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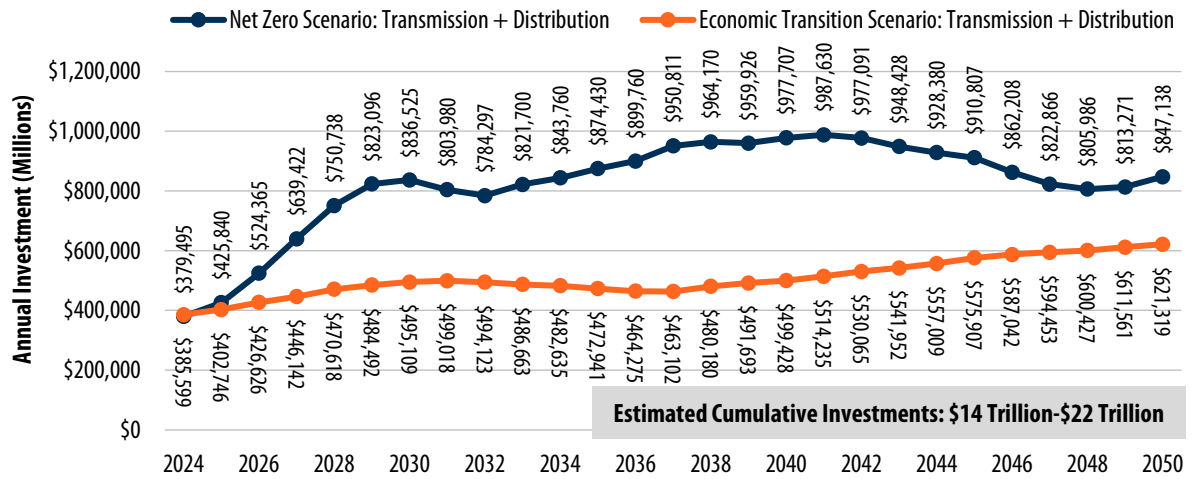
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New Vectors of Electricity Demand Add Urgency for Power Grid Expansion and Modernization

Demand for electricity is likely to soar over the next decade as a convergence of new, power-hungry innovations reach critical mass, which may require massive investments to modernize and expand power grids around the world. While growing electricity demand from electric vehicles (“EVs”) has emerged over the past several years, the scale of potential demand from other new innovations, especially artificial intelligence (“AI”) and cryptocurrency, is often overlooked. In our view, the modernization of power grids around the globe represents an underappreciated potential secular growth opportunity for investors. Below, we discuss these trends, highlighting the First Trust NASDAQ® Clean Edge® Smart Grid Infrastructure Index Fund (GRID).

Estimated Global Power Grid Investment (2024-2050): "Net Zero Scenario" and "Economic Transition Scenario"



Source: Bloomberg New Energy Finance. *New Energy Outlook*. May 2024. **There is no guarantee that past trends will continue, or projections will be realized.**

Artificial Intelligence’s Insatiable Appetite for Electricity

The potential for AI to transform the economy has led to significant capital investments by corporations and sovereign entities in recent years, with forecasts for additional investment ahead. Over the last eight years, capital expenditures made by five of the largest global tech companies has grown at an annualized rate of 20%, with total spending exceeding \$150 billion in 2023.¹ Jensen Huang, NVIDIA co-founder and CEO, has estimated that annual spending on data centers will be in the hundreds of billions of dollars in the next five years, doubling global capacity.²

A key corollary to this ramp up in artificial intelligence infrastructure spending is expected to be a surge in electricity consumption. New generative-AI tools that use large language models and vast data sets demand substantial processing power to train models and respond to user queries. The Association of Data Scientists estimates that a 7 billion parameter model would require 50 megawatt-hours (“MWh”) of energy to train, 5 MWh of energy to validate, and 0.1 MWh to process 1 million queries.³ According to the International Energy Agency (“IEA”), a single generative-AI prompt requires nearly 10 times more power as a traditional internet search.⁴ While individual prompts require minimal amounts of power, ChatGPT (which has 175 billion parameters) already handles 200 million user requests daily, suggesting the power required for these technologies is already significant.⁵

