INVESTING IN ENERGY: NEW & OLD

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TABLE OF CONTENTS

Introduction

At the end of January 2021, Emerald Advisers released a white paper outlining some of our thoughts regarding the broad category of clean technology and renewable energy. In that report, we stated that we believe clean tech to be an extremely investable area that will continue to reward highly risk tolerant, patient investors, but it will require stock picking on a highly individualized basis. We made note of a few macroeconomic and societal trends that are shaping the space. Those trends included increasing governmental and corporate support for renewable and carbon-neutral projects, decreasing costs throughout the supply chain, and changing consumer preferences to include ESG criteria in purchase decisions.

In this paper, we hope to update readers on how those trends have changed in the approximate two years since that first report.

Emerald has worked hard to transition and broaden our research efforts to cover these renewable-oriented energy companies, and we have stepped up our communication efforts between analyst coverage groups to ensure that companies that fall within areas of research that overlap, such as in Transportation, Industrials, Materials, and Technology are more fully covered and vetted. This transition and concentration of research resources has resulted in Emerald identifying, researching, and investing in what we believe are some of the fastest-growing alternative energy companies in the domestic equity universe.

Currently, it is a fossil fuel world, but in many ways that is rapidly changing. Our job at Emerald is to continually assess which energy sources will be the long-term market share gainers and which companies from producers to equipment and component manufacturers, to midstream and service companies will succeed in generating industry-leading sales and earnings growth. Most companies will fail to produce robust repeatable results; some will win regardless of the energy source; and a few will develop the scale, intellectual property, margins, and structures to be the potential long-term investable winners. Our challenge is to identify and invest in these companies, preferably before the rest of the market notices them. This is something we have strived to do over the past 30 years and have already focused on in the renewable energy space over the recent past, through investments in selected high-growth small and mid-cap renewable energy companies.

The following is our discussion on the current state of the energy market. We discuss the major sources and uses of energy both domestically and worldwide. We highlight some of the major climate change policies that are pushing unprecedented renewable energy adoption. We also

review some of the newer energy sources including costs, potential uses, some pros and cons of their production and uses, as well as potential market sizes.

In the following pages, we will include some of the facts, trends, predictions, constraints, limitations, and conditions that we consider when conducting our deep fundamental research on industries and companies as well as our perspective on many of these factors including investments we have made.

SHIFTING LANDSCAPE OF CLEAN TECH UNIVERSE

2020 marked a pivotal year for the clean technology sector, as evidenced by the impressive performance of the S&P ECO index, which recorded a rise of over 200%. However, this was followed by a downturn, with a -30% decline in 2021 and a further -45% decrease in 2022.

In a previous publication, Raymond James released an aggregated list of U.S.-listed clean technology companies. At the time, there were 123 companies with a combined market capitalization of $1.5 trillion. In the latest update from Raymond James, it has been noted that despite a two-year period of significant decline, the overall market capitalization has remained around $1.12 trillion. This is attributed to the increase in the number of companies, with a recent total of 236, due to robust SPAC and IPO activity in the past two years.[1]

Figure 1: U.S. Listed Clean Tech Universe

U.S.-Listed Clean Tech Universe

	Number of Companies	Market Cap ($ MM) Total	Smallest	Largest
Electric Vehicles	63	$614,428	$8	$427,084
Power Storage	38	$98,704	$16	$26,752
Solar Power	34	$122,470	$11	$41,339
Water Technology	21	$67,796	$126	$19,850
Biomaterials	19	$37,659	$18	$11,443
Wind Power	16	$130,114	$36	$37,299
Hydrogen	13	$15,723	$21	$7,133
Energy Efficiency	9	$12,477	$13	$8,824
Natural Gas Fuels	7	$7,984	$67	$4,718
Smart Grid	4	$6,183	$26	$2,248
Biopower	2	$3,598	$56	$3,543
Geothermal Power	2	$5,151	$207	$4,944
Synthetic Materials	2	$1,172	$111	$1,061
Carbon Technology	2	$801	$76	$725
Wave Power	2	$48	$20	$28
Microturbines	1	$23	NA	NA
Small Nuclear Power	1	$469	NA	NA
Total	**236**	**$1,124,800**		
Total ex-Tesla	**235**	**$697,716**		

Source: FactSet, Raymond James research

EMERALD'S PERSPECTIVE: *Given the volatility we've seen over the last three years, if there is a generalization to be made about trading in the clean tech space, it is that these companies tend to trade emotionally. These stocks are high beta, driven by sentiment and momentum, and are prone to relentless volatility, including sometimes for no apparent reason. Looking forward, investing in Energy is going to be a stock pickers market; it simply does not lend itself to making broad calls. Within each vertical – even the narrow ones – we still have to focus on*

each individual company's positioning (product mix, margin structure, industry partners, geographic footprint, etc.).

