Energy
Powering the Future: Global Energy Markets

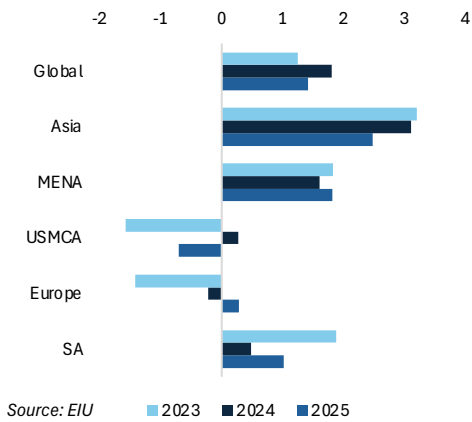## Contributors

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Fig. 1: Total Energy Demand (% change y-o-y)

Source: EIU
■ 2023 ■ 2024 ■ 2025

Fig. 2: Source of Energy (% of total, 2024)

5.1%
11.0%
27.3%
24.1%
32.5%

■ Coal ■ Petroleum ■ Natural Gas ■ Renewables ■ Nuclear

Source: EIU

Fig. 3: Electricity Demand – Data Centres (TWh)

13.4% of total forecasted demand

90
580
345

2022   2026

■ Traditional data centres ■ Dedicated AI data centres
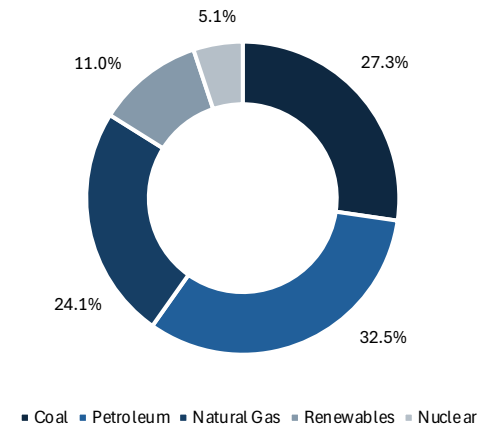
Source: Statista

The Energy Market: An Overview

The global energy market in 2024 is strongly characterized by the intersection of major forces such as developments in artificial intelligence (AI), increasing power demand, geopolitical tensions and the accelerating transition towards renewable sources.

Fossil fuel consumption still dominates the market driven largely by the strong demand in Asia and the Middle East, contributing to the expected 1.8% growth in total global energy consumption in 2024 but the market is still grappling with ongoing geopolitical conflicts, further complicated by growing efforts to reduce emissions. Our key concerns revolve around the issues of energy security and the pressure exerted on existing infrastructure by the growing energy demand while considering the momentum behind renewable energy as a possible mitigating factor.
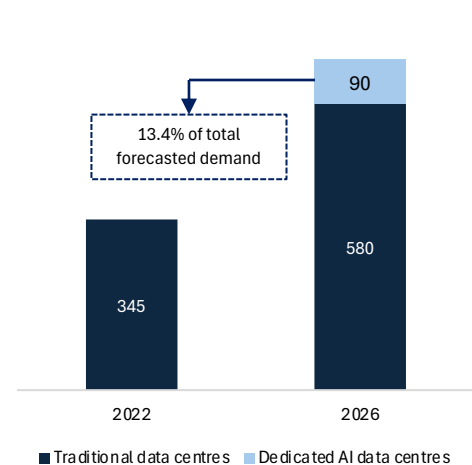
Executive Summary

This presents us with an investment landscape that is rife with both opportunities and challenges, demanding for utmost intricacy in navigating the complex interplays between surging demand and sustainable energy solutions. Fossils fuels still currently accounts for 91% of total energy consumption in the world, but renewables are making significant inroads with an impressive 11% year-on-year growth for solar and wind energy capacities. Hydrogen production too, is expected to be growing component of future energy systems, which we expect to generate even more opportunities for clean energy investments.

While the current long-term outlook favours renewables, we expect fossil fuels to still make up most of the energy mix for the foreseeable further, with oil demand projected to peak in 2029, along with growing investments in natural gas for industrial use and LNG exports that will remain highly attractive. Despite this, sector stakeholders will have to take into consideration additional regulatory pressures, especially in the North America and Europe regions.

The surge in AI has placed an unprecedented pressure on existing energy infrastructure, creating a growing demand for electricity to power dedicated AI data centres alongside traditional data centres, amounting to a forecasted 13.4% for total data centre electricity demand by 2026. Companies involved in storage and transmission infrastructure are well-poised to take advantage of the current situation.

Such rapid growth is certain to reshape the sector, creating a unique opportunity for both the traditional and renewable energy industries to develop solutions that can support this transition. Heavy investments in the current energy infrastructure will be necessary to substantiate the long-term growth potential brought by future AI projects. Investors will have to take note of regulatory changes, particularly in the North American and European regions, which could alter the current trajectory of fossil fuel production and renewable energy growth. Existing supply chain disruptions and rising commodity prices are likely to persist in the near future, painting a layer of uncertainty for involved sectors.

Thesis 1: AI: The turning point for Energy

Insatiable desire across sectors for the adoption of AI, reflected through sky-high optimism in market prices. With the leading question looming across everyone's minds, are we in an extravagant AI bubble? Potential signs of froth currently present in markets, with more than 40% of companies already mentioning AI in their earnings call. It's clear as day that we're relatively late to the AI trade, so where's the trade here?
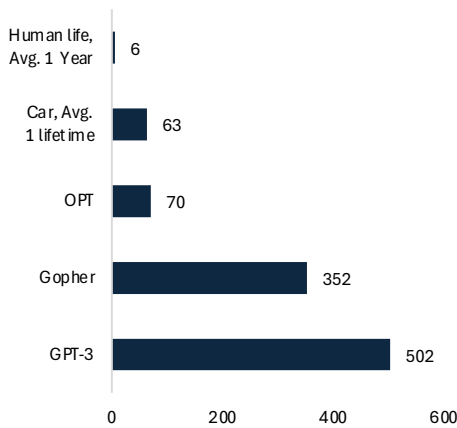
Adopting a pick-and-shovel stance, the group looks into the energy sector as a pristine opportunity, capturing the potential of the immense growth in AI while maintaining rationality. In a market where participants seemingly chase market euphoria, our focus remains on long-term value rather than speculative hype.

