

Rethinking the role of long-term investors in the energy transition

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Executive summary

While global investments in clean energy have steadily increased in recent years, the pathway to net zero aligned with the Paris Agreement remains riddled with investment gaps.

Long-term investors, particularly sovereign wealth funds (SWFs) and large public pension funds (PPFs), can play a key role in driving the energy transition and helping to bridge the financing gap. However, the volume of capital emanating from these investors still falls short of what

is necessary to achieve global decarbonisation goals, particularly in emerging markets.

This report highlights the role that these long-term investors can play in fostering international cooperation, driving sustainable investments and supporting the global energy transition. It showcases three approaches and several case studies which may inspire investors and encourage them to bolster their investments in assets and projects that enable the energy transition.

1.

Trailblazer

Long-term investors adopting the **trailblazer approach** pioneer new investment theses. This tactic entails using their resources to think differently about problems, develop innovative solutions and execute them. This can be done by adopting a different way of looking at matters such as regulatory risk, country risk and market risk—making propositions less risky and providing appropriate risk-adjusted returns.

These investors become the first movers in the market, which allows them to hit higher returns quickly, sell at a profit and trailblaze the path, showing other investors how such investments can be made. They can then use the resources thus gained to continue shaping new markets and investment theses to push forward the energy transition.

2.

Whole-of-life

In the early stages of an energy-transition asset's life cycle, the risks are similar to those faced by private equity or venture capital companies. As the assets mature, they generally become less risky, eventually reaching the 'ready to build' or 'brownfield' stage. These assets can then be moved from a higher risk fund into an infrastructure fund. However, moving assets between funds can be very challenging for asset managers.

Long-term investors, and SWFs specifically, are able to avoid such restrictions. In the **whole-of-life approach**, they handle asset allocation differently from traditional asset managers and assess the risk-adjusted returns across an energy-transition asset's entire life cycle. They may hold an asset throughout its life cycle, from early-stage development through to operations.

3.

Blended finance

Blended-finance structures allow long-term investors such as SWFs and PPFs to collaborate with multilateral development banks (MDBs), development-finance institutions (DFIs), foundations, philanthropies, and private investors to finance energy-transition projects that bring in solid financial returns while achieving socioeconomic development goals. While blended finance has existed since the mid-2000s, long-term investors such as SWFs and PPFs have not made much use of such structures, particularly when it comes to investments in the energy transition.

Through blended-finance structures, long-term investors can use their institutional standing and state connections to provide catalytic capital for energy-transition projects and collaborate with private and public sector investors to de-risk such investments.

The investment approaches outlined in this report demonstrate that SWFs and large PPFs have flexibility in how they deploy capital into the energy transition and can help bridge the existing financing gap.

Their strategic long-term investment horizon and ability to de-risk projects in emerging markets and throughout

an asset's life cycle make them well-positioned to attract additional private investors. The alignment of their investment strategies with international climate goals can set a precedent for other financial institutions, helping maintain momentum towards the global energy transition.



1

Introduction: The energy transition and the investment gap



In light of increasing climate-related impacts, the energy transition—the shift from a fossil-fuel-based system of energy production to one based on low-carbon energy sources¹—stands as a key mechanism to decarbonise the global economy. This is in line with the United Nations’ sustainable development goal (SDG) 13 on climate action and also supports progress towards four other SDGs:²

- **SDG 7: Affordable and clean energy.** This goal recognises the critical role that energy plays in economic development, poverty eradication and climate change mitigation. It seeks to ensure universal access to ‘affordable, reliable, sustainable and modern energy for all’.
- **SDG 8: Decent work and economic growth.** This goal seeks to ‘promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all’. The concept of a ‘just transition’ stipulates that the energy transition must be both environmentally effective and socially equitable.
- **SDG 9: Industry, innovation and infrastructure.** This goal seeks to ‘build resilient infrastructure, promote inclusive and sustainable industrialisation and foster innovation’.

- **SDG 11: Sustainable cities and communities.** This goal seeks to ‘make cities and human settlements inclusive, safe, resilient and sustainable’. Sustainable cities essentially strive to find a balance between economic growth, environmental considerations and societal equity.

