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From Grid to Growth: Energy Infrastructure Fuels our Future



Technology has a profound impact on society— it shapes how we live, work, and communicate. From phrases like “Google it” to interactions with virtual assistants like Siri, technology has become deeply ingrained in our daily lives. Now, the advent of artificial intelligence (AI) is ushering in the next frontier of technological advancement. However, it’s more crucial than ever to not overlook or underestimate the foundational infrastructure that supports these technologies. Companies operating infrastructure play a vital role in facilitating the seamless functioning of modern technological systems and their integration into society.

At Tortoise, we believe energy infrastructure companies in particular provide the essential framework necessary for deploying and operating emerging technologies. We think they offer stable investment opportunities, contributing to economic advancement and long-term growth.

In a landscape where attention often gravitates towards flashy tech innovations, recognizing the enduring significance of energy infrastructure is crucial. We believe investing in this sector ensures resilience and sustainability in the face of rapid technological change.

Understanding Infrastructure Assets

The common characteristics of infrastructure assets include:



The primary types of infrastructure assets that embody these core characteristics include:

- **Energy** – oil and gas pipelines, gathering & processing plants, liquified natural gas (LNG) facilities, storage tanks
- **Power** – electric generation, transmission, and distribution, nuclear plants
- **Renewable** – wind, solar, hydropower, and biofuels
- **Water** – distribution, treatment plans, pumping stations
- **Communication** – cell phone towers, internet servers, satellites, data centers
- **Transportation** – airports, roads, bridges, railroads
- **Waste Management** – landfills, recycling facilities, solid and hazardous waste transportation logistics

In light of these traits, we feel investing in infrastructure is a prudent choice for investors seeking income, stability, growth and diversification in their portfolios.

Investment Attributes of Essential Infrastructure

Essential infrastructure typically consists of real assets whose growth is tied to population and GDP increases. These assets tend to generate steady cash flows, enabling companies to return cash to shareholders through dividends. Each sector within the essential infrastructure sector has unique growth drivers beyond population and GDP growth, which are expected to boost cash flows at varying rates. The table below highlights these sector-specific qualities: It's no surprise that the rise of AI has catalyzed an increase in investment directed towards data centers. In the chart below, McKinsey projects a 5% annual increase in capital spending on data centers through 2030.

Essential Infrastructure						
	Energy	Power	Renewable	Communication	Transportation	Waste Management
Types of Assets	<ul style="list-style-type: none"> Pipelines Gathering & Processing Storage 	<ul style="list-style-type: none"> Generation Transmission Distribution 	<ul style="list-style-type: none"> Wind Solar Hydro 	<ul style="list-style-type: none"> Data Centers Cell Towers Cloud Support 	<ul style="list-style-type: none"> Toll Roads Bridges Airports 	<ul style="list-style-type: none"> Collection Landfill Recycling/RNG
Dividend Yields ¹¹	6% - 7%	4%	7%	4%	3%	1%
Rates of Returns	10% - 20%	8% - 12%	Less than 10%	8% - 15%	Less than 10%	10% - 20%
Growth Drivers	<ul style="list-style-type: none"> U.S. LNG exports Permian pipelines Permian processing 	<ul style="list-style-type: none"> Electrification Transmission Grid modernization 	<ul style="list-style-type: none"> Solar Onshore wind Battery storage 	<ul style="list-style-type: none"> Cloud computing Artificial Intelligence (AI) 5G network 	<ul style="list-style-type: none"> Population growth Transmission Grid modernization 	<ul style="list-style-type: none"> Renewable natural gas Population growth Industry consolidation
Growth Rates	3% - 5%	4% - 6%	8% - 10%	5% - 10%	1% - 3%	3% - 5%
Capital Allocation Priority	Dividend Growth - HIGH Stock Buyback - HIGH Capital Investment - LOW	Dividend Growth - MED Stock Buyback - LOW Capital Investment - HIGH	Dividend Growth - MED Stock Buyback - LOW Capital Investment - HIGH	Dividend Growth - MED Stock Buyback - LOW Capital Investment - HIGH	Dividend Growth - HIGH Stock Buyback - MED Capital Investment - LOW	Dividend Growth - HIGH Stock Buyback - LOW Capital Investment - HIGH
Balance Sheet Strength	3.0 - 5.0x	4.0 - 6.0x	5.0x+	3.5 - 6x levered for REITS		

Source: Digital Realty

¹¹ As of 2/20/24. Energy represent yield of Alerian Midstream Index and Alerian MLP Index. Power represents yield of Dow Jones Utility Average. Renewable is average of yields of Northland Power, Boralex, NextEra Energy Partners, Clearway Energy, Atlantica Sustainable Infrastructure, Brookfield Renewables. Communication average of Digital Realty Trust, Equinix, and Crown Castle.