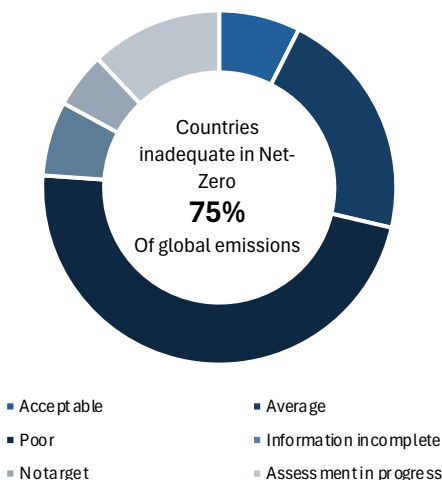**Fig. 4: Adoption of AI vs Use of Gen AI (% of respondents)**

Adoption of AI ——
Generative AI ——

2017 2018 2019 2020 2021 2022 2023 2024
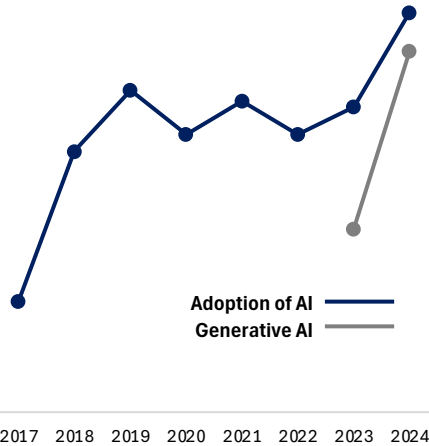
Source: McKinsey and Company

Fig. 5: CO2 equivalent emissions (tonnes)

Human life, Avg. 1 Year	6
Car, Avg. 1 lifetime	63
OPT	70
Gopher	352
GPT-3	502

Source: AI Index Report

Fig. 6: Countries Inadequate in achieving net-zero

Countries inadequate in Net-Zero
75%
Of global emissions

- Acceptable
- Average
- Poor
- Information incomplete
- No target
- Assessment in progress

Source: Climate Action Tracker

Dawn of a new era

Historically, equities across the energy sector have long records of underperformance against the indexes. We reaffirm some signs of an inflection point, particularly in the AI frenzy

The nascent AI trend is redefining all sectors, as we rethink the possibilities of its use-case. Energy required to train and utilise current AI-models is absurdly high. Popular AI-models like GPT-4 use almost 10-times more electricity than a google search. With current trajectory of AI adoption, experts are forecasting 85-134 TWh annually by 2027. As industries and transportation electrify, and with AI powering much of this transformation, reliable and sustainable energy is more essential than ever.

Heightened demand for data centres and computational processes in AI is driving a substantial increase in energy consumption. This heightened demand can boost the entire energy sector, offering growth opportunities for companies involved in electricity generation, transmission, and distribution. The synergy between AI's expansion and energy needs suggest vast opportunities within the sector.

Political Climate

AI Policy discussion across the globe have caught the eyes of many policymakers' attention. Mentions of AI in legislative proceedings across the globe have nearly doubled. The number of U.S. regulatory agencies issuing AI regulations increased to 21 in 2023 from 17 in 2022, indicating a growing concern over AI regulation among a broader array of American regulatory bodies.

With majority of nations striving for net-zero, we greatly anticipate policymakers to show their hands regarding efforts to curb energy consumption from AI. Expecting favourable political tailwinds as we anticipate growing incentives for increased investments in energy production and distribution.

As AI technology integrates deeper into everyday life and industries, its environmental impact cannot be ignored. Energy-hungry algorithms and data centers pose a significant challenge to the net-zero ambitions of many countries. Policymakers face the dual challenge of fostering AI innovation while minimizing its energy footprint. Will they push for stricter regulations on AI's energy use or incentivize greener technologies? The balancing act between innovation and sustainability grows with greater urgency by the day.

With growing ubiquity in AI, alongside the emission dilemma it brings, there's a beautiful irony in here. Which way, Mr Policymaker?

# Thesis 1: AI: The turning point for Energy (cont.)

It's become increasingly synonymous that a well-developed nation, is one with high technological advancement. The widespread use-case of AI and its attempts to efficiently automate processes is driving the usage in growing economies like India, and China. Electrification growth amongst the emerging economies is continuing to drive demand for energy. AI can serve as a critical enabler in addressing the challenges of growing electricity demand and achieving electrification goals.
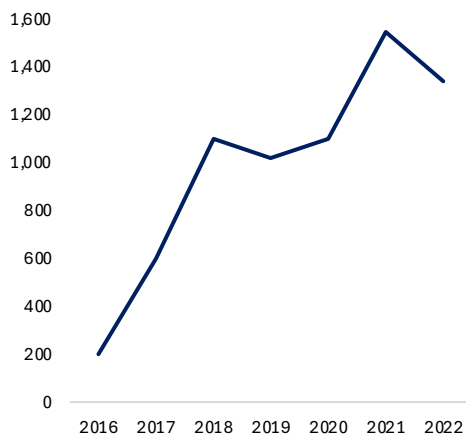
Fig. 7: Energy consumption (quadrillion BTU)
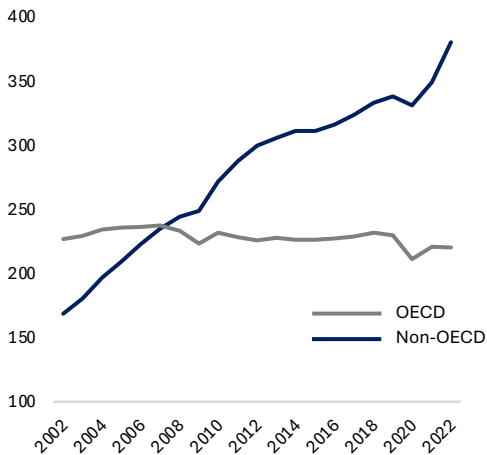
Source: ResearchGate

Fig. 8: S&P Index Elections Agnostic
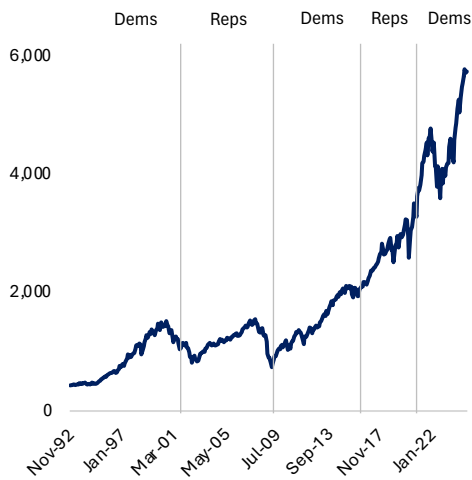
Source: CapIQ

Fig 9: No. of AI mentions in legislative meetings across 81 countries

Source: AI Index Report 2023

Emerging market and low-income countries are experiencing increased energy demands due to rapid urbanization, industrial growth, and improved living standards. According to the International Energy Agency (IEA), energy demand in non-OECD countries is projected to rise by 3-4% annually over the next decade, outpacing the slower growth in OECD countries. This surge in energy consumption is driven by factors such as high population growth and economic expansion, positioning these markets as key players in global energy dynamics.