Even with clean-energy investment rising to unprecedented levels, the world faces a major shortfall in funding for the energy transition. For instance, the ongoing rapid uptake of energy-hungry generative AI solutions across all sectors and industries is expected to increase energy demand in the coming years. Among potential providers of clean energy finance, two types of long-term investors stand out: SWFs and large PPFs.

SWFs are the highest-profile long-term investors. They have long served as vehicles for investing domestic capital surpluses in international markets, aiming to generate strong financial returns.

PPFs provide consistent returns to pay for pension schemes and other social-security benefits in their home countries. Although some PPFs—particularly the large ones—have ambitious investment strategies that seek to incorporate energy-transition assets with long-term prospects alongside more traditional investments, many are reluctant to make risky investments.

Among potential providers of clean energy finance, two types of long-term investors stand out: sovereign wealth funds and large public pension funds.

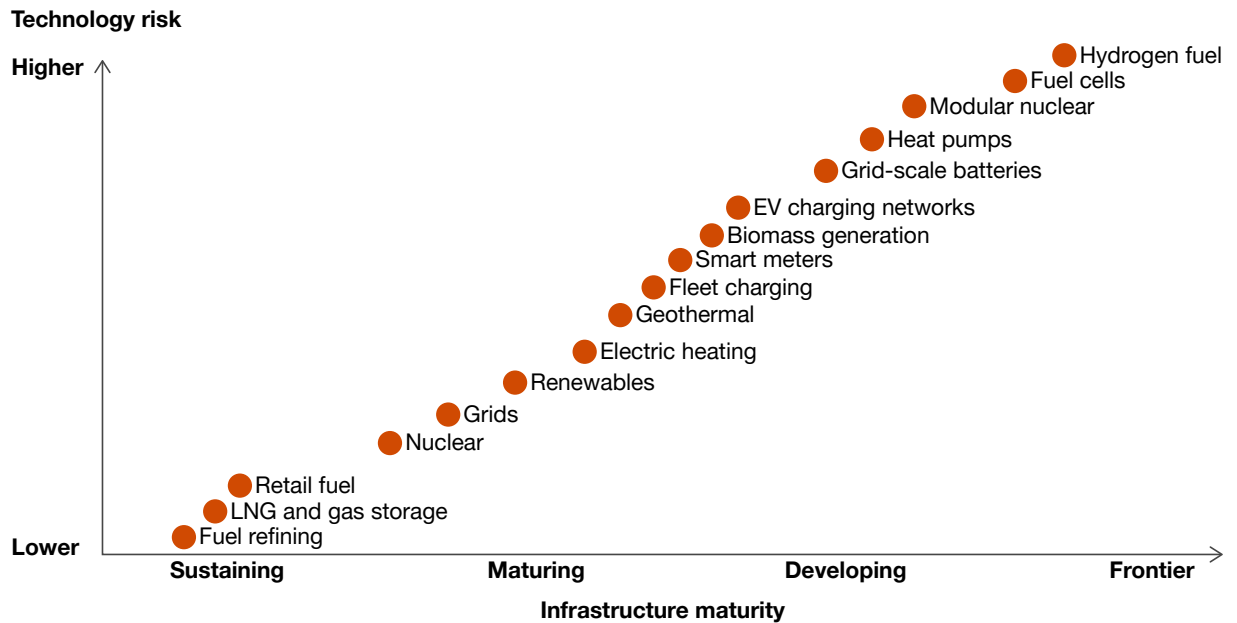
In theory, the strategic long-term investment horizons of SWFs and PPFs could allow them to take on short-term risks that other investors would be reluctant to accept, and thereby look at energy-transition assets throughout their life cycle. Figure 1 shows the technology risk and infrastructure maturity of different energy-transition-related projects. Frontier-stage or developing infrastructure comes with higher technology risks, for the technologies tend to be in development and their potential is not yet proven.

