CHANGE NEVER FELT SO FAMILIAR

Infrastructure in the energy transition

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STEPSTONE

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Introduction

Energy is critical to the functioning of our society—it has fueled technological advancement and human progress over the past two centuries. According to the US Energy Information Administration, global energy consumption has increased by at least 1% every year since 1966. Between 1990 and 2020, it jumped 60%, and by 2050 global energy consumption could rise by an additional 50%.

So far, most of the energy we've used has come from fossil fuels. While cheap and abundant, they are also the largest contributor to carbon emissions. As a result, governments around the world are working to curb carbon emissions while also meeting the energy needs of society. The way we produce, distribute and consume energy needs to change, this is what the energy transition seeks to do.

This shift, however, cannot happen without infrastructure: It is the backbone that enables the technology, production, integration and storage of renewable resources and the transmission of clean energy.

The energy transition presents a significant opportunity for GPs, LPs and direct investors alike. Because of the global shortfall in public spending on infrastructure, governments and businesses are turning to private capital to fund, build and deliver transition projects at speed, quality and scale. Infrastructure GPs have recognized the opportunity, targeting more than $185 billion for energy transition funds between 2021 and 2023.[1] And if estimates from the International Energy Agency (IEA) are correct, and nearly 20x more capital is needed to bring about the transition, this is just the beginning. LPs should be prepared to evaluate a broad range of opportunities from managers on this topic.

Though the terms are sometimes used synonymously, the energy transition is more than renewable energy; everything from hydrogen to battery storage and carbon capture falls within the broad remit of the energy transition. Within this remit lie opportunities outside the risk-return norms of infrastructure. "PE-like returns" may become a common refrain.

Because of the sheer breadth of this space, for the LPs contemplating an allocation to it, the diligence required may bring new challenges as their investment teams become comfortable with unfamiliar terminology, new technologies and emerging business models. Yet despite the seeming newness of these opportunities, they are still, well, infrastructure: fundamental assets that society needs to function. To that end, investors should expect the energy transition to offer the same potential as other "traditional" infrastructure assets: Diversification. Uncorrelated returns. Steady cash flows.

To prudently seize the opportunity and select the right GPs, we are working with LPs to help them up the learning curve. In this paper we explore the opportunity for private infra–structure capital to support the energy transition, and we illuminate various strategies that may help investors capitalize on this opportunity.

[1] SPI by StepStone, 2024. Includes infrastructure funds dedicated to renewables, the energy transition or both.

Bridging the gap to the future energy system

The energy transition will bring about a major structural change in how energy is supplied and consumed. To accommodate this change, the future energy system will require modern infrastructure that reliably and sustainably enables the production, storage, transportation and distribution of clean energy. This future energy system will be more decentralized, digitized and electrified. Energy will be more easily stored, markets nimbler and more easily re-formed. Ultimately the new energy system will be more resilient and integrated.

EVOLVING SYSTEMS

Energy is not used at a steady rate across hours, days or seasons. Energy systems must be able to both deliver the total energy quantum over a given period and meet instantaneous peak demand. Because the two most scalable renewable energy technologies—wind and solar—are intermittent, balancing the supply and demand of the system across the seasons becomes a critical success factor.

SHIFTING MARKET DYNAMICS

In traditional fossil fuel energy markets, most of what consumers pay covers the cost of the fuel itself, with infrastructure expenses like pipes and wires making up a smaller portion of the bill. The competitive nature of energy production keeps prices in check and favors the most efficient. Policymakers intervene mainly to ensure there's enough capacity in the system.

However, in the future energy market, intermittent energy sources and technological advancements will enable flexible energy consumption. As a result, the traditional dynamics of supply and demand, which have been largely based on stable, predictable sources of energy and consistent patterns of consumption, will change. Instead, energy supply will fluctuate based on factors like weather conditions and time of day, while consumers will have more control over when and how they use energy. This shift represents a fundamental change in how energy is produced, distributed and consumed, with implications for energy markets and the infrastructure that supports them.