South Asia and Africa have the potential for growth due to their large and expanding populations and historically low levels of energy access, with almost a quarter of people living off the grid. This scenario creates fertile ground for investment in energy infrastructure, renewable technologies, and innovative energy solutions.

Risks and Mitigations

The US Presidential Elections: Embracing Volatility Amidst Policy Flip-Flopping. With the 2024 elections concluding and the recent incumbent presidency of Donald Trump and the republican party, the US clean energy market is again subject to policy disruption. We reaffirm that the energy sector is agnostic to election results, with ESG framework, Membership of Paris accord, IRA tax credit for clean energy, Weakening of EPA, to be consistent between both parties.

Mitigation #1: The group believes US candidate elections is a volatile event with no significant changes to long-term value – a nothingburger, to put it facetiously. To diversify within the energy sector itself, the group decides to invest in an ETF, believing the entire basket will rerate significantly. The ETF chosen is globally diversified, aiming to capture gains equally from advanced, developing, and emerging economies.

Echoes of the Crypto Fractal: The question rises when echoes of the crypto frenzy draws scary similarity to the current AI outlook. We reaffirm that the niche use-case for cryptocurrency like Bitcoin, and AI is drastically different. The incorporation of AI into routine financial activities demonstrates AI's development. Customer experiences are being improved by chatbots and virtual assistants, while risk management tactics are being refined by machine learning algorithms. Tangibility of AI's use case extends far beyond Cryptocurrency.

Government regulation on AI or carbon emissions could significantly impact energy companies' financial performance, especially those investing heavily in AI-based automation. For instance, unexpected carbon taxes or restrictions on energy-intensive AI applications could lead to higher costs, affecting stock prices.

Mitigation #3: Diversify AI investments across energy sources to reduce exposure to policy risks. Maintaining close monitoring of policy developments is crucial to adjusting strategies in real time.

Recommendations

With the aforementioned factors driving energy, the group has picked out two recommendations, each with unique characteristics that will capture the AI boom. Together, they offer exposure to both established and emerging dynamics within the evolving energy landscape.

Fig 10: VST Performance Benchmarked Against SPY

Source: CapIQ

Fig. 11: ICLN's Sector Exposure Breakdown

Sector	%
Electric Utilities	33.8
Renewable Electricity	26.4
Heavy Electrical Equipment	11.7
Semiconductors	10.2
Electrical Component & Equipment	7.4
Semiconductor Equipment	6.8
Others (Cash, Construction, Commods)	3.8

Source: CapIQ

Fig. 12: ICLN's Geographical Breakdown

- NA 27%
- EMEA 31%
- Japan 4%
- Asia Ex Jap 21%
- South America 10%
- Others 6%

Source: CapIQ

Vistra Corp (VST)

One potential equity in our watchlist is Vistra Corp (VST). VST is a leading power-energy company with a diverse generation portfolio, including natural gas, coal, nuclear, and renewable energy assets, primarily serving Texas. It benefits from its integrated model of power generation and retail operations, providing stable cash flow. In recent years, VST has outperformed the index immensely, suggesting favourable investors' optimism towards VST.

Vistra Corp (VST) is well-positioned to benefit from the current political climate supporting clean energy and infrastructure investment. With strong federal incentives for renewable energy projects, Vistra's focus on expanding its solar and battery storage capacity aligns well with these priorities. This political support enhances Vistra's ability to grow its renewable portfolio, helping it secure a competitive advantage in the energy sector.

Government backing for grid modernization and reliability improvements provides Vistra with opportunities to strengthen its operations and meet rising energy demand. These tailwinds offer Vistra both financial and operational benefits, positioning it favorably in the shift toward a more sustainable energy future. Alongside transformative trends: rising energy demand and the integration of Artificial Intelligence (AI) in energy management, Vistra can position itself favourably amongst growing appetite for energy amongst AI giants.
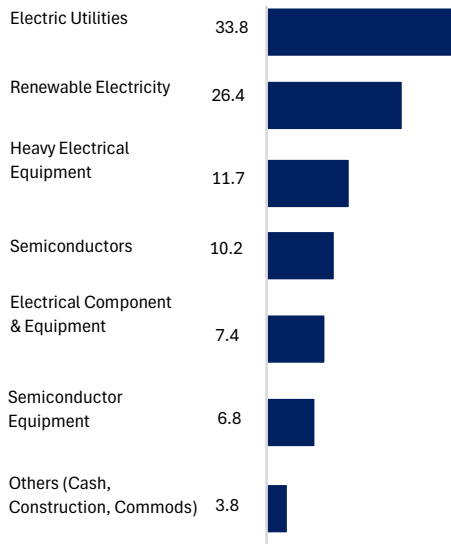
### Ishares Global Clean Energy ETF (ICLN)

The iShares Global Clean Energy ETF (ICLN) has consistently struggled to match the performance of broader market indices like the S&P 500. This underperformance is attributed to various structural challenges in the clean energy sector, including the high costs of developing renewable infrastructure and the inherent volatility due to fluctuating regulatory support and investor sentiment. As a result, the clean energy sector has often been viewed as riskier and less consistently profitable than traditional energy sectors or diversified indices, limiting the ETF's ability to attract and retain long-term investors.
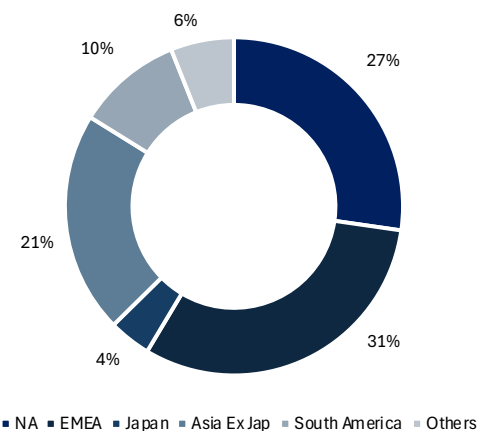
The integration of AI technology and the current surge in global energy demand may mark a critical turning point for ICLN. AI is enabling clean energy companies to improve operational efficiency, such as by optimizing energy storage and forecasting power generation more accurately, which helps address the intermittency issues of renewable energy. Additionally, with rapidly increasing energy needs across industries and heightened pressure to reduce emissions, there's a growing urgency to expand renewable capacity. This combination of technological advancements and high demand could enhance the profitability and stability of clean energy companies, potentially boosting ICLN's performance and shifting investor sentiment more favorably toward the ETF. With diversified exposure ranging from strong superpowers like US, to emerging markets like Brazil, India, and China, makes ICLN a top choice and can be viewed as a contrarian bet.