SWFs and PPFs can be pioneers by choosing to align their investment strategies with international climate

goals, setting a precedent for other financial institutions and long-term investors by demonstrating a higher risk appetite and acting as the early movers in emerging technologies. These early movers could reap the benefits and build momentum towards a cleaner energy system.

For this report, we focus on the energy transition as it relates to capital flows towards clean energy, as opposed to examining specific sectors. While we recognise that policy developments are one of the critical elements that drive sovereign capital and long-term investors into energy-transition investments,³ they are not covered in our analysis.

Figure 1. Technology risk and maturity of energy infrastructure projects



Note: The term 'technology risk' refers to the extent to which a technology is unproven or still under development. For instance, hydrogen fuel is considered to have a high technology risk because the ecosystem to manufacture, transport and use it is still under development. Source: PwC Global AWM & ESG Research Centre

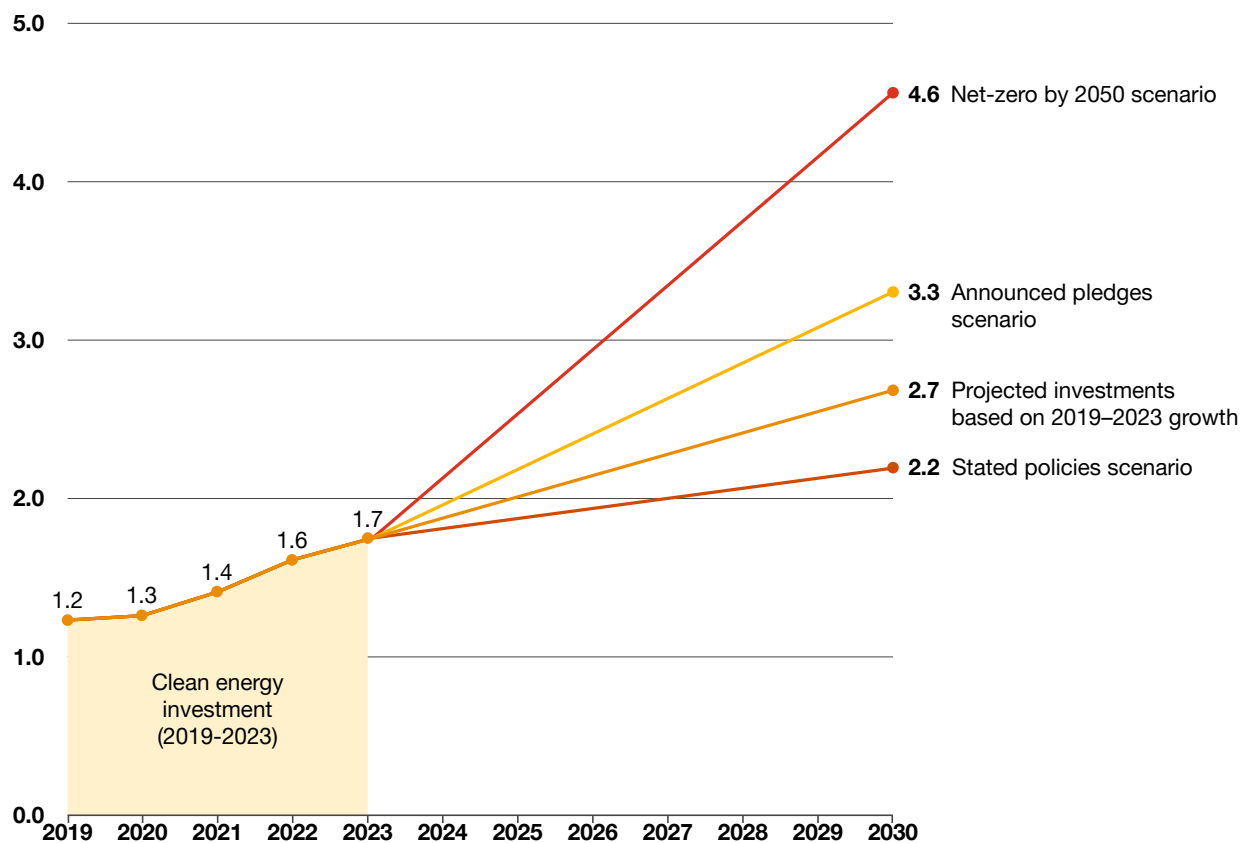
US\$2 trillion

of clean energy investment expected in 2024.