SHIFTING SYSTEM DYNAMICS

Likewise, in the future energy system, sustainable energy sources like solar and wind will have minimal production costs because they do not require fuel. This stands in contrast with traditional energy sources like fossil fuels, which incur ongoing fuel expenses. As a result, revenue streams from renewable energy projects, often stabilized by models like contract for difference (CfD), are less susceptible to market fluctuations over time.

As more energy production systems adopt such models, the energy system will come to resemble an interconnected ecosystem, in which prices will be determined by the costs of building and maintaining infrastructure, rather than by production costs or consumer demand. If this comes to pass, it will fundamentally change the economics of the energy industry.

POLICY AROUND CAPACITY

In the future energy system, keeping costs down and ensuring the stability of the system and market while safeguarding consumers' interests will become a policy decision rather than a market outcome. Policymakers must strike a balance in energy capacity to avoid both shortages and surpluses. Capacity is based on peak demand—i.e., the highest level of energy consumption during a specific period—but will be made up of both production and storage. A well-designed system will aim to minimize costs by building only the necessary infrastructure to meet demand effectively.

MANAGING DEMAND FOR STABILITY AND COST CONCERNS

Excessive demand during peak periods can lead to higher costs and supply disruptions. Thus, it becomes important to find ways to reduce and stabilize peak demand, including through demand response programs and government-led energy initiatives. Managing the troughs—i.e., periods of low demand—is equally challenging and, left unchecked, might result in undesirable market distortions such as producers paying consumers to use excess energy (a.k.a. negative pricing).

Storage technologies, therefore, are a critical piece of the puzzle.

- Short-term storage solutions (e.g., batteries) are good at managing daily demand fluctuations.
- Seasonal storage solutions, which involve storing excess energy for longer periods, are important for utilizing energy during times of low demand.
- These longer-term solutions often rely on storing hydrogen and biomethane in natural geological formations, ensuring that energy can be used efficiently over time.

Overall, policymakers must implement strategies—from government-led initiatives to effective energy storage solutions—that manage the peaks and troughs alike to ensure a stable and cost-effective energy system for consumers.

Roles

GOVERNMENTS AND POLICYMAKERS

As businesses and governments search for ways to quickly hit their net-zero targets, their primary goal is to deliver clean, reliable and affordable energy in sufficient quantities to meet the demands of society. They must also do so equitably.

Recognizing the scale of this challenge, governments are intervening on pricing in a range of ways such as organizing auction rounds for specific technologies, like offshore wind in the UK, or providing direct subsidies, like solar feed-in tariffs in Australia.

Governments are also enacting laws to close the funding gap.

- In the US, the Inflation Reduction Act offers incentives and subsidies to stimulate private capital investment in renewable energy sources.
- Germany has implemented a greenhouse gas quota, and Europe's Green Deal and REPowerEU offer significant investment opportunities in clean energy infrastructure.
- Some developing markets have also shown policy support for infrastructure development. The Indian government has included $120 billion for infrastructure spending in its current budget, for example.

Despite such positive developments, it is important to remember that public policy is not immutable. Public resistance to higher energy costs might lead to policy adjustments—especially to those regarded as unjust or burdensome to consumers. With governments trying to realize their energy transition goals, many will be left competing for the most attractive capital pools—namely, private infrastructure and energy investors with strong heritages. The ability of private market investors to look over their portfolios to leverage their experience across asset types, technologies, business models and geographies will place them at an advantage.

SYSTEM ARCHITECTS AND OPERATORS

Traditional energy systems have evolved mainly organically, based on where coal and oil deposits are found. These systems are run by an operator (think: NESO in the UK, AEMO in Australia or PJM in the US). In addition to overseeing day-to-day management, operators ensure the reliable and efficient delivery of energy and balance supply and demand in real time. But because the future energy system will be a more complex, interconnected and decentralized mix of technologies, a new role is emerging: the System Architect.

System Architects maximize efficiency, reliability and resilience in energy networks while minimizing adverse environmental effects and negative externalities. They are also well-placed to manage volume and commodity risks on behalf of consumers. With this transfer of risk, asset owners, in turn, may be better compensated on an availability basis, with existing infrastructure business models like regulatory asset base (RAB) or cap-and-floor arrangements likely to serve as common remuneration frameworks. With time, System Architects may become the energy system equivalent of central banks, de-risking investments by determining asset use cases rather than leaving it to the markets. We expect this will provide opportunities for investors to pursue a growing variety of structured revenue outcomes surrounding energy transition assets.