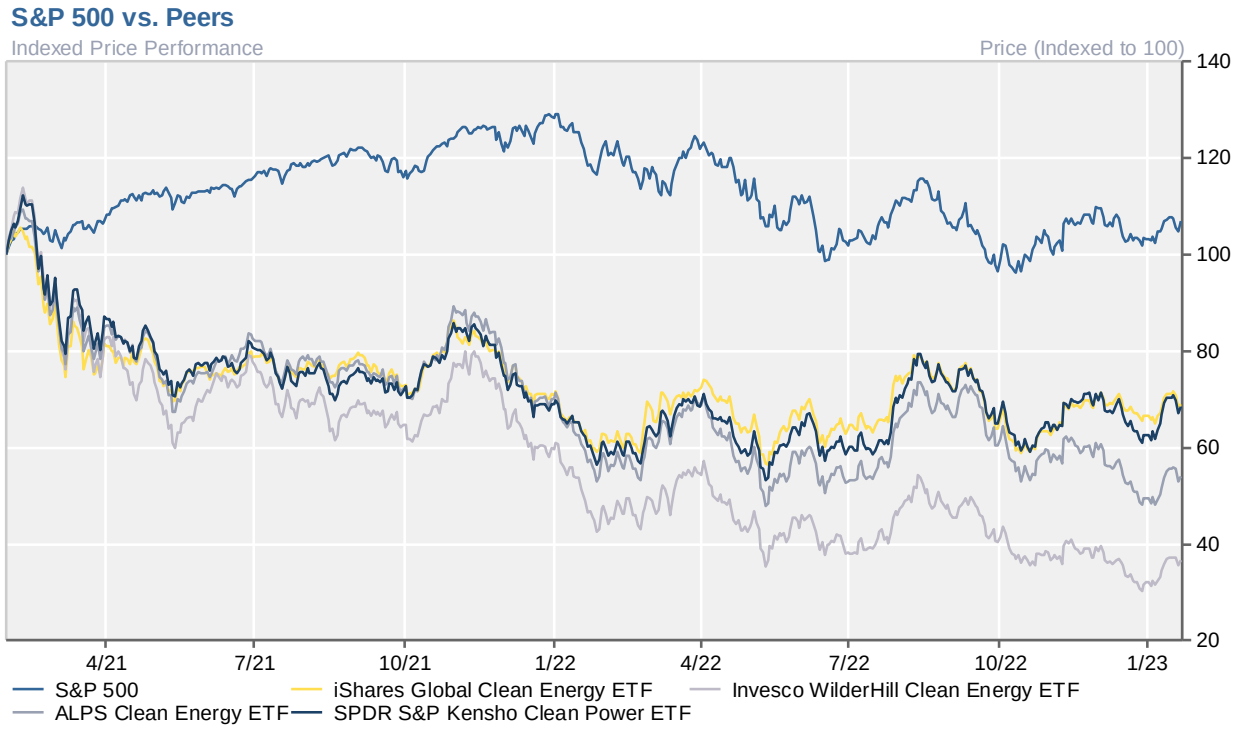
PERFORMANCE OF THE LARGEST CLEAN-TECH ETFS

The table below shows the performance of four of the largest broadly diversified clean technology exchange-traded funds (ETFs) in comparison to the S&P 500 since the publication date of our last report. These ETFs are offered by the leading providers and collectively represent approximately $7.2 billion in AUM. An equally weighted portfolio of the four ETFs would have yielded a negative return of 41.6% over this period, in contrast to the 6.7% return for the S&P 500 over the same time frame.

Figure 2: Performance of Largest Clean-Tech ETFs

Issuer	Fund Name	Fund Ticker	AUM as of (11/30/2022)	Return Since 1/31/2022
Blackrock	iShares Global Clean Energy ETF	ICLN	$5.26B	-29.7%
Invesco	Invesco WilderHill Clean Energy	PBW	$885.26M	-62.4%
SS&C	ALPS Clean Energy ETF	ACES	$679.31M	-43.2%
State Street Global	SPDR S&P Kensho Clean Power	CNRG	$358.50M	-31.1%
			Equal-Weight Return	**-41.6%**
			S&P 500 Return	6.7%
			Difference	-48.3%

Figure 3: Chart Performance of Largest Clean-Tech ETFs



CLEAN TECH AND ESG FUND FLOWS

Sustainability funds are still attracting new capital despite the market volatility and falling securities prices. ESG mutual funds and ETFs attracted a net $120 billion in the first half of 2022 compared to net outflows of $139 billion from broader-market funds.[2] Europe has attracted the vast majority of new assets invested in ESG funds in 2022 with investors transferring a net $109 billion to European ESG funds in H1 2022 while investing only $9 billion in US-based ESG funds.[3]

In times of market volatility, sustainable funds have shown to be more resilient compared to traditional funds, this is due to the nature of the investors of these funds being more values-driven and long-term oriented, making them less likely to withdraw their investments. Investors also generally prefer passive investments. Index equity funds had a net inflow of $311 billion in H1 2022, while actively managed equity funds had a net outflow of $180 billion during the same period.

***EMERALD'S PERSPECTIVE**: Despite the comparatively poor performance, ESG-related funds have shown resilience in terms of fund flows. This provides additional support for names around current levels even in a recessionary environment. If these values-based investors shift to having less conviction the bottom could fall out of broad-based ETFs, strengthening our belief that opportunities exist in the clean-tech universe but will require stock-picking on a highly individualized basis.*

CHANGING LANDSCAPE IN THE UNITED STATES

Since our last report, the United States federal government has passed two landmark pieces of legislation: The Infrastructure Investment and Jobs Act (IIJA), and The Inflation Reduction Act (IRA).

THE INFRASTRUCTURE INVESTMENT AND JOBS ACT (IIJA)

The IIJA is a roughly $1 trillion bill that was passed on August 10th, 2021. It aims to support climate priorities but is likely to do more to reach 2050 targets than 2030 targets[4]. The IIJA includes provisions related to transportation, power, industry, and buildings, but is unlikely to bring about significant emission reductions or technological leaps in these sectors. In the transportation sector, the bill includes $15 billion for low-carbon mobility, including investment in electric vehicle charging infrastructure and funding for low-carbon ferries and buses. In the power sector, the bill includes funding for grid infrastructure and clean energy tax credits but falls short of the Biden administration's original proposal. In the industry sector, the bill includes funding for research and development but does not address the problem of emissions from heavy industry.

In the buildings sector, the bill includes funding for energy efficiency and building electrification but does not address the problem of emissions from the operation of buildings.

Overall, the IIJA is an arguably unprecedented step in the right direction as a vehicle of a green industrial strategy for a long-term transition to clean energy. However, as a climate strategy to meet the immediate goals of a rapidly dwindling carbon budget, it falls far short of what is needed to reach climate targets.

Figure 4: States with Clean Tech Targets

State	The Goal	Year
California	100% carbon-free electricity	2045
Colorado	100% carbon-free electricity	2050
Connecticut	100% carbon-free electricity	2040
District of Columbia	100% renewable energy	2032
Hawaii	100% renewable energy	2045
Illinois	100% clean energy	2050
Louisiana	Net zero greenhouse gas emissions	2050
Maine	100% clean energy	2050
Maryland	Net-zero greenhouse gas emissions	2045
Massachusetts	Net-zero greenhouse gas emissions	2050
Michigan	Economy-wide carbon neutrality	2050
Nebraska	Net-zero carbon emissions from generation resources	2050
Nevada	100% carbon-free electricity	2050
New Jersey	100% carbon-free electricity	2050
New Mexico	100% carbon-free electricity	2045
New York	100% carbon-free electricity	2040
North Carolina	Carbon neutrality in the electricity sector	2050
Oregon	Greenhouse gas emissions reduced 100% below baseline emissions	2040
Puerto Rico	100% renewable energy for electricity	2050
Rhode Island	100% renewable energy electricity	2033
Virginia	100% carbon-free electricity	2045
Washington	100% zero-emissions electricity	2045
Wisconsin	100% carbon-free electricity	2050

THE INFLATION REDUCTION ACT (IRA)

The Inflation Reduction Act, passed in August of 2022 represents the largest and most important piece of climate legislation in U.S. history. The IRA is a 700+ page document with ambitious plans for reducing CO2 emissions in the U.S. by 40% by 2030, with $369 billion allocated for Energy Security and Climate Change programs. It aims to significantly increase renewable energy, potentially tripling clean energy production and reaching 40% renewable energy sources (wind, solar, energy storage) by 2030.