The energy transition is underpinned by the infrastructure that directly produces or contributes to producing clean energy, such as infrastructure related to renewable power generation, nuclear energy, electricity grids, storage, low-emission fuels, end-use renewables and electrification.

In recent years, there has been a steady increase in clean energy investment, from US\$1.2 trillion in 2019 to US\$1.7 trillion in 2023. International Energy Agency (IEA) estimates suggest that the US\$2 trillion of clean energy investment expected in 2024⁴ represents less than half the roughly US\$4.6 trillion needed annually by the early 2030s to achieve net-zero emissions by 2050 (Figure 2).⁵ In other words, more funding is required from every available source.

Figure 2. Annual clean energy investment needs by IEA scenarios (US\$ trillion)



Note: 'Clean energy investment' includes renewable power, nuclear energy, electricity grids, storage, low-emission fuels, efficiency improvements, end-use renewables and electrification.

Source: PwC's Global AWM & ESG Research Centre, IEA

To reach net zero, significant gaps must be bridged between the current energy system and the clean-energy system of the future. The biggest gap is the development of renewable-energy capacity: the solar farms, wind farms, chemical battery storage and hydroelectric dams needed to supply the world with carbon-free electricity. In tandem, demand for critical materials, such as lithium and rare-earth metals used for solar panels and batteries, will likely increase.

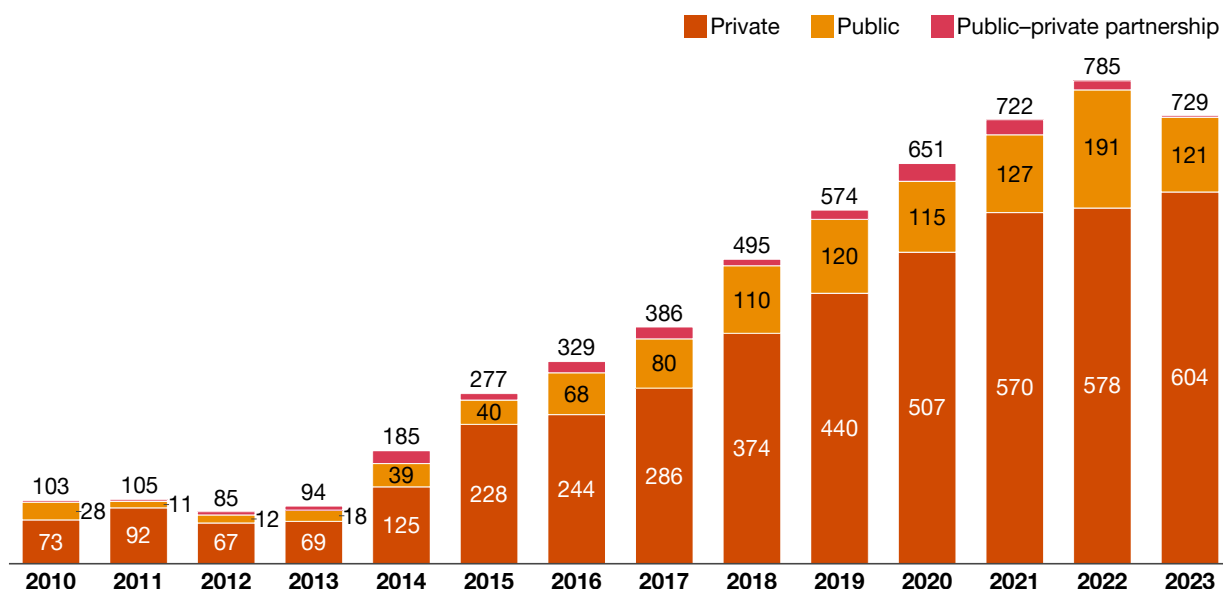
But just scaling up renewable generation is not enough. Other gaps in the world's energy infrastructure must also be bridged. Five of these gaps could offer significant potential to long-term investors:

- **Mass electrification.** Electrification continues to spread as a decarbonisation measure, but there is still a long way to go before reaching net-zero objectives. Increasing demand for electric cars, electrified residential areas and electric-powered industrial production are major contributors to this trend.
- **Power demand for digital infrastructure.** Technological developments such as AI and cloud computing are prompting an increase in global energy demand. This means that the energy transition will need not only to replace the existing supply but also to produce more than the current global output.