Energy Infrastructure

Energy infrastructure incorporates the physical assets needed to connect energy production to end-users. The U.S. energy infrastructure network includes several key components:

- **Gathering Systems:** These are the first forms of energy infrastructure that energy commodities such as natural gas, oil, and NGLs enter after production. The U.S. has over 100,000 miles of smaller diameter pipelines connected to well production sites that transport these commodities to processing plants for refinement.
- **Processing Plants:** These plants remove water and other impurities from the hydrocarbon stream. There are approximately 500 plants that support the major oil and gas producing basins in the U.S. After processing, the energy output is transported via pipeline, rail, or truck.
- **Natural Gas Pipelines:** The U.S. network includes over 200,000 miles of interstate and intrastate pipelines. These pipelines deliver natural gas to electricity generation plants, industrial and manufacturing facilities, LNG export facilities, and storage facilities.
- **Crude Oil Pipelines:** The 80,000-mile network transports oil from production sites like the Permian and Bakken basins and those around Canada to U.S. refineries and export locations, including the Gulf Coast.
- **Natural Gas Liquid (NGL) pipelines:** These pipelines transport NGLs such as ethane, propane, butane, and natural gasoline. Over 70,000 miles of NGL pipelines deliver these products to fractionation facilities for separation and further utility in consumer products or heating.
- **Storage Terminals:** Nearly 1,500 above-ground terminals store crude oil, gasoline, diesel, and jet fuel; additionally, 400 underground natural gas storage facilities assist in balancing supply and demand imbalances.
- **Liquefied Natural Gas (LNG) terminals:** LNG terminals include import and export facilities. Import terminals convert LNG back to gas through intense cooling, while export terminals liquefy natural gas for international shipment. The U.S. has eight primary LNG export facilities.
- **Refined Product Pipelines:** The U.S. has over 62,000 miles of refined pipelines that distribute gasoline, diesel, and jet fuel, primarily from Gulf Coast refineries, to domestic and foreign export markets.
- **Local Distribution Lines:** Nearly 1.5 million miles of small diameter pipelines serve as the last-mile taking natural gas from major pipelines into end-user residential, commercial, and industrial customers.
- **Shipping Vessels:** Crude oil and LNG are transported via large tankers. Crude oil can be shipped using very large crude carriers (VLCCs) or ultra-large crude carriers (ULCCs), while LNG carriers transport liquefied gas. The Jones Act requires goods shipped between U.S. ports to use U.S.-built, owned, and operated ships, impacting the number of compliant tankers.
- **Railroads:** While pipelines transport all natural gas and most of crude oil, a small amount of crude oil is transported via rail. There are six major rail systems in North America that span almost 24,000 miles of track and over 7,500 engines, transporting oil and other products like coal, grain, and automobiles.
- **Trucks:** Trucks are used for short-distance transportation when pipelines, railways and waterways are not available.

Below represents our opinion of some key points to consider regarding the sector's dividend yields, rates of return, growth drivers, and capital allocation:

- 1. High Dividend Yields:** Publicly traded energy infrastructure companies typically offer dividend yields between 6% and 7% on average, which are notably higher than other sectors and the broader market. These dividends can be appealing to income-oriented investors seeking consistent cash flow.
- 2. Regulated Assets and Rates of Return:** Some energy infrastructure assets are regulated, with projected rates of return generally ranging between 10% and 20%. This regulatory environment provides stability and predictability for cash flows, supporting the sector's ability to sustain high dividend payouts.
- 3. Modest Growth Outlook:** The sector's primary sources of growth come from population growth, GDP growth, and the expansion of oil and gas production basins. Forecasted growth rates for future cash flows typically range between 3% and 5% per year. Despite being a mature industry, we find the sector continues to benefit from increasing energy production volumes, particularly from regions like the Permian Basin, and rising U.S. energy exports.
- 4. Limited Capital Investment Needs:** Energy infrastructure requires limited ongoing capital investment. This reduced emphasis on capital expenditure allows companies in the sector to generate meaningful free cash flow after dividends. Free cash flow, defined as excess cash flow after deducting operating cash flow, capital investments, and dividends paid, provides flexibility for companies to pursue various strategic initiatives, including debt reduction, share buybacks, or further dividend increases.