The IRA includes provisions that support the financing of renewable energy projects by allowing for the transfer of renewable energy tax credits to corporate taxpayers in a direct sale. The act extends existing tax credits for solar and wind energy and plans to offer credits for all clean technologies from 2025 to 2032. The IRA also provides incentives for domestic production of renewable components, projects in "energy communities," renewable fuels, and sustainable aviation fuel. Additionally, the act makes energy storage projects eligible for Investment Tax Credits and offers tax credits for electric vehicles.[5]

Despite record amounts of money going to renewables, many believe “Carbon Neutral by 2050” simply is not possible. In September, the Electric Power Research Institute (EPRI), the research

arm of the U.S. electric utility industry, released a report titled "Net-Zero 2050: U.S. Economy-Wide Deep Decarbonization Scenario Analysis." The EPRI report concludes that the utility industry can't attain net zero. They posit no amount of wind turbines, solar panels, hydropower, nuclear power, battery power, electrification of fossil-fuel technologies, or energy-efficiency technologies will get us to net zero by 2050.[6] To achieve even the deep decarbonization scenario by 2050, the EPRI says, "a broad portfolio of options that includes low-carbon fuels and carbon removal technologies will be required."[7] The problem is that low-carbon fuels and carbon removal technologies have not proven they can reach an efficient scale.

NEM 3.0

The California Public Utilities Commission (CPUC) commissioners voted to ratify the new CA net billing tariff NEM 3.0 with minimal changes from the Proposed Ruling. Customers of PG&E, SCE, and SDG&E who have solar systems will be paid an average of 8 cents per kWh for the energy they send back to the grid. This is a significant reduction from the previous rate of 30 cents per kWh under NEM 2.0.

EMERALD'S PERSPECTIVE: *We expect a demand pull forward of residential solar installations in 1H23 and a subsequently weaker 2H23 (or at least 4Q23) and 2024 as customer economics will worsen to ~10-year payback from ~6 years under NEM 2.0 today. We expect solar system demand to reduce 30% y/y in CA once NEM 2.0 sunsets, partially offset by higher demand for battery storage and improving economics as utility electric bills keep growing with inflation and higher gas prices. Customer paybacks improve with the addition of energy storage to ~8 years, which will drive attachment rates up, offsetting revenue losses for residential solar stocks.*

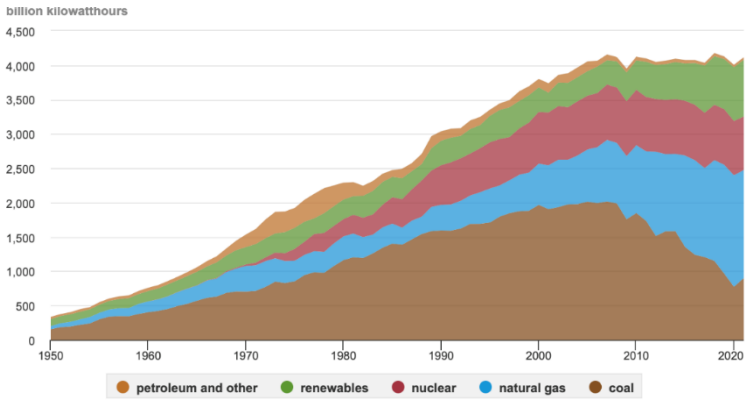
Power storage is close to a combined $100B market cap. Power storage comprises EV battery suppliers as well as companies providing storage for the grid. Historically, just about the only U.S.-listed names in this value chain had been lithium suppliers. In the last few years, there have been several notable special purpose acquisition companies (SPACs). Power storage is a new and rapidly evolving industry and Emerald has invested in companies involved in the design and manufacture of power generation and storage products.

WHERE ARE WE TODAY?

The United States generates electricity from diverse sources and uses many different technologies which have shifted over time, but the changes have been at an accelerating pace over the past two decades.

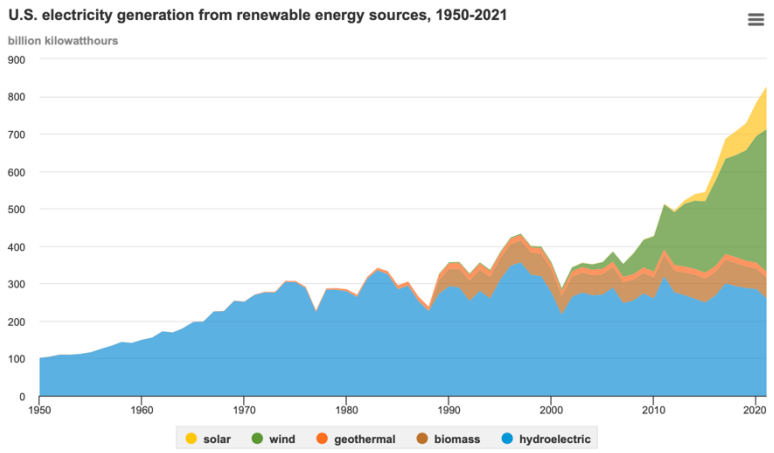
The area chart in Figure 5 shows how the composition of energy generation has shifted over the last 70 years. Of note, total electricity generation has not moved much over the last 12 years; however, the source of electricity has shifted quite dramatically. In 2007, coal represented 48.5% of the 4.15 trillion kWh generated. By 2021, that percentage dropped to only 23.5% of the 4.13 trillion kWh of electricity generated, dropping in both relative and absolute measures.[8]

Figure 5: U.S. electricity generation by major energy source 1950 - 2021 (EIA.gov)



In 2021, fossil fuels were still the largest sources of energy for electricity generation, with natural gas being the largest at 38% and coal being the second largest at 22%. Petroleum accounted for less than 1% of electricity generation in 2021. In the past, coal played a larger role, representing 52% of electricity generation at the turn of the century, but has decreased to 21% in 2021.

Figure 6: U.S. electricity generation from renewable sources, 1950-2021 (EIA.gov)



In 2021, the U.S. generated approximately 4.12 trillion kWh of electricity. Approximately 63% was from fossil fuels (coal, natural gas, petroleum, and other gases). About 19% was from nuclear energy, and about 20% was from renewable energy sources.[9] This is up from 17% at the time of our last paper.