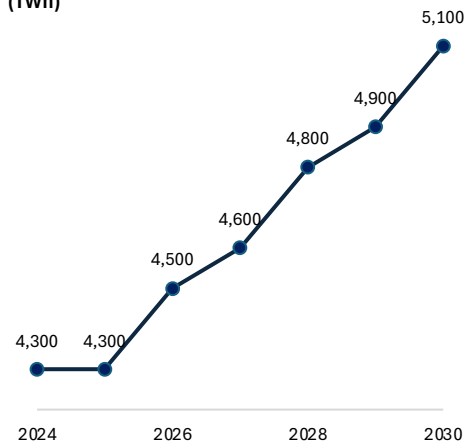## Thesis 2: Generating Alpha from Infrastructure Investments

Artificial Intelligence (AI) has transformed industries and daily life, experiencing exponential growth over the past decade, with projections to contribute an additional $13 trillion to the U.S. economy by 2030. However, as AI integration deepens and its capabilities expand, it increasingly depends on robust infrastructure and energy systems—the foundational elements that sustain its progress. As infrastructure and energy systems continue to evolve, innovation will play a key role in unlocking value for investors. This long-term potential offers a promising path for sustained returns, particularly as new technologies reshape global markets. With the growing emphasis on sustainability and efficiency, we foresee infrastructure advancements being likely to drive transformative change across multiple sectors.

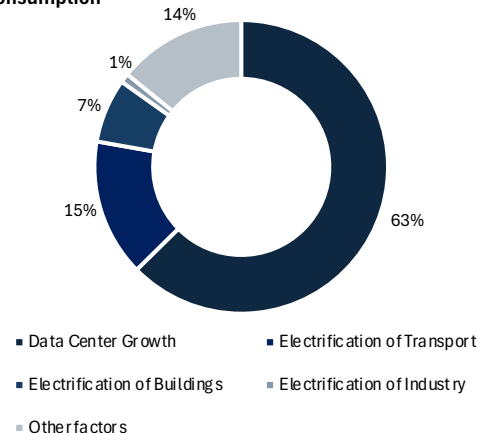**Fig. 13: Forecasted AI Chip Shipment CAGR for global data centres**

- 2024E: 67%
- 2025E: 76%
- 2026E: 73%
- 2027E: 77%
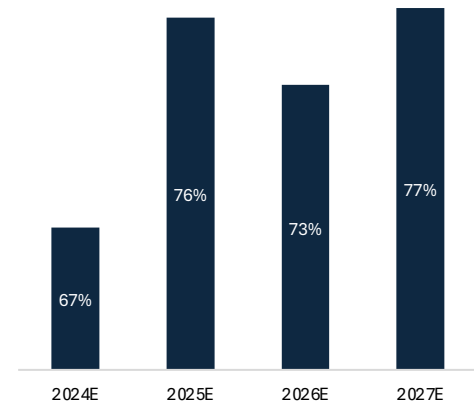
Source: Mercury Research

Fig. 14: Estimated total US project energy demand (TWh)

- 2024: 4,300
- 2025: 4,300
- 2026: 4,500
- 2027: 4,600
- 2028: 4,800
- 2029: 4,900
- 2030: 5,100

Source: Boston Consulting Group

Fig. 15: Composition of the 800 TWh growth in power consumption

- Data Center Growth: 63%
- Electrification of Transport: 15%
- Electrification of Buildings: 7%
- Electrification of Industry: 1%
- Other factors: 14%

Source: Boston Consulting Group

Building AI's Backbone: The Infrastructure and Energy Imperative

Infrastructure serves as the backbone for AI innovation and advancement. It provides the computational power, data management capabilities and security required to support the development, deployment and operation of AI solutions. Real-time AI applications such as autonomous vehicles, healthcare diagnostics, and industrial automation, demand low latency to ensure rapid decision-making capabilities.

To support this, the construction of additional data centers will be necessary to reduce response times and improve the overall performance of AI-driven technologies. To meet the accelerating growth of the AI market, chip demand in data centers is expected to experience a compound annual growth rate (CAGR) of 67% to 77% over the next few years. This rapid growth will drive chip shipments from 5.1 million units in 2023 to an anticipated 46 million units by 2027.

Energy is also another critical pillar supporting the growth of AI, providing the power necessary to fuel its rapid advancements. Data centers could drive up US power demand growth from 2024 to 2030, expecting to contribute greater than 60% of incremental power demand. Much of the demand stems from AI-enabled devices and applications (smart sensors, autonomous vehicles and "internet of things" (IoT) devices), placing additional strain on existing telecommunications networks and power grids which rely on high-speed internet connectivity and uninterrupted power supply to function effectively.

U.S. power consumption is projected to increase by 3% annually from 2024 to 2030, with total consumption in 2030 expected to be 800 TWh higher than in 2024. Data center expansion is expected to account for 62% of this growth, driven by demand for AI and cloud computing, while the rest will stem from other factors like economic growth, automated agriculture, and the electrification of transport, buildings, and industries.

The growing demand for AI is poised to reshape infrastructure and energy systems, driving higher power consumption and increasing the operational costs of running AI technologies. We spot opportunities in companies who can provide energy efficient solutions via smart grid and edge computing technologies, and companies in data center construction, chip manufacturing, and network infrastructure. A fund of interest would be the newly launched U.S. based Global AI Infrastructure Investment Partnership (GAIIP). A joint venture between BlackRock, Global Infrastructure Partners and Microsoft, it aims to fuel AI innovation and economic growth by making investments in new and expanded data centers to meet growing demand for computing power, as well as energy infrastructure to create new sources of power for these facilities.

Thesis 2: Generating Alpha from Infrastructure Investments (cont.)