Overall, we believe the energy infrastructure sector offers investors attractive dividend yields, supported by stable cash flows, regulated assets, modest growth prospects, and limited capital investment needs. This combination makes the sector an appealing option for income-focused investors seeking reliable returns and cash flow generation.

Power Infrastructure

Power infrastructure is a critical component of essential infrastructure, providing reliable electricity to residential, industrial, and commercial end-users. It includes several key components:

- **Electricity Generation:** Involves the production of electricity from over 7,000 electric power plants in the U.S.
- **Electricity Transmission:** After generation, electricity is transmitted over long distances from power plants to local distribution networks. This involves high-voltage transmission lines, typically carrying up to 380,000 volts, forming a vast network spanning over 160,000 miles. These lines are mainly owned by public utilities and operate across seven regional transmission grids, such as the California ISO, ERCOT, and PJM Interconnection.
- **Electricity Distribution:** Once transmitted, electricity is delivered to residential, commercial, and industrial customers. Distribution involves a network of power lines, transformers, substations, and other infrastructure that carry electricity at lower voltages suitable for local consumption. This network spans millions of miles across the U.S., ensuring that electricity reaches every corner of the country.

The considerations of the power infrastructure sector include:

1. **Dividend Yield and Rates of Return:** The weighted-average yield of the sector, represented by the Dow Jones Utility Average, is approximately 4%, reflecting the dividends paid out to shareholders. Most assets in the power infrastructure sector are regulated by federal and/or state agencies, earning regulated rates of return between 8% - 12%. We find regulation provides stability and predictability for cash flows, as well as a framework for ensuring fair returns on investments.
2. **Investment in Regulated Assets:** These businesses tend to invest excess cash in capital projects that grow their regulated asset base. This investment is aimed at enhancing the reliability, efficiency, and capacity of infrastructure assets to meet growing demand and regulatory requirements. By expanding their regulated asset base, power infrastructure companies can generate growth for shareholders while fulfilling their obligations to provide reliable electricity services to customers.
3. **Electrification as a Growth Driver:** After a decade of stagnant electricity demand growth in the U.S., electrification initiatives, along with increased manufacturing and industrial activity from re-shoring, are expected to spur a new wave of demand growth. Factors such as energy efficiency standards and technological advancements have historically offset increases in electricity demand. However, emerging trends such as electrification of transportation and heating, as well as increased industrial activity, are expected to drive growth in electricity demand in the coming years.
4. **Negative Free Cash Flow:** It's noted that power infrastructure companies generally produce negative free cash flow after paying dividends. This indicates that cash generated from operations is primarily reinvested into the business to fund capital expenditures and expand regulated assets. While negative free cash flow is characteristic of the sector, it's important for investors to assess the sustainability of dividend payments and the long-term growth prospects of the companies within the sector.

In summary, the power infrastructure sector plays a vital role in delivering reliable electricity to a broad range of end-users. We believe it offers attractive dividend yields and stable returns due to regulated assets, while investments in expanding infrastructure ensure long-term growth. Emerging trends in electrification and industrial activity present significant growth opportunities despite the sector's characteristic negative free cash flow.

Renewable Infrastructure

Renewable infrastructure encompasses various forms of energy generation that rely on more sustainable sources. Here's an overview of the different types:

- **Hydroelectric Power:** Generates electricity using large dams with most facilities located in Washington, California, and Oregon.
- **Biomass:** Utilizes organic materials such as wood, agricultural crops, waste materials, and animal manure to generate electricity.
- **Wind Power:** The largest source of renewable power infrastructure, with over 70,000 wind turbines contributing almost 10% of total electricity generation in the U.S.
- **Solar Power:** The fastest growing source of renewable power, potentially surpassing wind power capacity soon. There are over 2,500 utility-scale solar generation facilities, primarily located along the West and East coasts of the U.S.
- **Residential Solar:** Involves solar panels generating electricity for individual homes. Over 4 million American homes are equipped with solar panels, with nearly 2 million in California.
- **Energy Storage:** Essential for integrating renewable energy sources into the grid by storing excess energy generated during high production periods and releasing it during high demand. Current technologies include lithium-ion, lead-acid, and zinc-bromine batteries, which are limited in their long-term storage capacity.