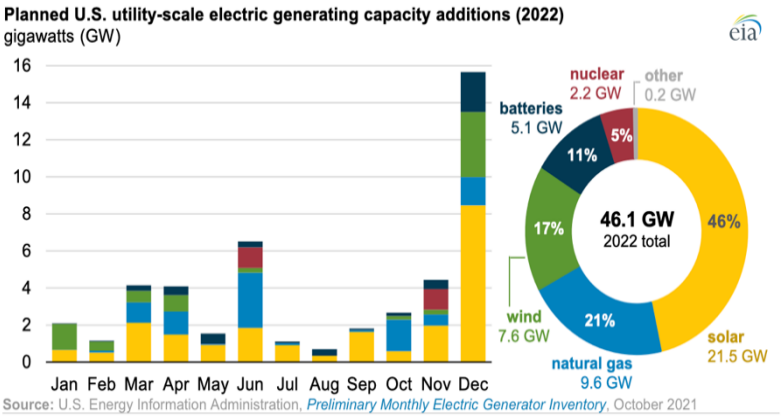
While in 2021, renewables (the green part of the area chart in Figure 5) only represented 20.1% of electricity generated, Emerald believes this is one

Figure 7: Source: EIA.gov, Emerald Advisers, LLC

	% of Energy Generation					
	Today		As of Last Report		Change	
Energy Source	% of Total U.S. Energy	% of Renewables	% of Total U.S. Energy	% of Renewables	% of Total U.S. Energy	% of Renewables
Wind	9.2 %	46.0 %	7.1 %	40.5 %	2.1 %	5.4 %
Hydropower	6.3 %	31.5 %	7.0 %	39.6 %	(0.6)%	(8.1)%
Solar	2.8 %	13.9 %	1.7 %	9.9 %	1.0 %	4.0 %
Biomass	1.3 %	6.7 %	1.4 %	7.9 %	(0.0)%	(1.2)%
Geothermal	0.4 %	2.0 %	0.4 %	2.1 %	0.0 %	(0.2)%
Total Renewable	**20.1 %**	**100.0 %**	**17.6 %**	**100.0 %**	**2.5 %**	**- %**

area poised for significant growth in the coming decades. Consider this staggering statistic: the PV industry has accounted for approximately one-third of the world's total power generation new builds every year starting in 2017.[10] [11]The chart in Figure 8, from the EIA, shows that solar will represent an estimated 46% of utility-scale new builds in the U.S. in 2023.

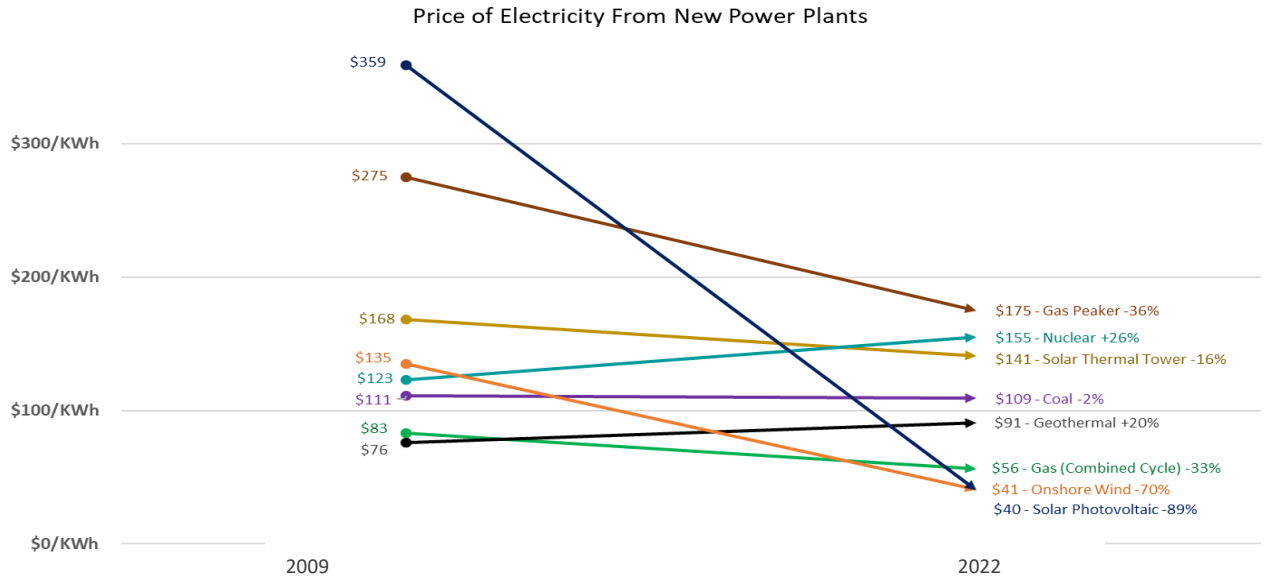
Figure 8: Planned U.S. utility scale generation additions



CURRENT GENERATION COSTS BY ELECTRICITY SOURCE

Wind and solar have dramatically increased as a part of total U.S. energy generation, in large part, based on economic merit alone, with government subsidies and incentives acting as a boost. Referring to the Levelized Cost of Energy (LCOE) in Figure 9 below, solar and onshore wind are routinely the cheapest sources of energy globally. The LCOE compares different methods of electricity generation on a consistent basis. The AppliedEnergy Journal explains the LCOE as "a measure of the average net present cost of electricity generation for a generating plant over its lifetime. The LCOE is calculated as the ratio between all the discounted costs over the lifetime of an electricity generating plant divided by a discounted sum of the actual energy amounts delivered." [12]

Figure 9: Price of Electricity from New Power Plants (Our World In Data)

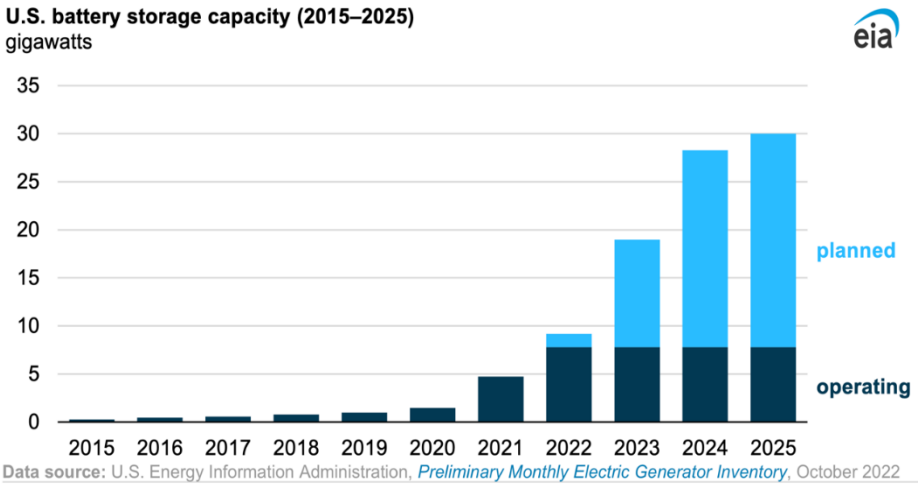


EMERALD'S PERSPECTIVE: *One of the biggest barriers to the proliferation of renewable energy is cost. The long-term trend has lowered the costs of solar PV and on-shore wind dramatically. Supply chain issues of the last year and a half along with geopolitical tensions have impacted costs temporarily but have not impacted the long-term trend and does not shake our confidence for improved costs going forward.*

RISING NEED FOR BATTERY STORAGE

For the United States to increase its exposure to renewables, battery storage capacity will have to significantly increase, and quickly. According to the EIA, developers and power plant owners plan to increase utility-scale battery storage capacity in the United States over the next three years, reaching 30.0 gigawatts (GW) by the end of 2025 (see figure 10).[13] Battery storage capacity in the United States was negligible prior to 2020 and has grown to 7.8 GW in 2022. From 2023 to 2025, they expect to add another 20.8 GW of battery storage capacity.