While infrastructure is currently one of the fastest growing sectors in private markets, three megatrends that are currently spurring the global economy have also caught our eye. Decarbonization, digitalization, deglobalization and supply chain reallocation are essential to keeping up with the needs of the robust growth of the AI sector that strongly ties in with infrastructure and energy.

We believe the key to generating alpha returns from infrastructure investments lie within investing in the three megatrends of energy transition, which presents a significant investment opportunity in the coming years. As demand for efficient infrastructure continues to rise, we present and offer investors a unique opportunity to participate in the transformation of global infrastructure landscapes.

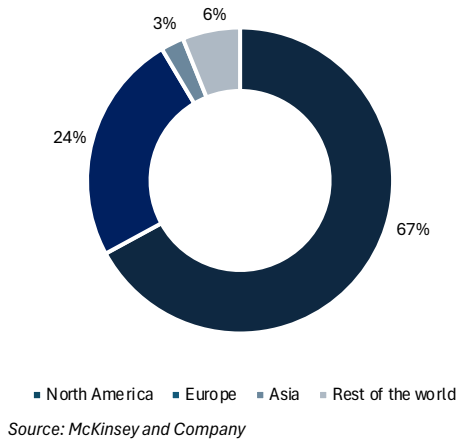**Fig. 16: Global Infrastructure Investment Allocation**

Source: McKinsey and Company

Fig. 17: Infrastructure Investments in Brazil

Source: Statista

Fig. 18: Brazil's Infrastructure Investments by Sector

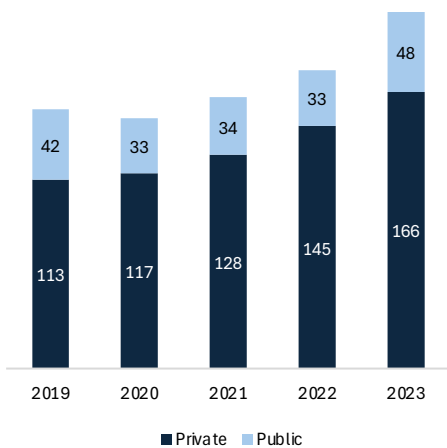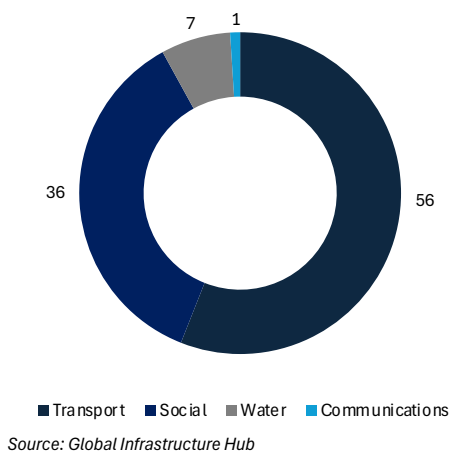*Source: Global Infrastructure Hub*

Investment Opportunities in Emerging Markets

The energy transition presents a significant challenge, but also an immense investment opportunity, particularly in growth markets like Latin America, Asia, the Middle East, and Africa. Despite representing 90% of the global population, these regions receive just 9% of global infrastructure investment, leaving substantial untapped potential. As these markets transition to more sustainable energy systems, the opportunity to bridge this investment gap and support their economic development is clear.

A Rising Star in Infrastructure Investment

Brazil is a key market that we highly recommend for investors. As one of the largest emerging markets, Brazil has made significant strides in recent years, particularly in infrastructure investment. This trend has accelerated, with 2023 marking a high point in the country's efforts to modernize and expand its infrastructure. While North America attracts most global infrastructure investments, these assets remain vulnerable to natural disasters like hurricanes. In contrast, Brazil, with minimal hurricane exposure, benefits from resilient infrastructure developed to withstand frequent heavy rainfall and flooding. Additionally, Brazil is increasingly incorporating sustainability and climate adaptation measures into its infrastructure. Growth markets like Brazil benefit from strong demographic and economic growth, driving energy demand. These regions are rich in natural resources, such as strong winds and abundant solar energy, making them ideal for renewable generation. Renewables have thus become cost-competitive, even considering intermittency, and are in high demand.

Brazil's commitment to infrastructure development is a critical driver of its economic growth. A prime example of this is Brazil's collaboration with Nokia to overhaul and improve its internet infrastructure, as well as Microsoft investing $2.7bn in cloud and AI infrastructure in Brazil. Other infrastructure sectors such as transportation and energy are also seeing substantial investment, positioning Brazil as an attractive destination for long-term investment.

As infrastructure investment continues to expand, investors can anticipate long-term growth driven by public-private partnerships and increasing demand for sustainable infrastructure solutions. Brazil's commitment to green energy, coupled with its large consumer base, presents a robust opportunity for investors looking to benefit from the Amazonian giant's economic transformation. We see strong opportunities for private sector participation, supported by recent government initiatives in Brazil aimed at attracting private investment and fostering public-private partnership projects through concessions and investment plans.

## Thesis 2: Generating Alpha from Infrastructure Investments (cont.)

Considering the huge investment opportunities we spot in Brazilian infrastructure, one of the funds we are keeping an eye on is Patria's newly launched **Infrastructure Private Credit Fund (NASDAQ:PAX)** which focuses on areas that directly impact the energy transition as well as the Brazil's economic and social development, such as renewable energy, basic sanitation and urban mobility. The fund targets a long-term capital raise of up to R$5 billion (approximately US$1 billion) and has already secured 20% of this amount through contributions from the Brazilian Development Bank (BNDES), the International Finance Corporation (IFC), CAF, and other institutional investors. With additional interest from pension plans, Patria remains confident in reaching the full R$5 billion goal within three years.