Handling the computing workload behind AI models are new, cutting-edge graphics processing units (“GPUs”), which tend to consume more power than previous generations of chips. For example, NVIDIA’s latest GPU, dubbed “Blackwell,” may consume up to 70% more power than previous generations.⁶ In 2023 alone, NVIDIA sold enough data center GPUs to consume the same amount of power as 1.3 million households annually.⁷

As the use of AI-enabled tools increases, so do the energy needs of the power-hungry infrastructure behind them. According to Dominion Energy, data centers that support AI models may consume 233% more power than traditional data centers.⁸ Total energy consumption by U.S. data centers could grow 67% by the end of the decade,⁹ accounting for 9% of all electricity generated in 2030, according to the Federal Energy Regulatory Commission (“FERC”).¹⁰ On a global scale, annual data center electricity consumption could surpass 1,000 terawatt-hours (“TWh”) in 2026, the same amount of electricity used by the country of Japan.¹¹

¹Bloomberg. Data from 2015-2023. There is no guarantee that past trends will continue.

²NVIDIA Corporation Fiscal Fourth Quarter Conference Call, February 21, 2024, via Nasdaq. February 2024.

³The Association of Data Scientists. July 2024.

⁴IEA, Electricity 2024 Analysis and forecast to 2026, Page 34. January and May 2024.

⁵The New Yorker. “The Obscene Energy Demands of A.I.” March 2024.

⁶The Register, Fierce Electronics. March 2024.

⁷Tom’s Hardware. June 2024.

⁸Dominion Energy. March 2024.

⁹Federal Energy Regulatory Commission, page 46. May 2024.

¹⁰Utility Drive. May 2024.

¹¹IEA, Electricity 2024 Analysis and Forecast to 2026. January and May 2024.

The Energy Cost of the Digital Gold Rush

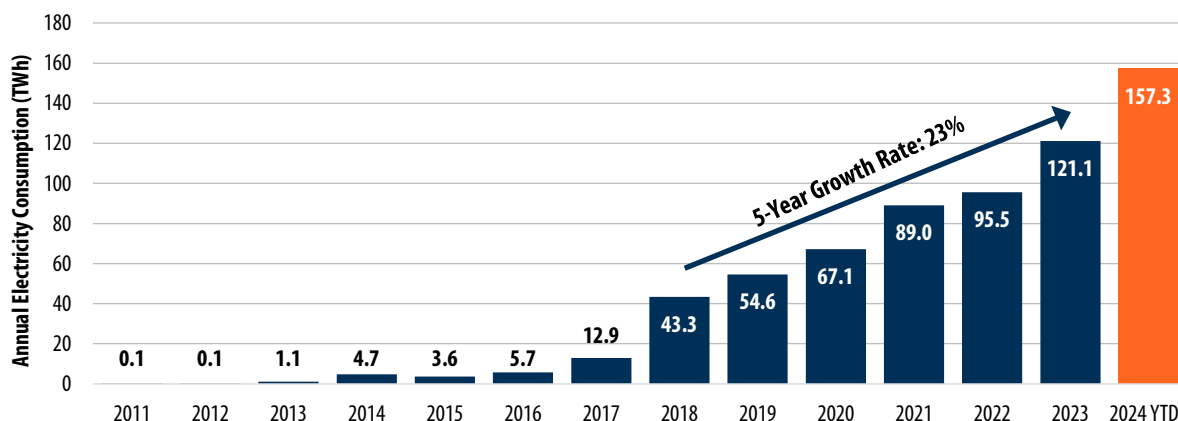
Though it tends to receive less attention, we believe the popularity of Bitcoin and other cryptocurrencies could further augment electricity demand in the coming years. Most cryptocurrencies issue tokens through a process known as “mining,” by which new digital currency is created by enticing networks of computers, called nodes, to guess the answer to a complex puzzle. The difficulty level of that puzzle is set such that the solution is found at a specific interval. The interval for Bitcoin, the largest cryptocurrency, is approximately 10 minutes. The first node to guess the answer posts a list of transactions that occurred during those 10 minutes to their copy of the blockchain and is rewarded with some amount of that cryptocurrency. Then, the remaining miners validate the transactions, come to a consensus, and update their own ledgers. This consensus mechanism is known as “proof of work.”¹²

Roughly once every four years, the block creation rewards are halved, allowing only the most efficient nodes to remain profitable. By reducing the reward, the supply growth of new currency may slow, potentially leading to an increase in the underlying price of the token over time, assuming demand remains stable. An increase in price of the token “post-halving” may offset the smaller reward size for the miners who remain in business.