As energy systems become more interconnected, System Architects and operators must optimize technology and capacity, weighing practical considerations like volume, commodity risks and the placement of renewable energy sources. For example, solar and wind power are generated independently of fossil fuels, allowing for location decisions to be based on factors such as resource availability, politics (sensitivity of site) or proximity to demand, rather than proximity to fossil fuels.

PRIVATE INVESTORS

While System Architects will probably determine what to build and where, the funding for that infrastructure will largely come from private infrastructure investors.

One of the biggest investment cycles is underway. The world is already on pace to invest over $2 trillion in the energy transition by 2030, per the IEA. And if countries take more aggressive action, that amount could grow by at least half

> While System Architects will determine what gets built, most of the funding will come from private infrastructure investors.

(**Figure 1**). However, this may not be enough to bring about a net-zero future. To overcome this so-called ambition gap, the IEA estimates a trillion more dollars over what's been pledged need to be invested (the net-zero scenario). In other words, the role of private markets could be even greater.

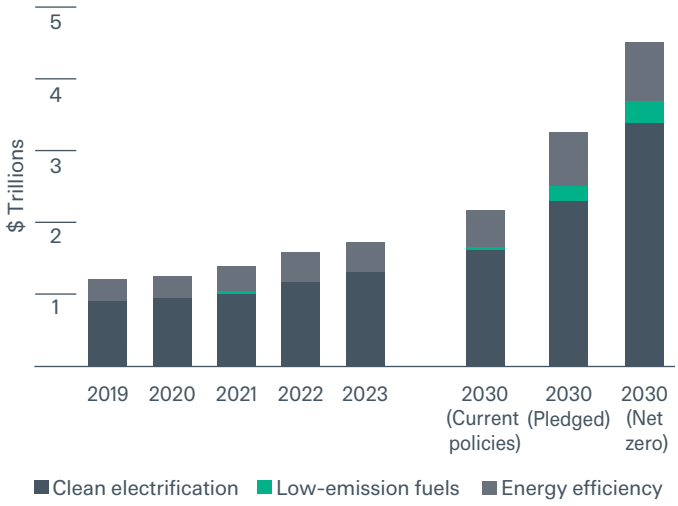
Infrastructure investors are also the consummate project managers—experts in minimizing operational risks, regulatory uncertainties and market fluctuations. Unlike public funding sources, which may be subject to bureaucratic delays and political constraints, investors can move quickly to support businesses in seizing opportunities and responding to changing market conditions, which is critical given the urgency of the energy transition.

The opportunity for investors

CAPITAL DEPLOYMENT

We are actively monitoring over 100 energy transition managers, 80% of which are in-market. As seen in **Figure 2**, these managers were looking to raise more than $90B in 2023, almost double the target from 2022. If this trend continues, we expect to see managers raising more capital across a range of energy transition funds, along with an increase in the amount of co-investment opportunities.

FIGURE 1: CLEAN ENERGY INVESTMENTS



Source: IEA, 2023.

FIGURE 2: GROWTH OF ENERGY TRANSITION FUNDS BY VINTAGE

Source: SPI by StepStone, 2024.

A testament to the breadth of the opportunity, energy transition strategies can vary greatly—with target fund sizes ranging from $200M to over $15B—and run the gamut from core to opportunistic. Many of these funds are marketed as offering private equity–like returns.

This provides investors with opportunities to meet a range of investment objectives.