Figure 10: US Battery Storage Capacity

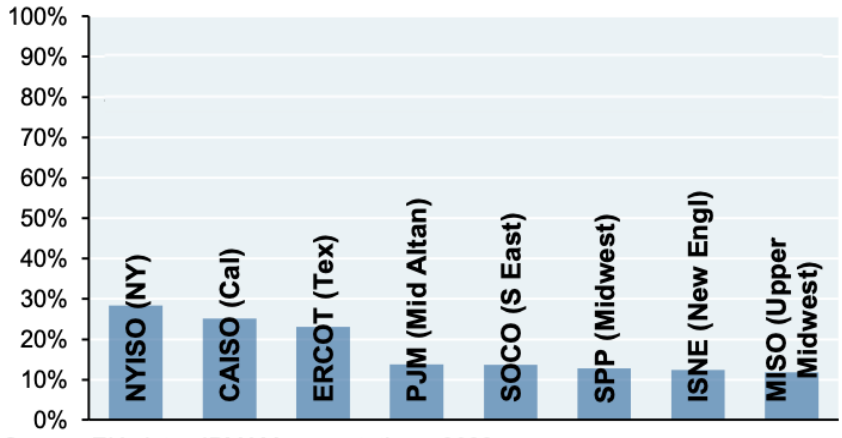


Wind and solar are both intermittent resources; they can only provide electricity when the wind is blowing or when sunshine is available. Batteries solve the intermittency problem by storing extra energy produced by wind or solar generators for use later.[13]

ADDING WIND AND SOLAR DOES NOT REPLACE NATURAL GAS 1:1

As wind and solar penetration rise, a lot of capital will still need to be spent building and maintaining backup thermal power plants and utility-scale energy storage. Because wind and solar energy are not consistently available, backup thermal power generation and/or energy storage are required in systems that rely heavily on renewable energy sources.

Figure 11: Adding Wind and Solar Does Not Replace Natural Gas 1:1



Source: EIA data, JPMAM computations. 2022.

The chart to the right (Figure 11) was prepared by J.P. Morgan and illustrates the extent to which natural gas capacity can be reduced by incorporating additional wind and solar power, based on the current power generation resources. Currently, 1 MW of additional wind and solar capacity results in the decommissioning of just 0.1 to 0.3 MW of natural gas.[14]

Additionally, a significant amount of funding will also need to be invested in the transmission infrastructure, since wind and solar power facilities are typically located farther away from areas with high energy consumption.

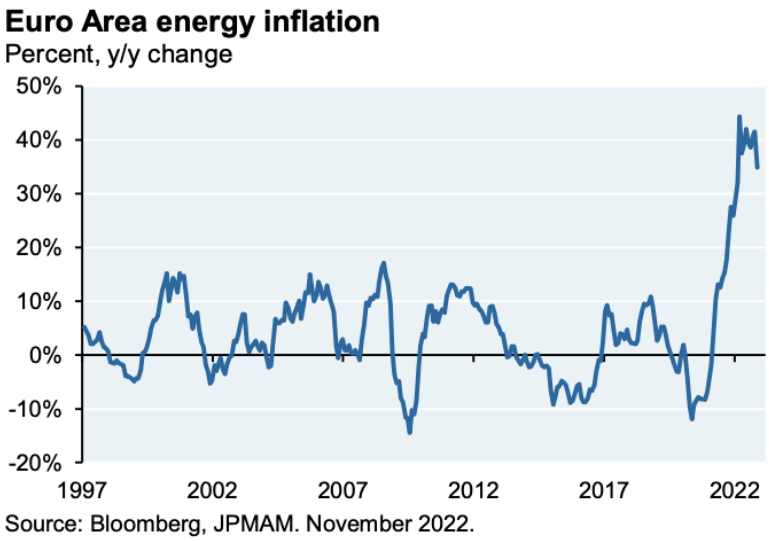
EMERALD'S PERSPECTIVE: *The U.S. will also have to continue to invest in natural gas drilling, completions, infrastructure, generation, and distribution. Years of chronic underinvestment in natural gas has contributed to large price spikes both domestically and internationally (particularly in Europe).*

ENERGY INFLATION IN EUROPE

Europe is in the middle of a dynamic battle with energy prices as they face the consequences of its previous dependence on Russia for energy. In addition, featuring a pricing structure in which electricity produced from renewable sources such as wind, solar, hydro, and nuclear are priced the same as power generated from natural gas.

The issue is that fossil fuel power producers often set the marginal prices in Europe, and when the cost of natural gas increases, this marginal price is applied to all power producers. To address this, Europe is implementing household subsidies and limits on the prices paid to non-gas power producers, which could offset about 60% of the price increase.

Figure 12: Euro Area Energy Inflation



In Germany, the first of five LNG import terminals regasification has been completed, and the estimated cost has tripled to around $10 billion. In France, the nuclear power industry is operating at around 50% of its capacity. If this trend continues through the winter, it could lead to additional strain on gas and electricity prices in France and neighboring countries that rely on nuclear power exports.

EMERALD'S PERSPECTIVE: *The Russian war versus Ukraine and the concomitant sanctions and cutoffs of oil and natural gas to Europe has shown Europe's huge need to diversity its energy sources. Natural gas, transported as LNG, has surfaced as a prime fuel source to transition Europe from its fossil fuel reliance to a cleaner energy future. Emerald has made numerous LNG related investments over the years. We still believe growth in LNG volume and geographies will be beneficial for selected stocks.*

THE UNITED STATES DOES NOT HAVE ENOUGH CHARGING STATIONS

A significant obstacle to the widespread adoption of electric vehicles is the uncertain financial model for the commercial charging stations that support them. The implementation of EV charging infrastructure presents a classic catch-22 scenario. To stimulate widespread adoption of EVs, there must be a robust charging network that provides convenient and accessible charging options. However, businesses are hesitant to invest in charging infrastructure until there is a sufficient number of EV drivers to ensure utilization and profitability. This creates a barrier to widespread EV adoption, as consumers are reluctant to make the switch until they feel confident in the availability and accessibility of charging options.[15]

Industry experts argue that the US requires a significant increase in fast charging stations. While there are more than 145,000 places to refuel traditional gasoline vehicles, the U.S. currently has only 11,600 points for fast charging of any EV, according to Atlas Public Policy.