As more nodes compete to win the reward, more computing power—and electricity—is necessary to guess the solution. In 2023, Bitcoin consumed 121 TWh of electricity. For reference, this is higher than the five-year average electricity consumption for the Netherlands, which was 116 TWh (2018-2022). Based on year-to-date (“YTD”) rates, Bitcoin’s electricity consumption may grow by 30% in 2024 which would equate to 157 TWh (as of 7/19/24). Based on the five-year growth rate (23%), Bitcoin electricity consumption could surpass Sweden in 2024, Spain in 2027, the U.K. in 2028, and France in 2030.¹³

Combining the forecasts for both cryptocurrency mining and artificial intelligence, electricity consumption from these innovations could grow to roughly 4% of global energy demand by 2026, doubling their energy needs from 2022 levels.¹⁴

Global Bitcoin Electricity Consumption by Year¹³



Source: University of Cambridge Centre for Alternative Finance. Average electricity cost assumption is 0.05 USD/kilowatt-hours (kWh). **There is no guarantee that past trends will continue or projections will be realized.** *As of 7/19/24, estimate, based on YTD growth rate.

Electric Vehicles

[While we’ve written about the relationship between EVs and the power grid before](#), recent concerns surrounding the high cost of ownership, range anxiety, and uncertainty related to tax incentives has dampened near-term consumer demand, in our opinion. In response, several automakers have adjusted aggressive plans to transition to EVs, and instead refocused on hybrid technologies.¹⁵ However, public policies in the U.S. and EU remain supportive, and we believe a long-term transition to EVs is still likely, albeit at a slower pace. According to IEA forecasts, EVs could account for 6-8% of global electricity consumption by 2035, compared to 0.5% in 2023.¹⁶

Forecasted Investments in Power Grids

The convergence of these electricity-hungry innovations has led grid operators to boost their estimates for power demand. During the ten years ended in 2023, net electricity generation in the U.S. was relatively steady, growing by just 0.27% annually (2.8% cumulatively), as population growth was generally offset by energy efficiency gains.¹⁷ Looking forward, however, filings with FERC showed electric grid authorities are expecting substantially higher load growth, according to Grid Strategies. In just one year, grid planners nearly doubled their cumulative electricity growth estimates for the next five years, from 2.6% in 2022 to 4.7% in 2023.¹⁸

In our opinion, meeting growing energy needs will require significant investments in power generation and grid infrastructure. In its October 2023 report, the U.S. Department of Energy estimated that 54,500 gigawatt-miles of new regional transmission lines would be needed by 2035, a 64% increase from today’s transmission capacity.¹⁹ Globally, Bloomberg forecasts that investments in the power grid between 2024 and 2050 could total between \$14 and \$22 trillion (\$400 billion to \$1 trillion annually), depending on public policies and environmental regulations, as well as how quickly the transition to alternative energy sources unfolds.²⁰

References to specific securities should not be construed as a recommendation to buy or sell and should not be assumed profitable.

¹²Blockworks, April 2024 and Coincenter.org, June 2021.

¹³Cambridge Centre for Alternative Finance and IEA, June-July 2024.

¹⁴IEA, Electricity 2024 Analysis and Forecast to 2026, Page 8. January and May 2024.

¹⁵The Wall Street Journal. May 2024.

¹⁶IEA. Global EV Outlook, Outlook for Battery and Energy Demand, April 2024.

¹⁷U.S. Energy Information Administration, Electricity Data Browser. July 2024.

¹⁸Grid Strategies and Utility Dive. December 2023.

¹⁹Department of Energy National Transmission Needs Study, October 2023, via Power. May 2024.

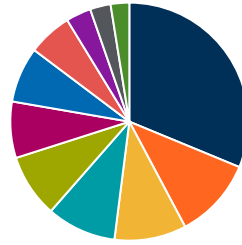
²⁰Bloomberg New Energy Finance. *New Energy Outlook*. May 2024.