The renewable infrastructure sector is dynamic with several factors to consider:

1. **Dividend Yield:** Publicly traded renewables companies average dividend yields of around 7%.
2. **Low Rate of Returns:** Historically low interest rates and high investor appetite in renewables projects have contributed to reduced returns, often falling below 10%. However, federal and state tax incentives, such as investment tax credits or production tax credits, tend to help improve project economics and attract investment.
3. **Decarbonization Driving Growth:** Growth in renewable infrastructure is primarily driven by decarbonization efforts in the U.S., with solar and onshore wind power forecasted to deliver the highest growth rates, around 10% annually. Biomass may experience some growth due to increased demand for renewable natural gas and diesel, while hydroelectric power demand is expected to remain slow. Residential solar, which has seen significant growth in the past, may experience slower growth or even contraction due to higher financing costs. Offshore wind is likely to face challenges as well.
4. **Capital Investment and Financing:** Given the backlog of renewable infrastructure growth projects, companies in the sector are expected to use excess cash flow for increased capital investment. Many of them will need to access the capital markets, raising debt and equity to finance growth projects.

Despite challenges such as financing costs and technological hurdles, wind and solar development projects are expected to continue driving growth in the renewable infrastructure sector, offering returns in the range of 8% - 10%. However, careful consideration of regulatory environments, technological advancements, and financing dynamics is essential for successful investment in this sector.

Communication Infrastructure

Communication infrastructure is vital for facilitating connectivity and data transmission in modern society. It includes:

- **Cell Phone Towers:** With over 142,000 cell towers across the U.S., these towers form the backbone of cellular networks, enabling wireless communication for mobile devices.
- **Data Centers:** The U.S. operates the largest number of data centers in the world, with almost 3,000 facilities. Data centers are essential for storing, processing, and distributing digital information, supporting various applications and services, including cloud computing, online storage, streaming media, e-commerce, AI, and enterprise software.

Communication infrastructure is characterized by the following:

1. **Dividend Yields and Rates of Returns:** Communication infrastructure companies, often structured as real estate investment trusts (REITs), typically offer dividend yields averaging around 4%. Project returns generally range between 8% and 15%.
2. **Growth Drivers:** The sector's growth is driven by increasing wireless data consumption, the rollout of 5G technology, and efforts to enhance wireless network quality and capacity. Additionally, the growth of data centers is fueled by the expansion of computation processing power requirements and the proliferation of data generated by technologies such as the Internet of Things (IoT), 5G, autonomous vehicles, and AI. The sector is forecasted to grow between 5% and 10%, with cell towers growing at the lower end of the range and data centers trending toward the higher end. AI, in particular, is expected to drive significant growth for data centers due to its demanding requirements for computing power and data storage.
3. **Capital Allocation:** Similar to renewable infrastructure companies, this sector prioritizes capital investment to support growth, with less emphasis on stock buybacks. Increasing debt levels may also be necessary to finance capital investments required to meet growth targets.

As a whole, communication infrastructure is critical for enabling seamless connectivity, information exchange, and access to digital services. These components form the backbone of modern telecommunications networks and support the growing demand for data-intensive applications and technologies. As technology advances and society becomes increasingly reliant on digital connectivity, investment in communication infrastructure will remain essential.

Transportation Infrastructure

Transportation infrastructure is a vital component of modern societies, facilitating the movement of people and goods essential for economic growth and development. Key aspects include:

- **Toll Roads:** These highways charge a fee for usage to fund maintenance, improvements, and expansions. While most of the 5,000 miles of toll roads in the U.S. are owned and operated by federal, state, and local governments, there are opportunities for investors to participate in publicly traded toll roads in other countries. For example, investors can invest in toll roads in China through companies like Jiangsu Expressway and Zhejiang Expressway.
- **Airports:** Airports are critical hubs for air travel, connecting passengers and cargo to destinations worldwide. While the majority of the 5,000 public airports in the United States are owned by governments, there are opportunities for investment in individual airports internationally. For instance, investors can consider investing in airports such as Charles de Gaulle Airport in Paris and Vienna Airport.
- **Ports:** Ports facilitate maritime cargo shipments and are typically government-owned in the U.S. However, there are publicly listed stocks for ports in countries like India and China, as well as for specific terminals such as a coal export in Canada.