The IRA has aimed to accelerate the shift towards electric vehicles by providing incentives such as federal tax credits. It is projected that about $1.7 billion in tax credits for chargers and alternative fuel equipment will be claimed in a decade. States will distribute around $7.5 billion over multiple years from last year's infrastructure law to improve the availability of charging stations. However, questions remain around who will sell electricity to drivers and who will bear the costs of the infrastructure. [15]

EMERALD'S PERSPECTIVE: *In several renewable industries, like wind, there has been so much consolidation that the few remaining companies are too large for Emerald's small-cap portfolio. Or, also in the case of wind, none of the main wind turbine manufacturers are U.S.-domiciled. As a result, Emerald has taken a "Picks and Shovels" approach to wind and solar. Identifying companies up or down-stream that are poised to benefit from a rise in the industry but agnostic to who wins share further downstream.*

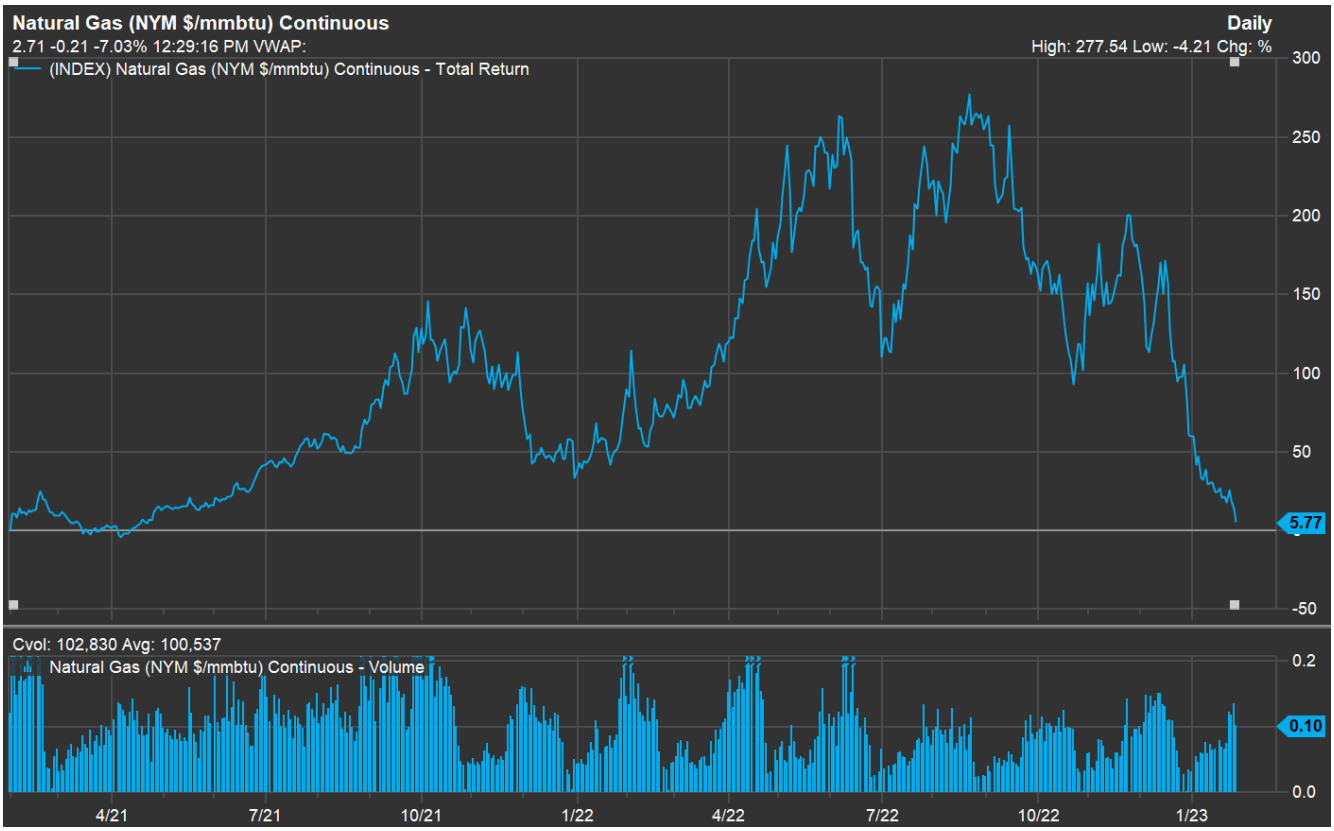
NATURAL GAS

Natural gas is still technically a fossil fuel which some investors say immediately disqualifies it from a clean tech conversation. Emerald disagrees for two reasons. First, natural gas is assisting in the shift from petroleum and coal, and second, in the conversation about carbon intensity, renewable natural gas (especially from dairy farms) has the lowest GHG emission profile possible, registering at ~-300 vs. +100 for diesel.

A single LNG cargo can displace 140-200 thousand metric tons of carbon, as compared to coal.[16] Compressed natural gas (CNG) is a gasoline substitute used in passenger cars, light trucks, and buses. LNG is a diesel substitute, used in buses and heavy-duty trucks. LNG can also be used in "high horsepower" applications – railroad locomotives and marine vessels – but these are early-stage end markets. Relative to LNG, CNG is much more mainstream, due to its lower cost structure and also the fact that it can be easily produced on-site at fuel stations."[17]

As it refers to "clean" energy, Emerald believes the most interesting piece is RNG, renewable natural gas. RNG is a catch-all term for both CNG and LNG derived from bio-based gas, sourced from landfills and agricultural operations. RNG comprised 45% of the natural gas fuels in the U.S. in 2022. RNG's growth rate - volumes nearly quadrupled since 2015 - is outpacing the conventional variety, despite RNG's generally higher costs.

Figure 13: Natural gas pricing from 1/30/21 to 1/30/23



Source: FactSet

***EMERALD'S PERSPECTIVE**: In Figure 13 above you can see that since our last report natural gas is essentially flat after peaking at around $278 MMBtu. Looking forward in the oil and gas end markets, while we think there could be some lumpiness (given some moderation in oil prices and increased focus on green initiatives), we do see some potentially positive O&G project capex tailwinds in '23.*

We believe spending could increase globally. In '22, global upstream capex rose ~32%, and we could see another 20% rise in global capex, with international growth forecasted at ~15%, led by Latin America and the Middle East, in 2023.