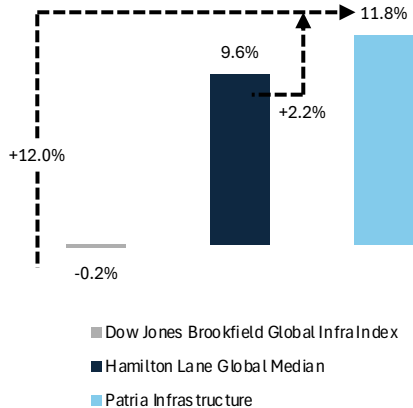**Fig. 19: Patria's AUM YoY Growth: 2Q23 vs 2Q24**
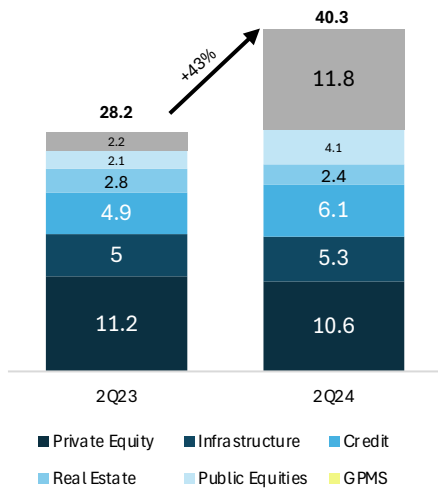
Source: Patria

Fig. 20: Fund Investor Composition ($mn reals)
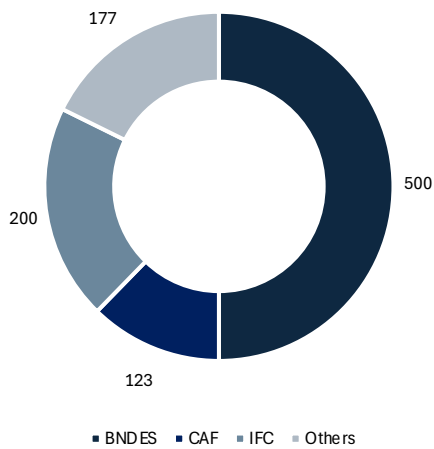
Source: Patria

Fig. 21: Patria Infrastructure Net IRR against global benchmarks

Source: Patria

Infrastructure Debentures: Pioneering Brazil's Path Forward

Patria Investments Limited, a global leader in alternative asset management in Latin America with over 35 years of experience and $40.3 billion in assets under management, offers investors access to high-impact, long-term opportunities in sectors like infrastructure and private credit. With a strong 43% year-over-year growth in Patria's AUM, from $28.2 billion in 2Q23 to $40.3 billion in 2Q24 driven by significant gains in Global Private Market Solutions (GPMS) and Infrastructure, this highlights Patria's strategic focus on high-growth sectors within Latin America.

Their latest initiative, the Infrastructure Private Credit Fund, is a prime example of Patria's commitment to sustainable growth in Brazil. The fund presents a unique opportunity for institutional investors to access Brazil's high-potential infrastructure sector under a new regulatory framework. Unlike traditional funds focused on incentivized debentures, this fund invests in infrastructure debentures that provide direct tax incentives to issuers, enabling better project financing conditions. With a long-term investment horizon of up to 20 years, the fund is specifically designed to meet the needs of institutional investors, providing them with a stable and sustainable growth opportunity.

Targeting smaller-scale infrastructure projects valued between R$50 million and R$100 million, the fund supports initiatives aligned with Brazil's strategic growth priorities, including energy transition, water and waste management, and urban mobility. Many of these projects are part of the Brazilian government's flagship growth acceleration program, making this fund an ideal avenue for investors looking to participate in impactful national development projects.

The fund fills a critical gap by providing capital access to companies often excluded from traditional markets, unlocking new investment channels in high-growth sectors. Supported by IFC, CAF, and BNDES, the fund is committed to sustainability and ESG principles, aligning with the rising demand for responsible, risk-mitigated investment opportunities.

Patria's fund exemplifies the vital role of private capital in driving sustainable economic growth, especially within a constrained public funding environment. By creating a channel for impactful investments in Brazil's infrastructure, the fund aligns with global ESG standards, offering institutional investors both long-term returns and a meaningful stake in Brazil's development. Patria's infrastructure funds demonstrate a strong performance track record, with a net internal rate of return (IRR) of 11.8%, significantly outpacing global benchmarks such as the Hamilton Lane Infra Global Median and the DowJones Brookfield Global Infra Index. With the strategic support of IFC, CAF, and BNDES, this fund stands as a compelling opportunity for investors seeking not only strong financial performance but also lasting, responsible impact in Latin America.

## Thesis 3: Augmentation of energy supply caused by clean energy transition

The global energy landscape is undergoing a significant transformation, driven by the need to enhance energy security and reduce reliance on imported fossil fuels. This transition is propelled by climate concerns, and unprecedented investments in artificial intelligence (AI) enhanced energy infrastructure to meet net-zero targets. With this shift, AI has emerged as a critical enabler in optimizing energy production, distribution and consumption. The convergence of AI with clean energy is impactful for energy economies, where infrastructure development is gaining traction, fueled by financial aid and investments from ESG-focused investors. These initiatives pose distinct investment initiatives, particularly in areas which strengthen this clean energy transition, such as grid modernization.

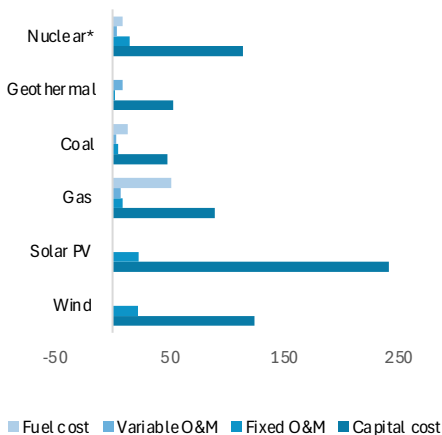**Fig. 22: Global Cumulative Renewable Capacity Installed (GW)**
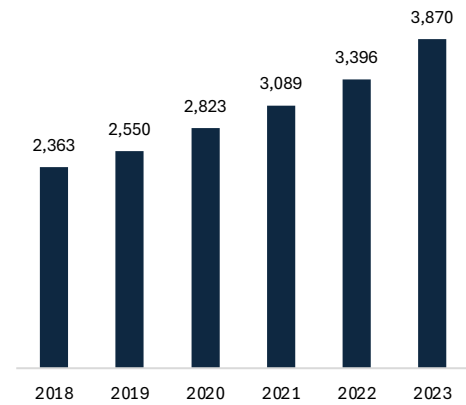
Source: Statista

Fig. 23: Fossil Fuel and Clean Energy Share of Total Energy Sector Investment (%)
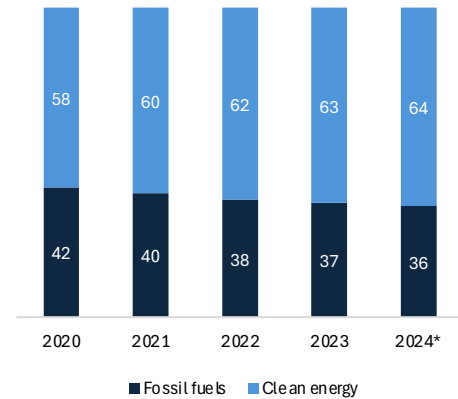
Source: Statista

Fig. 24: Low-end of Levelized Cost of Energy (LCOE) 2024

Source: Statista

Investments and Policies Boosting Renewable Energy Share

Emerging economies are also increasingly prioritizing renewable energy projects. This is enabled by multiple financial institutions, such as the World Bank but they *World Bank's Scaling Solar Program* and International Finance Corporation, which are channelling funds into renewable infrastructure, and sovereign green bonds that attract foreign investment. AI-driven smart grids and microgrid solutions are attracting investment due to their ability to stabilize energy supply and reduce transmission. These projects support the clean energy transition on a global scale, creating substantial investment opportunities in technology and infrastructure.