Investing in a Smarter Grid with GRID

We believe companies involved in the buildout and modernization of the power grid may benefit from rising demand for energy. The First Trust NASDAQ® Clean Edge® Smart Grid Infrastructure Index Fund (GRID) is an index-based ETF comprised of stocks that provide smart grid technologies or are involved in grid-related activities. The underlying index assigns an 80% weight to “pure play” companies that derive the majority of their revenue from grid-related activities, and 20% to “diversified” stocks that generate less than half of their revenue from grid-related activities.

GRID invests in global equities, with its largest allocations to companies domiciled in the United States (28.38%) and Europe (58.67%), as of 6/30/24. Industrials (57.1%) and Information Technology (18.2%) were GRID’s largest sector exposures, as of 6/30/24.

GRID Sector Exposure (%)

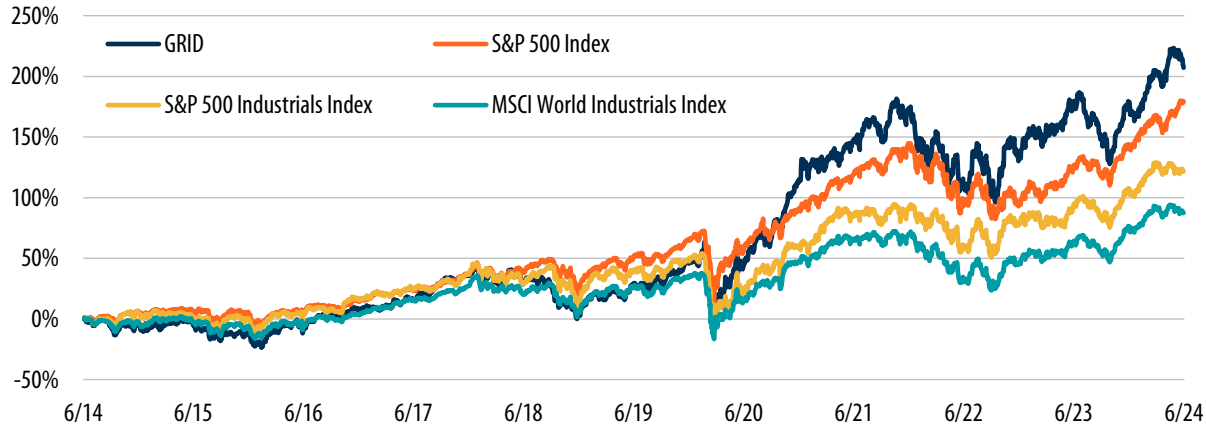


As of 6/28/24.

Electrical Components	31.23
Diversified Industrials	11.00
Other	9.78
Conventional Electricity	9.45
Multi-utilities	8.61
Semiconductors	7.65
Electronic Equipment: Control and Filter	7.55
Engineering and Contracting Services	5.99
Auto Parts	3.41
Renewable Energy Equipment	2.80
Automobiles	2.53

10-Year Cumulative NAV Total Return

GRID vs. S&P 500® Index and Industrials Benchmarks



Data from 6/30/2014–6/30/2024. **Past performance is not a guarantee of future results.** Index data is for illustrative purposes only and not indicative of the fund. Indexes do not charge management fees or brokerage expenses, and no such fees or expenses were deducted from the performance shown. The S&P 500® Index is an unmanaged index of 500 companies used to measure large-cap U.S. stock market performance. The S&P 500® Industrials Index is capitalization-weighted and is comprised of 500® Index constituents representing the industrials sector. The MSCI World Industrials index is a free float-adjusted market capitalization-weighted index that is designed to measure the industrials sector performance of 23 developed markets around the world.

Performance data quoted represents past performance. Past performance is not a guarantee of future results and current performance may be higher or lower than performance quoted. Investment returns and principal value will fluctuate and shares when sold or redeemed, may be worth more or less than their original cost. You can obtain performance information which is current through the most recent month-end by visiting www.ftportfolios.com.

Conclusion

As advances in data science, cryptocurrencies, and mobility transform our lives in the coming decades, we believe these new innovations are likely to boost global demand for energy and require significant investment in energy infrastructure. In our view, companies with the expertise to provide an efficient, reliable, and capable electric grid are particularly well positioned to benefit from these global trends.

References to specific securities should not be construed as a recommendation to buy or sell and should not be assumed profitable.

