminary_Report_2022-08-04.pdf

3 The Stated Policies Scenario (STEPS) can be viewed as its baseline, as it reflects current policies in place across all countries. The Announced Policies Scenario (APS) includes pledges made by countries to reduce emissions that have yet to be formally implemented. Last, the Net-Zero Emissions by 2050 Scenario (NZE) is the IEA's assessment of required investments to reduce emissions in an effort to limit the rise in global temperatures to 1.5 degrees Celsius (2.7 degrees Fahrenheit) by 2100.

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7 Energy Information Administration, U.S. Dept. of Energy. Annual Energy Outlook 2021.

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20 IEA report titled "Net Zero by 2050" May 2021.

21 In 1997, the Toyota Prius became the first mass-produced hybrid electric vehicle. It was first released in Japan. The History of the Electric Car | Department of Energy.

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Key risks of investing in private markets:

Private markets investments can be important contributors and diversifiers in the context of a broader portfolio. However, investors should require a higher return target or return premium as compensation for the assumption of additional risks. Prior to committing capital to a private markets fund, the following risks need to be fully understood and carefully evaluated:

- Limited liquidity exists because the underlying assets held by private markets funds generally cannot be quickly and easily sold at full price. For this reason, general partners of private equity funds typically structure their funds as long-term investment vehicles, greatly limiting the ability of limited partners to redeem their investments at any given time. Investors generally look for an illiquidity premium in the form of a higher return target to compensate for the higher risk.
- Operational risk is the risk of loss from inadequate internal controls or processes and is particularly important in private markets because of the illiquidity of investments and limited regulation. Operational risk exists at both the general partner level, where it can be mitigated through effective manager due diligence, and at the underlying portfolio company level, where it can be mitigated by the general partner's due diligence.
- Leverage includes the use of additional debt by general partners to finance transactions. Leverage is commonly used by fund managers in private markets to increase returns and optimize the capital structure of their companies. However, the use of leverage also increases risk.
- Less regulation and transparency are the case with private funds. They are not subject to the same U.S. SEC registration as mutual funds and can instead rely on exemptions from such registration. What's more, investors have less transparency on underlying investments, generally committing capital to the fund prior to the fund having made any investments. These limitations make thorough due diligence particularly important when researching private funds.

Stock risks:

Different types of investments involve varying degrees of risk, and there can be no assurance that the future performance of any specific investment, investment strategy, or product made reference to directly or indirectly in this document, will be profitable or equal any corresponding indicated historical performance level(s).

Securities markets are volatile and the market prices of securities may decline. Securities fluctuate in price based on changes in a company's financial condition and overall market and economic conditions.

Risks related to company size:

Generally, the smaller the market capitalization of a company, the fewer the number of shares traded daily, the less liquid its stock and the more volatile its price. For example, medium- and small-capitalization stocks may be less liquid and more volatile than stocks of larger, well-known companies. Companies with smaller market capitalization also tend to have unproven track records, a limited product or service base, and limited access to capital.

During certain market periods, large-capitalization, dividend-paying value stocks will trail returns from the overall stock market. Large-cap stocks tend to go through cycles, which can last years, of doing better—or worse—than other segments of the stock market or the stock market in general.

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These include weather, geopolitics, foreign events, new technologies, which can all be particular risks and may lead to volatility for this asset class.

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GLOSSARY

Capital discipline describes a situation in which a company exercises discipline and prudence in how much money it borrows, raises, and spends in order to deliver the best returns to its shareholders and help ensure long-term stability.

Carbon dioxide (CO_2) comes from both natural sources (including volcanoes, the breath of animals, and plant decay) and human sources (primarily the burning of fossil fuels like coal, oil, and natural gas to generate energy). The world's forests emit an average of 8.1 billion metric tons of CO_2 into the atmosphere annually due to deforestation and other disturbances.

F-gases (fluorinated gases) are man-made gases used in a range of industrial applications with an even higher warming potential than CO_2.

Federal investment tax credit allows residents to deduct a certain percentage of installation costs from federal taxes.

Methane is the second-most abundant human-caused GHG and is 86x more powerful than CO_2 over 20 years.

Natural gas is mainly methane that leaks into the atmosphere from oil and natural gas wells, storage tanks, pipelines, and processing plants.

Nitrous oxide (sometimes referred to as laughing gas) is the most important greenhouse gas after methane and CO_2 and the biggest human-related threat to the ozone layer.

Petroleum includes the production, import, processing, transportation, and distribution of crude oil and refined products such as gasoline, heating oil, diesel, propane, and jet fuel. It is a major source of U.S. GHG emissions.

Risk premium is a measure of excess return that is required by an individual to compensate being subjected to an increased level of risk. It is a premium paid for less risk.

Total return refers to interest, capital gains, dividends, and distributions realized over a given period of time.