In the United States, decarbonization policies are aligned with energy security objectives. Currently, 29 states, which represent around half of all U.S. electricity sales, have mandatory renewable portfolio standards. More states, local governments, and public utilities are expected to invest in renewable energy in 2024, supported by the Inflation Reduction Act (IRA). For instance, the IRA provides a 10-year extension of the Investment Tax Credit (ITC) and Production Tax Credit (PTC), which are essential in driving wind and solar projects, contributing to the clean transition. These policies are projected to boost renewable investments in 2024, increasing domestic energy production and working closely towards energy security goals. ExxonMobil, among other companies, traditionally a major player in fossil fuels, is investing in carbon capture and storage techniques, and exploring renewable energy options. This push for decarbonization and the resulting demand for cleaner energy significantly augment the overall energy supply, creating a more sustainable and resilient energy system aligning with broader efforts to combat climate change.

The cost of electricity generated from renewable sources, which is the levelized cost of electricity (LCOE), has declined significantly in the Asia Pacific (APAC) region, reaching an all-time low in 2023. This makes renewable energy economically competitive with coal, due to a drop in costs to build renewable energy projects. In 2023, renewable energy was 13% cheaper than coal, and by 2030, is expected to be 32% cheaper. Meanwhile, fossil fuel generation costs have risen by 12% since 202 due to carbon pricing, making renewables an increasingly attractive option for stable energy. Therefore, we believe that this will encourage companies to move towards renewable energy adoption, and the long-term outlook for renewables remains positive.

Lastly, imported fossil fuels are not only subjected to volatile prices caused by the changing geopolitical climate, but they are also severely sensitive to supply chain disruptions. By diversifying renewable energy sources, there will be stronger resilience against geopolitical and supply risks for the portfolio.

Thesis 3: Augmentation of energy supply caused by clean energy transition (cont.)

Natural gas, the cleanest fossil fuel, is the leading energy source for electricity consumption, responsible for about 43.1% of U.S. electricity production. Hence, it should experience growth as electricity demand increases. Unlike coal, which emits higher levels of carbon dioxide and other pollutants, natural gas is inherently easier to filter and contains fewer impurities that contribute to greenhouse gas emissions. When burned, natural gas produces about 50% to 60% less CO_2 than coal per unit of energy. Renewable energy sources such as solar and wind have gained traction in recent years. However, their outputs are intermittent. Therefore, natural gas is the most reliable and cost-effective option to fuel the AI boom, supporting intermittent renewable sources while minimizing the environmental impact compared to coal.

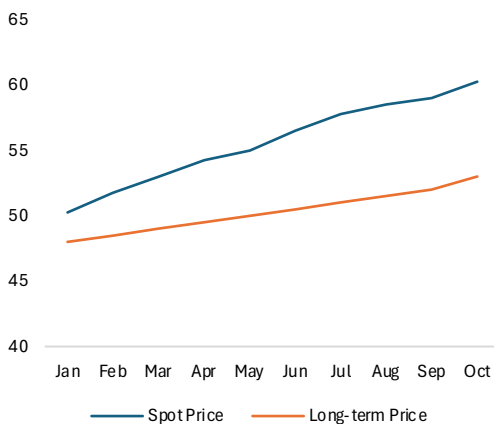**Fig. 25: Avoided Emissions from Solar PV Additions**
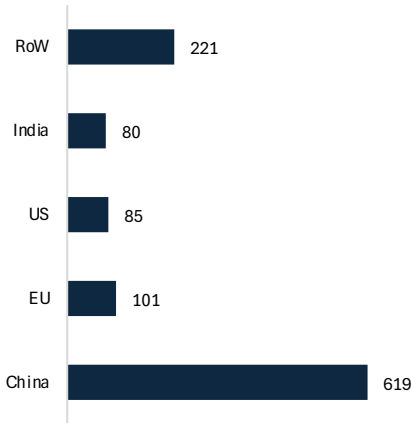
Source: Statista

Fig. 26: Electrolysis Capacity at Final Investment Decision (by region)

■ Europe   ■ North America   ■ China   ■ India   ■ RoW
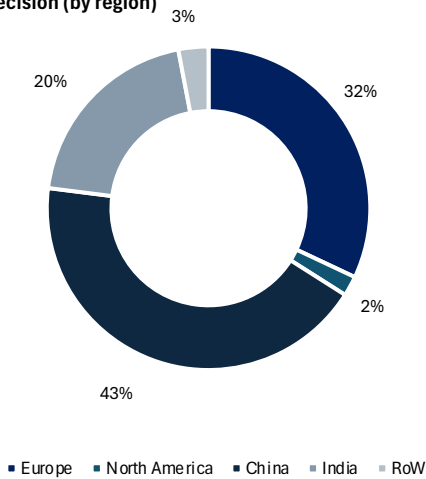
Source: Statista

Fig. 27: Uranium Price (USD/lb)

Spot Price   Long-term Price

Source: Statista

Hydrogen is becoming a cornerstone of the clean energy transition, serving as a flexible and low-emission energy source which can support sectors where electrification alone may be insufficient. According to the International Energy Agency (IEA), global demand for hydrogen reached approximately 97 million tonnes in 2023, with projections suggesting that demand could increase nearly five times by 2050, if net zero goals are achieved. Investments in hydrogen infrastructure are also expanding rapidly, with global investment in hydrogen projects projected to reach $570 billion by 2030. With green hydrogen costs on the decline, which positions hydrogen as a scalable solution for a sustainable energy system, we feel that there are investment opportunities in hydrogen.