The key financial attributes of transportation infrastructure companies include:

1. **Low Dividend Yields and Low Rates of Returns:** These companies are characterized as low dividend yields averaging around 3%, and low rates of return on assets, projected to be less than 10%. These lower rates reflect the capital-intensive nature of the industry, as well as its relatively stable and predictable cash flows.
2. **Growth Drivers:** Mobility, particularly in the context of airports and toll roads, is gradually returning to pre-COVID levels, with future growth expected to be driven by population growth and the health of the global economy. Growth in ports, on the other hand, is closely tied to GDP growth, as increased economic activity drives demand for maritime cargo shipments. While globalization has historically driven port growth, there is a potential shift towards deglobalization in some regions, which could impact future growth prospects.
3. **Capital Allocation:** With limited growth opportunities, these companies prioritize dividends as the primary means of returning capital to investors. This emphasis on dividends reflects the stable and cash-generating nature of transportation infrastructure assets, allowing companies to distribute a portion of their earnings to shareholders while retaining sufficient funds for ongoing operations and maintenance.

Overall, transportation infrastructure is crucial in supporting economic activities and enabling global connectivity. While many transportation assets are owned by governments, there are opportunities for private sector involvement and investment in infrastructure projects and publicly traded companies, both domestically and internationally. As governments seek to address infrastructure needs and promote economic development, partnerships between the public and private sectors will continue to play a significant role in advancing transportation infrastructure initiatives.

Waste Management Infrastructure

Waste management infrastructure is essential for managing the substantial amount of waste generated daily in the U.S., which averages five pounds per person daily. Key components of waste management infrastructure include:

- **Collection Facilities:** With almost 9,000 facilities nationwide, these centers play a critical role in picking up and transporting waste and recyclable materials from residential, commercial, and industrial sources to transfer stations, recycling facilities, or disposal sites.
- **Landfills:** There are over 2,000 active landfills in the U.S., which serve as the primary depositories for solid waste disposal. These engineered facilities are designed to safely contain and manage waste materials, including household garbage, construction debris, and industrial waste.
- **Recycling Facilities:** With over 1,000 recycling facilities nationwide, these facilities play a crucial role in diverting recyclable materials from the waste stream for processing and resale or other forms of disposition. These facilities utilize various methods, including sorting, shredding, and cleaning, to separate recyclable materials such as paper, plastic, glass, and metal.

The financial attributes of waste management infrastructure companies highlight key aspects of their operations, growth potential, and capital allocation strategies:

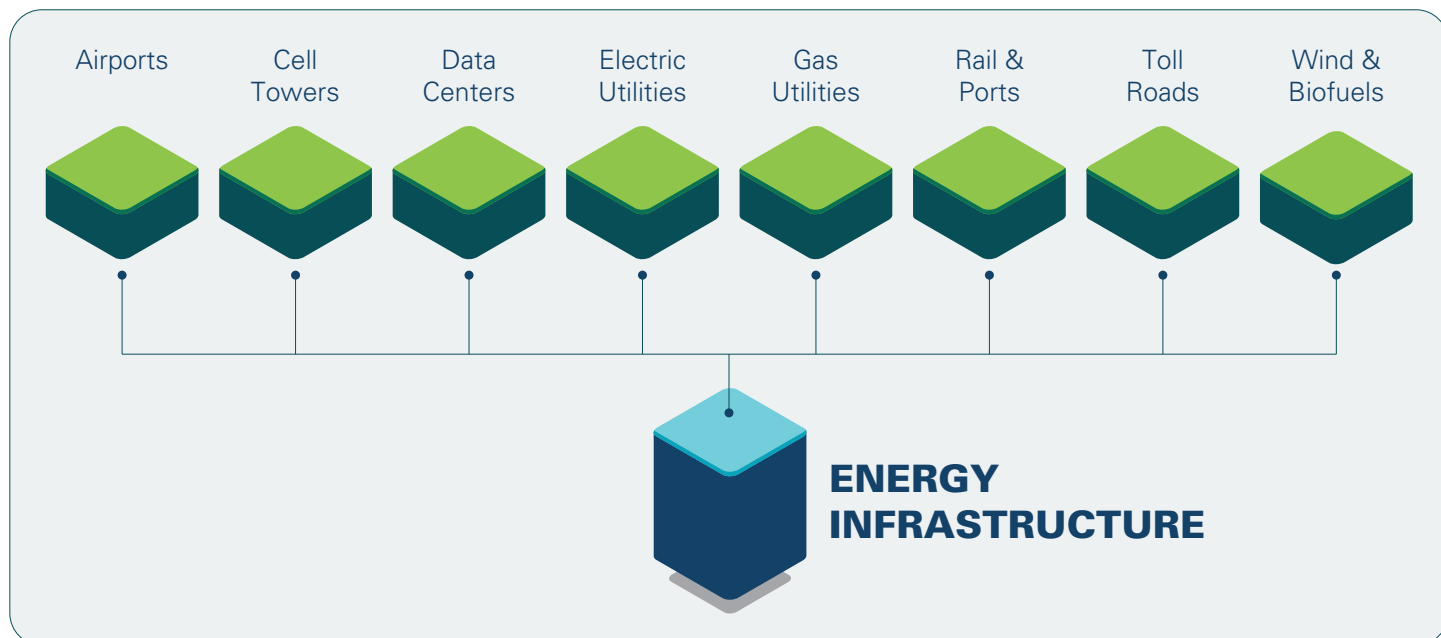
1. **Low Dividend Yields but Solid Rates of Returns:** Waste management infrastructure companies typically offer low dividend yields, averaging around 1%. However, these companies often achieve solid rates of returns on capital investment, ranging from 10% to 20%. This indicates that while dividend payouts may be modest, investors can benefit from attractive returns on their investment in the form of capital appreciation and overall profitability.
2. **Growth Drivers:** Population and GDP growth serve as steady drivers of growth for waste management companies, as increasing economic activity and urbanization result in higher waste generation. Additionally, the transition to a circular economy, driven by decarbonization efforts, is expected to further fuel growth in recycling activities. Opportunities to capture methane from landfill facilities and convert it into renewable natural gas represent another source of growth. Furthermore, the potential consolidation of the industry presents opportunities for companies to expand their market share and achieve economies of scale.
3. **Capital Allocation:** With numerous growth opportunities and anticipated rates of return, we find most waste management infrastructure companies prioritize capital investment. While dividends remain part of the investment story for investors, many companies are emphasizing stock buybacks less in favor of reinvesting in growth initiatives. This approach allows companies to capitalize on growth opportunities, enhance operational efficiency, and drive long-term shareholder value.

Altogether, waste management infrastructure companies offer investors the potential for solid returns driven by population growth, economic expansion, decarbonization efforts, and industry consolidation. By strategically allocating capital to finance growth initiatives and maintaining a focus on operational excellence, these companies aim to capitalize on market opportunities and deliver value to shareholders over the long-term.

ENERGY INFRASTRUCTURE

The Essential of the Essential

Infrastructure is fundamental to the development of economies and our daily lives. Energy infrastructure in particular is the “essential of the essential” as depicted below:



Without energy infrastructure, essential services would grind to a halt, and economic activity would come to a standstill.

Energy infrastructure services as the backbone of essential services and economic growth:

- 1. Essential Services Reliability:** Hospitals, data centers, communication networks, manufacturing plants, and industrial facilities rely on a continuous and reliable supply of energy to operate effectively. Energy infrastructure ensures that these critical services remain uninterrupted, providing heating, cooling, electricity, and power for essential operations 24/7.
- 2. Transportation:** Energy is essential for powering various modes of transportation, including planes, trains, automobiles, and maritime vessels. Without energy, transportation systems would be paralyzed, impacting not only the movement of people but also the transportation of goods and services necessary for commerce and trade.
- 3. Economic Growth Catalyst:** Energy serves as a catalyst for economic growth by enabling various industries and sectors to function efficiently. Energy infrastructure forms the foundation upon which other forms of infrastructure, such as transportation networks, telecommunications systems, and manufacturing facilities, rely. Without reliable energy infrastructure, economic development and progress would be severely hampered.
- 4. AI and Energy Infrastructure:** As we look to the future and the integration of AI into various aspects of society, it's vital to recognize the critical role that energy infrastructure (EI) plays. Simply put, there is no AI without EI. Without energy infrastructure, the potential of AI and other advanced technologies would be limited.

Bottom Line

Energy infrastructure is not just essential; it's the backbone of modern civilization. It powers essential services, drives economic growth, and enables technological advancements that shape our future. As we continue to innovate and develop new technologies, ensuring the reliability and sustainability of energy infrastructure will remain paramount for the well-being and progress of society.

Disclosures

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