We see increasing capex driven primarily by smaller-scale projects, expansions of current assets, and cost inflation. Despite falling energy prices, and increased demand for green energy and renewable energy, we have a positive outlook that global oil and gas project activity could pick up in '23.

Emerald has invested in a leading publicly traded company turning edible byproducts and food waste into sustainable products and is a leading producer of renewable energy such as renewable diesel.

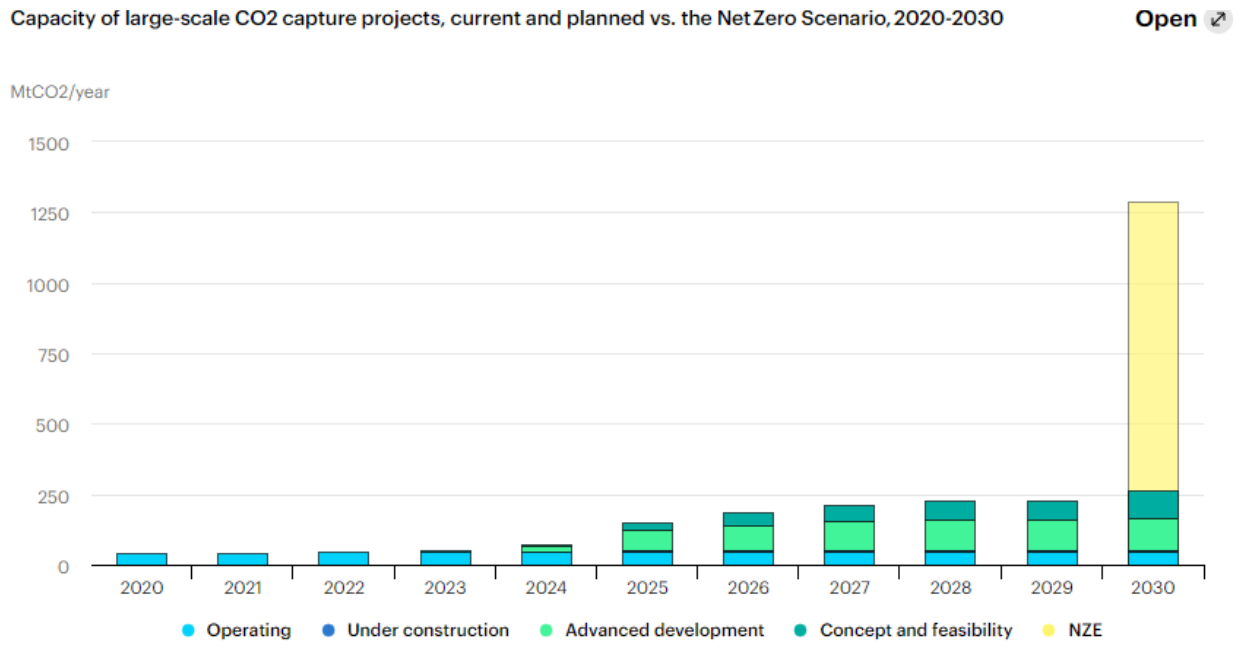
Emerald has also invested in one of the largest LNG producers in the U.S and a leading floating storage and regasification unit provider (FSRU) that also provides services up and down the natural gas value chain. Several of these companies are expanding up and down-stream to add value. We would not be surprised to see these LNG companies involved in distribution of future fuels, possibly hydrogen, as the technology and supply chain develops.

CARBON CAPTURE, UTILIZATION AND STORAGE (CCUS)

Carbon capture, utilization, and storage (CCUS) is a group of technologies aimed at reducing carbon emissions by capturing CO2 from large point sources, such as power plants or industrial facilities. The captured CO2 can be used in various applications, transported and stored in deep geological formations, or used in carbon removal processes. There are currently 35 commercial facilities applying CCUS to industrial processes, fuel transformation and power generation, with a total annual capture capacity of almost 45 Mt CO2.

In the past, implementation of CCUS technology has lagged behind expectations, but it has gained a lot of traction in recent years. There are approximately 300 projects in various stages of development with plans to have over 200 new capture facilities in operation by 2030, capturing a total of 220 million metric tons of CO2 per year. Currently, only 10 commercial capture projects have reached financial investment decision (FID) stage as of June 2022. Despite this growth, the deployment of CCUS technology is still far from meeting the Net Zero Scenario.

Figure 14: IEA estimates of CO2 operations, planned vs. current.



EMERALD'S PERSPECTIVE: *Emerald has invested in the Carbon Capture, Utilization, and Storage (CCUS) value chain through a leading CCUS company. This company recycles CO2 through enhanced oil recovery to produce Blue Oil, a carbon-negative and environmentally friendly product. As the proprietor of the largest CO2 pipeline network globally and with a burgeoning portfolio of sequestration locations, the company is poised to be a dominant player in the CCUS industry in the near and medium term.*

CCUS technology is just one part of a larger number of initiatives that will need to grow significantly if the United States expects to hit the climate goals of 2050 and certainly of 2030. Finally, as the viability of CCUS technology is further established through large-scale implementation, it is likely that some of the smaller companies operating within the sector may become attractive acquisition targets for the major oil and gas corporations.

SOLAR

The solar industry has undergone substantial transformations in recent years, marked by sanctions on products that have disrupted supply chains, as well as policy changes and panel efficiency changes that have altered the cost-benefit analysis for both consumers and utility-scale operations. Looking at improvements to efficiency, MIT researchers have developed an innovative design for perovskite solar cells that boosts their efficiency to match or exceed the typical range of 20-22% for silicon cells. The efficiency was improved by adding a conductive layer of tin dioxide, modifying the perovskite formula, and engineering the electron transport layer. Perovskites have the potential for low-cost, low-temperature manufacturing, and can be made into ultrathin, lightweight flexible cells. Other research teams have also made advancements in the field, with a team from Germany and Lithuania achieving a photovoltaic conversion efficiency (PCE) of 29.15% for a perovskite/silicon tandem cell.[18]

China is the largest producer of polysilicon, a key component in solar panels. The US and other countries aim to diversify supply and increase domestic production to reduce dependence on China and promote clean energy.[19] To achieve this, they must build capacity in other stages of the solar panel supply chain, compete with Chinese companies supported by government subsidies, and develop policies to support domestic solar manufacturing. Despite a 23% decrease in solar installations, storage installations rose 227% due to increased demand for batteries.[20]

EMERALD'S PERSPECTIVE: *In the residential solar systems market, we anticipate significant volatility but remain confident in the increasing adoption of battery storage systems.*

The solar energy market has an approximate combined market capitalization of $120 billion, with a significant portion of it being attributed to three major players. Similar to wind energy, Emerald evaluates investment opportunities across the entire solar energy supply chain. An example of this is PV trackers, which represent a less visible category of hardware. These trackers are primarily used in utility-scale projects and allow modules to follow the movement of the sun, thereby minimizing the angle of incidence of sunlight and improving energy yield.