DIVERSIFICATION

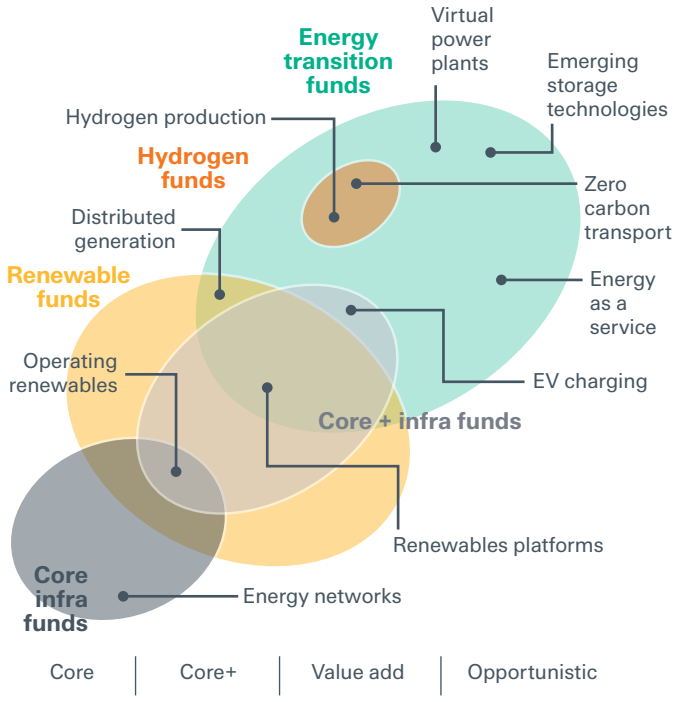
Owing to the breadth of the opportunity, investing in the energy transition can help investors diversify their portfolios across sectors, regions and risk-return profiles (**Figure 3**). Yet as broad as the opportunity set is, it is still expanding. From traditional greenfield investments in renewable energy, the energy transition has grown to encompass emissions reductions in fossil fuel–heavy sectors as well as Article 9 funds.[2]

ECONOMIES OF SCOPE

As the energy transition grows and evolves, so too will the fund strategies and their underlying risk-return expectations. For example, large core infrastructure funds are starting to place greater emphasis on energy transition assets—earmarking as much as 50% of the fund toward them. This is particularly true in places (like Europe) where net-zero plans are widespread.

While this could be evidence of style drift, it also suggests that investors are smartly applying their existing skills and know-how to capitalize on the next frontier within the infrastructure asset class.

FIGURE 3: ENERGY TRANSITION MARKET MAP



Source: SPI by StepStone, 2024.

- Energy investors that have historically focused on greenfield (traditional) renewables such as solar and wind can find scope to include behind-the-meter installations and technologies like energy storage, efficiency and grid stability solutions.
- Conversely, some segments of the energy market that have historically fallen outside the traditional remit of infrastructure are beginning to employ "infra-esque" devices (e.g., long-term contracts and downside protection mechanisms).

In either case, investors are finding the familiar in seemingly unfamiliar situations.

[2] The classification, which shows which funds prioritize climate-related objectives, mandates the comprehensive disclosure of sustainability-related information, enhancing transparency for investors to evaluate general partners' responsible investment practices.

Risks and considerations

Although the energy transition may provide many opportunities for investors to earn attractive risk-adjusted returns, there are several important risks to consider.

Portfolio construction and asset selection are critical: What was an attractive investment today may not be a year from now. Working closely with an experienced solutions provider or fund manager whose view of the market is panoramic yet able to zero in on the opportunities and idiosyncrasies of local markets may be helpful to investors navigating these complexities.

REGULATORY RISKS

Changes in government regulations, policies and incentives can affect the viability of projects. As a result, business models and contracts that offer stable and secure revenues for investors without causing major disruptions for consumers will become increasingly appealing to policymakers.

> Infra investors are the consummate project managers—experts in minimizing operational and regulatory risks.

TECHNOLOGICAL RISKS

While traditional energy market business models and revenue streams may be predictable, newer energy solutions are likely subject to greater uncertainty. These uncertainties are amplified by broader technological innovations like artificial intelligence, which can alter consumer demand and operating costs. Additionally, some projects could involve innovative and emerging technologies whose performance and reliability may still be unproven.

MARKET RISKS

Fluctuations in energy prices, supply-demand dynamics and market competition can affect the cost of energy transition projects. In the short run, price volatility may increase as more renewables connect to existing and increasingly constrained markets. Power purchase agreements and other forms of contracts may continue to offer the best solution. Despite the substantial scale of the energy transition, increasing competition in well-developed subsectors such as wind and solar in Europe could also adversely affect investor returns.