Performance Summary (%) as of 6/28/24

GRID Performance*	3 Month	1 Year	3 Year	5 Year	10 Year	Since Fund Inception
Net Asset Value (NAV)	1.41	11.21	8.88	20.29	13.13	10.86
Market Price	1.37	11.19	8.96	20.35	13.14	10.86
Index Performance**						
Nasdaq Clean Edge Smart Grid Infrastructure Index™	1.30	11.82	9.57	21.21	13.99	11.73
MSCI World Industrials Index	-2.13	15.71	6.01	9.74	8.20	9.76
S&P Composite 1500® Industrials Index	3.22	23.13	8.05	14.14	12.15	13.37
Russell 3000® Index	-3.22	15.54	8.23	12.01	10.62	12.93

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Inception Date: 11/16/2009. Gross Expense Ratio: 0.57%. Net Expense Ratio: 0.57%. Expenses are capped contractually at 0.70% per year, at least through January 31, 2025.

*NAV returns are based on the fund's net asset value which represents the fund's net assets (assets less liabilities) divided by the fund's outstanding shares. Market Price returns are determined by using the midpoint of the national bid offer price ("NBBO") as of the time that the fund's NAV is calculated. Returns are average annualized total returns, except those for periods of less than one year, which are cumulative. The fund's performance reflects fee waivers and expense reimbursements, absent which performance would have been lower.

**Performance information for each listed index is for illustrative purposes only and does not represent actual fund performance. Indexes do not charge management fees or brokerage expenses, and no such fees or expenses were deducted from the performance shown. Indexes are unmanaged and an investor cannot invest directly in an index.

You should consider a fund's investment objectives, risks, and charges and expenses carefully before investing. Contact First Trust Portfolios L.P. at 1-800-621-1675 or visit www.ftportfolios.com to obtain a prospectus or summary prospectus which contains this and other information about a fund. The prospectus or summary prospectus should be read carefully before investing.

Risk Considerations

You could lose money by investing in a fund. An investment in a fund is not a deposit of a bank and is not insured or guaranteed. There can be no assurance that a fund's objective(s) will be achieved. Investors buying or selling shares on the secondary market may incur customary brokerage commissions. Please refer to each fund's prospectus and Statement of Additional Information for additional details on a fund's risks. The order of the below risk factors does not indicate the significance of any particular risk factor.

Unlike mutual funds, shares of the fund may only be redeemed directly from a fund by authorized participants in very large creation/redemption units. If a fund's authorized participants are unable to proceed with creation/redemption orders and no other authorized participant is able to step forward to create or redeem, fund shares may trade at a premium or discount to a fund's net asset value and possibly face delisting and the bid/ask spread may widen.

Changes in currency exchange rates and the relative value of non-US currencies may affect the value of a fund's investments and the value of a fund's shares.

Current market conditions risk is the risk that a particular investment, or shares of the fund in general, may fall in value due to current market conditions. As a means to fight inflation, the Federal Reserve and certain foreign central banks have raised interest rates and expect to continue to do so, and the Federal Reserve has announced that it intends to reverse previously implemented quantitative easing. Recent and potential future bank failures could result in disruption to the broader banking industry or markets generally and reduce confidence in financial institutions and the economy as a whole, which may also heighten market volatility and reduce liquidity. Ongoing armed conflicts between Russia and Ukraine in Europe and among Israel, Hamas and other militant groups in the Middle East, have caused and could continue to cause significant market disruptions and volatility within the markets in Russia, Europe, the Middle East and the United States. The hostilities and sanctions resulting from those hostilities have and could continue to have a significant impact on certain fund investments as well as fund performance and liquidity. The COVID-19 global pandemic, or any future public health crisis, and the ensuing policies enacted by governments and central banks have caused and may continue to cause significant volatility and uncertainty in global financial markets, negatively impacting global growth prospects.

A fund is susceptible to operational risks through breaches in cyber security. Such events could cause a fund to incur regulatory penalties, reputational damage, additional compliance costs associated with corrective measures and/or financial loss.

Depository receipts may be less liquid than the underlying shares in their primary trading market and distributions may be subject to a fee. Holders may have limited voting rights, and investment restrictions in certain countries may adversely impact their value.

Equity securities may decline significantly in price over short or extended periods of time, and such declines may occur in the equity market as a whole, or they may occur in only a particular country, company, industry or sector of the market.