Nuclear Power: Balancing Stability with Public Perception

Nuclear energy offers continuous and reliable energy without greenhouse gas emissions, playing a pivotal role in energy security. With recent advancements in safety, which include small modular reactors (SMRs) and failsafe technologies, we believe that nuclear is positioned to offer a stable and low-emission alternative to renewables. Companies are actively exploring nuclear energy for data centers, indicating an interest in its potential to support energy resilience. With Kairos, Google is expecting to bring the first SMR online by 2030, with more to come through 2035, where the deal is projected to bring 500 megawatts of power to the grid.

Risk and mitigations

Nuclear power remains uncertain, facing high capital costs and public opposition challenges due to safety concerns. Misconceptions about meltdown risks, though largely mitigated by advanced containment and safety measures, remain prevalent. Public protests also impacts project approvals. Financing these projects will be another hurdle, accompanied by high development costs and regulatory barriers which may delay or prevent completion. Nevertheless, we believe that advancements in nuclear technology as well as containment measures are likely to ease some public concerns, potentially expanding nuclear's role in energy security.

The clean energy transition is highly dependent on materials such as copper, lithium, and rare earth elements essential for renewable technologies, EVs and energy storage. Global copper demand is projected to nearly double by 2035. However, the supply remains uncertain due to limited mining investments and rising costs. To mitigate against this, renewable energy developers are turning to alternatives, such as aluminium wiring, which reduces demand pressures. Additionally, recycling and circular economy approaches, particularly for rare earth elements, are gaining traction and can extend the lifecycle of existing materials and reduce dependency on new mining projects.

Fig. 28: Vaneck Uranium And Nuclear Technologies Ucits ETF (NUCL)

Source: Capital IQ

Fig. 29: U.S. Nuclear Capacity Outage (GW)

Source: U.S. Energy Information Administration
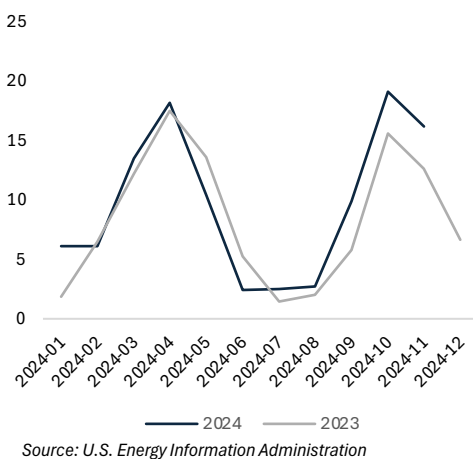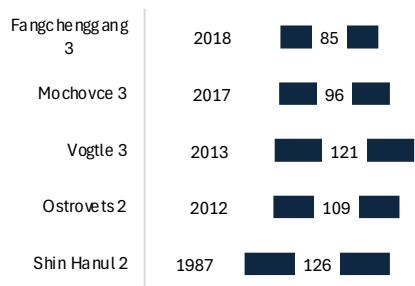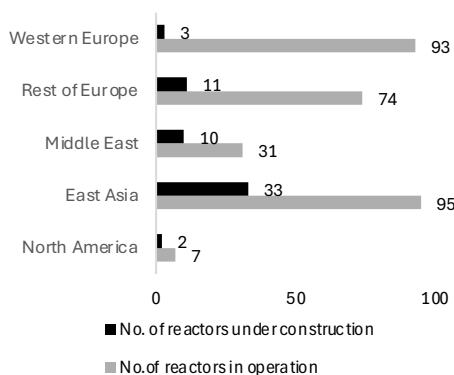
Fig. 30: Construction times of units grid-connected in 2023 (months from project start)

Source: Power Reactor Information System

Fig.31: Number of reactors in operation and under construction as of 2024

Source: Power Reactor Information System

Thesis 3: Augmentation of energy supply caused by clean energy transition (cont.)

As the global economy pivots toward decarbonization, the demand for diverse energy sources, from renewables to nuclear, continues to expand. Infrastructure investments in nuclear and energy infrastructure present opportunities for sustained growth and energy security, supporting the clean energy transition. With that, we recommend keeping the Vaneck Ucits Etfs Plc - Vaneck Uranium And Nuclear Technologies Ucits ETF (SWX:NUCL) fund on our watchlist.

Vaneck Uranium And Nuclear Technologies Ucits ETF (NUCL)

The VanEck Uranium and Nuclear Technologies UCITS ETF (NUCL) provides investors an opportunity to capitalize on the global clean energy transition. As nuclear energy regains prominence in the drive for decarbonization and energy security, NUCL offers diversified exposure to uranium mining and nuclear energy infrastructure. A reliable, carbon-neutral power source, nuclear energy provides continuous base-load power, complementing the intermittent nature of renewables like wind and solar. With an impressive year-to-date (YTD) return of 34.52% as of November 2024, NUCL presents a compelling investment for long-term growth.

The EU, the U.S., China, and Japan are among the leading economies recognizing the need for nuclear energy as a cornerstone of their clean energy transitions. The recent Nuclear Power Program in the US, Europe's commitment to maintaining nuclear as part of its Green Taxonomy, and China's ambitious plans to increase nuclear capacity demonstrate government backing which can drive sustained demand for uranium. The emergence of Small Modular Reactors (SMRs) is reshaping the nuclear power industry. Recent technologies offer a safer, more reliable form of nuclear power catering to broader needs. With several SMR projects gaining regulatory approval, the technology is expected to drive uranium demand, further supporting the value of this ETF.

NUCL invests across the nuclear value chain, providing a balanced exposure to uranium mining, reactor technology, and infrastructure. Top holdings include Cameco Corp and BWX Technologies. This diversity reduces reliance on any single element of the nuclear energy industry, offering a broader exposure to the sector's growth potential.

Nuclear energy is also recognized under the EU's taxonomy for sustainable activities as an ESG-friendly solution to reducing carbon emissions. NUCL enables investors to align their portfolios with sustainability goals while being a part of the decarbonization movement. Unlike traditional energy investments, NUCL offers a strongly based ESG-compliant way to access the sector's growth opportunities. Compared to other broader energy ETFs, NUCL's integration of uranium mining and nuclear technology investments allows it to capture significant upside from sector-specific trends.

Investments in commodities and related sectors such as uranium mining also often serve as effective hedges against inflation, riding on the stable nature of this unique commodity. As inflationary pressures rise globally, NUCL's strong exposure to uranium producers can act as a buffer, potentially leading to higher revenues and valuations for these companies.