OPERATIONAL RISKS

Energy transition projects may face operational risks related to construction, operation, maintenance and performance. While decarbonizing the electricity sector is progressing smoothly, decarbonizing other sectors like industry, transport and heating/cooling has been slower going because of the significant changes in consumer behavior that are needed. However, we expect the renewable energy products in these sectors to soon resemble traditional fossil fuel offerings. This shift will involve replacing petroleum products with sustainable

transport fuels and using green molecules as a clean energy substitute for natural gas. Over the short run, the limited availability of these "direct replacement" products is likely to result in higher prices, offering advantages for early investors.

GEOPOLITICAL RISKS

With more renewables projects using business models like CfD, which removes volume, commodity and technological risks by stabilizing revenue streams over time, investors' primary concern will shift to third-party risk, particularly the government with which they contract.

The perception of risk may vary across jurisdictions, with some seen as low-risk and others as considerably higher. But the most critical challenge lies in the changing attractiveness of asset types across different jurisdictions over time.

As policies shift, making smart investment decisions in the right places and at the right times—addressing the "what, where and when"—becomes an imperative. This requires investors to be educated and work with partners who have the data, scale and relationships to make informed investment decisions.

Manager selection

Brought on by the energy transition, the opportunity set in infrastructure is evolving and expanding. That said, the fundamental reasons to invest in the asset class have not changed: Portfolio diversification. Uncorrelated revenue streams. Long-term stakes in assets and services vital to society. It's important to consider that as the investment landscape evolves and becomes more complex, manager selection remains paramount in building a resilient portfolio.

To help investors determine whether an opportunity is right for them, there are several practical considerations to weigh.

- **Risk budget**—With the energy transition offering opportunities across the risk-return spectrum, having clarity on your risk budget can help you decide whether an opportunity is right for you. If you're targeting an opportunistic-level risk, funds focusing on novel energy storage solutions or green fuels may be appropriate. If your appetite is more aligned to core or core-plus, renewables may be more your speed.
- **Performance**—How has a manager performed across economic and technological cycles? How is their track record related to the asset types and management plans associated with the strategy?
- **Skills transfer**—As managers adapt their strategies in response to changing market conditions, some will be able to leverage their existing skills and networks to find economies of scope. How applicable are existing skills to new investment opportunities?
- **Trendspotting**—A corollary to performance: How well has a manager succeeded in being at the forefront of change? Early movers in other infrastructure sectors or subsectors may have an edge in anticipating society's needs.
- **Alignment**—The energy transition lends itself to fulfilling several objectives, including social and environmental impacts. Are your goals purely financial, or are you focused more on impact? How are the GP and its key individuals linked to these goals?
- **Co-investments**—Is the GP offering them? By investing alongside a GP, an investor can evaluate new sectors or technologies more deeply than a primary fund may allow. It also gives LPs valuable insights into the GP's team and capabilities, which can be helpful in evaluating that GP's future offerings.

Conclusion

The energy transition's success hinges on the infrastructure that enables the transport, storage and distribution of transition solutions and ultimately clean energy around the world. This shift is transforming siloed energy markets into an ecosystem. The business models that undergird this new energy paradigm focus on resource availability and sustainability. System Architects and operators are likely to lead the way, collaborating with private and public stakeholders to address concerns about resource intermittence, energy security, equity and sustainability. They will also develop energy and capacity solutions that meet the rising demand for transition solutions and clean energy. That most of the capital required to build the energy system of the future will come from private markets means we are in the midst of one of the largest investment cycles in history.

As such, the energy transition is probably the most important theme for infrastructure investors who find themselves with a huge opportunity to deploy significant capital into sustainable assets across the risk-return spectrum. But the market is dynamic, and it is crucial to choose the right technologies in the right place at the right time. Our firm is focused on working with clients to identify high-potential investment opportunities across the energy transition investment landscape and advising on strategies that enhance portfolio return and protection in this evolving space. We believe that having energy transition assets in your portfolio is a critical aspect of optimizing exposure to this global economic investment opportunity.

Despite the "newness" of the energy transition, it is still, well, infrastructure: fundamental assets that society needs to function.

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