Political or economic disruptions in European countries, even in countries in which a fund is not invested, may adversely affect security values and thus the fund's holdings. A significant number of countries in Europe are member states in the European Union, and the member states no longer control their own monetary policies. In these member states, the authority to direct monetary policies, including money supply and official interest rates for the Euro, is exercised by the European Central Bank. The implications of the United Kingdom's withdrawal from the European Union are difficult to gauge and cannot yet be fully known.

An index fund will be concentrated in an industry or a group of industries to the extent that the index is so concentrated. A fund with significant exposure to a single asset class, or the securities of issuers within the same country, state, region, industry, or sector may have its value more affected by an adverse economic, business or political development than a broadly diversified fund.

A fund may be a constituent of one or more indices or models which could greatly affect a fund's trading activity, size and volatility.

There is no assurance that the index provider or its agents will compile or maintain the index accurately. Losses or costs associated with any index provider errors generally will be borne by a fund and its shareholders.

Industrials and producer durables companies are subject to certain risks, including the general state of the economy, intense competition, consolidation, domestic and international politics, excess capacity and consumer demand and spending trends. They may also be significantly affected by overall capital spending levels, economic cycles, technical obsolescence, delays in modernization, labor relations, and government regulations.

Information technology companies are subject to certain risks, including rapidly changing technologies, short product life cycles, fierce competition, aggressive pricing and reduced profit margins, loss of patent, copyright and trademark protections, cyclical market patterns, evolving industry standards and regulation and frequent new product introductions.

Large capitalization companies may grow at a slower rate than the overall market.

Market risk is the risk that a particular security, or shares of a fund in general may fall in value. Securities are subject to market fluctuations caused by such factors as general economic conditions, political events, regulatory or market developments, changes in interest rates and perceived trends in securities prices. Shares of a fund could decline in value or underperform other investments as a result. In addition, local, regional or global events such as war, acts of terrorism, spread of infectious disease or other public health issues, recessions, natural disasters or other events could have significant negative impact on a fund.

A fund faces numerous market trading risks, including the potential lack of an active market for fund shares due to a limited number of market makers. Decisions by market makers or authorized participants to reduce their role or step away in times of market stress could inhibit the effectiveness of the arbitrage process in maintaining the relationship between the underlying values of a fund's portfolio securities and a fund's market price.

An index fund's return may not match the return of the index for a number of reasons including operating expenses, costs of buying and selling securities to reflect changes in the index, and the fact that a fund's portfolio holdings may not exactly replicate the index.

A fund classified as "non-diversified" may invest a relatively high percentage of its assets in a limited number of issuers. As a result, a fund may be more susceptible to a single adverse economic or regulatory occurrence affecting one or more of these issuers, experience increased volatility and be highly concentrated in certain issuers.

Securities of non-U.S. issuers are subject to additional risks, including currency fluctuations, political risks, withholding, lack of liquidity, lack of adequate financial information, and exchange control restrictions impacting non-U.S. issuers.

A fund and a fund's advisor may seek to reduce various operational risks through controls and procedures, but it is not possible to completely protect against such risks. The fund also relies on third parties for a range of services, including custody, and any delay or failure related to those services may affect the fund's ability to meet its objective.

A fund that invests in securities included in or representative of an index will hold those securities regardless of investment merit and the fund generally will not take defensive positions in declining markets.

High portfolio turnover may result in higher levels of transaction costs and may generate greater tax liabilities for shareholders.

The market price of a fund's shares will generally fluctuate in accordance with changes in the fund's net asset value ("NAV") as well as the relative supply of and demand for shares on the exchange, and a fund's investment advisor cannot predict whether shares will trade below, at or above their NAV.

Securities of small- and mid-capitalization companies may experience greater price volatility and be less liquid than larger, more established companies.

Smart grid companies can be negatively affected by high costs of research and development, high capital requirements for implementation, government regulations, limited ability of industrial and utility companies to implement new technologies and uncertainty of the ability of new products to penetrate established industries.

Trading on an exchange may be halted due to market conditions or other reasons. There can be no assurance that a fund's requirements to maintain the exchange listing will continue to be met or be unchanged.

First Trust Advisors L.P. (FTA) is the adviser to the First Trust fund(s). FTA is an affiliate of First Trust Portfolios L.P., the distributor of the fund(s).

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