Emerald has made strategic investments in several companies in the renewable energy sector. The first example is in a globally recognized designer and manufacturer of microinverters for the photovoltaic industry, whose products are compatible with a wide range of solar panels and boast industry-leading performance.

In addition, anticipating robust growth in the energy storage market, Emerald has invested in a premier producer of zinc-bromide, a material being used to power scalable and sustainable stationary energy storage solutions. Zinc bromide based batteries offer several advantages over traditional lithium-ion batteries, including lower costs, greater daily discharge capacity with minimal degradation, reduced fire risk, and more efficient recycling processes.

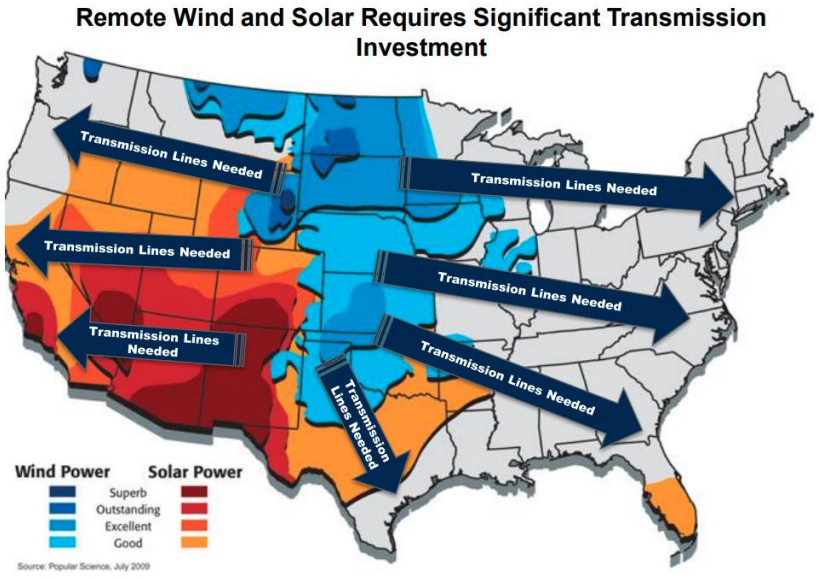
Both companies have demonstrated resilience and maintained their market share despite competition from Chinese competitors.

WIND

Wind turbines produce 5% of the world's electricity and are controlled as individual units but they are often part of larger wind farms. Engineers have found that optimizing control of individual units can increase energy output by 4.2% overall. This increase, if applied to all wind farms, would be equivalent to adding over 3,600 new wind turbines, enough to power 3 million homes.[21]

Wind turbine manufacturers have suffered declining revenues and

Figure 15: T&D lines needed from solar and wind.



missed targets due to project delays and supply chain issues, exacerbated by the COVID-19 pandemic and the invasion of Ukraine. The rise in material costs and intense competition has also put pressure on their margins. According to the American Clean Power's Q3 2021 report, US wind power installations dropped 78% YoY, resulting in only 356 MW, attributed to inflation, logistical challenges, delays, and phasing out of tax credits.

The Inflation Reduction Act is expected to boost wind and storage installations with tax incentives for wind and solar credits for the next 10 years and for energy storage projects, leading to $160 billion more investment in onshore wind, doubling installed capacity to 280 GW in a decade.

EMERALD'S PERSPECTIVE: *Wind energy is a significant market, with a total market capitalization of approximately $130 billion, which is largely dominated by three major players, all of which are internationally listed. Emerald believes that wind power will continue to gain momentum as a preferred energy generation source, driven by economic efficiency and further accelerated by the policies of the Biden administration. Due to the limited number of players within this market, direct investment in wind energy companies can be challenging for Emerald. As an alternative, we have identified and invested in companies that provide essential goods and services to the major wind turbine manufacturers, allowing us to participate in the growth of the industry while remaining agnostic to the specific market share distribution among the major players.*

Moreover, the siting of wind farms necessitates a concurrent investment in transmission and distribution infrastructure. In anticipation of this requirement, Emerald has invested in one of the premier companies specializing in the construction of electric transmission lines. This company is poised to play a critical role in enhancing the grid to effectively handle the power generated by wind farms. This company's backlog is currently larger than the last 6 years of projects combined.

EXPECTATIONS OF BROAD M&A ACTIVITY

EMERALD'S PERSPECTIVE: *In several of the industries mentioned above, the publicly traded companies are nascent. Many of these firms possess technologies that have yet to be validated or exhibit questionable scalability potential.*

In the coming years, it is our thesis that the leading energy conglomerates will likely emerge as key beneficiaries of the transition towards cleaner technologies. These firms possess the capability to acquire smaller companies as they gain proficiency in the technology and demonstrate scalability. Additionally, with ample financial resources and strong balance sheets, they will be able to make

significant investments in the most promising technologies, thereby reducing R&D costs by allowing smaller companies to pave the way.

WHAT DOES EMERALD LOOK FOR IN TRADITIONAL AND RENEWABLE ENERGY STOCKS?

This document represents only a fraction of the extensive research conducted by Emerald in the realm of renewable energy and clean technology. In conclusion, we will briefly outline our methodology for identifying viable investment opportunities within this sector.

In contrast to other investment firms which rely on a stringent screening process, Emerald's approach is to identify companies prior to their appearance on conventional screens. Our preference is for under-covered and under-followed stocks. We seek out companies with substantial and expanding TAMs, that demonstrate progress in gaining market share and display a clear trajectory for future market share expansion. We are drawn to companies with validated technologies that are either profitable or demonstrate a clear path to profitability. Our focus is not on speculative ventures, though we do maintain a vigilant monitoring of such developments.

Our view is that major players in this space are generally not small-cap companies for long, if they ever were. As a result, our investment strategy involves researching companies at various points along the value chain that align with our criteria. One of our preferred investment approaches is the "picks and shovels" strategy, that is to supply an industry with an in-demand good but to be agnostic of wins share further downstream.

In the energy sector, our investment focus is on companies that are price makers rather than price takers. We avoid businesses with negative gross margins or "story stocks." Our ideal investments are companies that contribute to the reduction of energy costs and have the potential to be leaders within the renewable energy industry, regardless of the specific fuel source employed.

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