- **Power-grid expansion.** Current electrical grids are not suited to a future where renewable energy is the predominant power source. They were initially developed to support large, centralised power stations and long-distance transmission rather than renewable-energy sources, some of which may be decentralised.
- **Access to critical minerals.** The demand for battery metals (e.g., lithium, cobalt and nickel) is rising sharply, fuelled by increasing competition among automakers and volatile raw-material costs, while the electrification of energy systems is amplifying the demand for copper.
- **The storage gap.** Renewable energy sources do not produce a constant stream of energy due to fluctuations in weather conditions. Batteries are therefore expected to become primary storage solutions.

The energy transition has become a more appealing investment theme among private-sector investors. Indeed, global private investments into the infrastructure underpinning the energy transition increased more than eightfold between 2010 and 2023, from US\$73 billion to US\$604 billion. This level of private investment surpasses the US\$121 billion of public investment in energy-transition infrastructure in 2023 (Figure 3).

Figure 3. Global investments into the infrastructure underpinning the global energy transition (US\$ billion)



Source: PwC Global AWM & ESG Research Centre, IJ Global



Recent academic research has shown that investments in the energy transition can potentially generate attractive returns and bring about a host of benefits. For instance, a March 2021 joint report by the IEA and the Centre for Climate Finance & Investment at Imperial College London analysed and compared the financial performance of publicly traded fossil fuel and renewable energy companies over five- and ten-year periods (up to end December 2020), calculating the total returns and annualised volatility of portfolios across four regions (global markets, advanced economies, emerging markets and developing economies, and China).

The report found that across all the portfolios analysed, ‘renewable power generated higher total returns relative to fossil fuel’ and that ‘the global renewable power portfolio was observed to be less correlated to the broader market than the global fossil fuel portfolio’. These findings hint that renewable energy investments bring a ‘potential diversification benefit’.⁶

A subsequent report from March 2022 focused on unlisted renewable energy assets and examined their risks and returns in global markets, emerging markets and developing economies. The report determined that, over the past ten years, ‘unlisted renewable assets outperformed the broader unlisted infrastructure assets, as well as the listed market benchmark’ used in the study (MSCI ACWI) ‘at a diversified index level’. Moreover, the report found, ‘Unlisted renewables exhibited lower volatility than unlisted infrastructure and the listed benchmark over the past ten years at a diversified index level.’⁷

However, when considering energy-transition investment returns, it is important to be cautious as the sector is still evolving, and institutional investors—although present in the segment for some years now—have only recently begun accelerating their capital deployment towards it. For instance, a recent paper by the EDHEC Infrastructure & Private Assets Research Institute found that the ten-year annualised total returns of green and brown power projects in 2021 ‘were 16% and 17% respectively’. Noting that ‘persistent shifts in investor preferences’ can impact asset prices ‘as the demand for these assets changes and supply responds’, the paper also found that green infrastructure outperformed the ‘core’ infrastructure market over the past decade. This outperformance is largely due to the ‘excess demand for such assets that has pushed asset prices up and discount rates down’.⁸

Overhyping returns can lead to unrealistic expectations. Moreover, infrastructure assets—within and outside the energy-transition umbrella—can face significant challenges before they get off the ground. From high upfront costs to cost overruns and potentially lengthy delays (e.g., due to complicated permitting processes), the hurdles can be immense. That is why long-term investors with the ability to look at an asset’s whole life cycle are particularly well-positioned to invest in the energy transition.

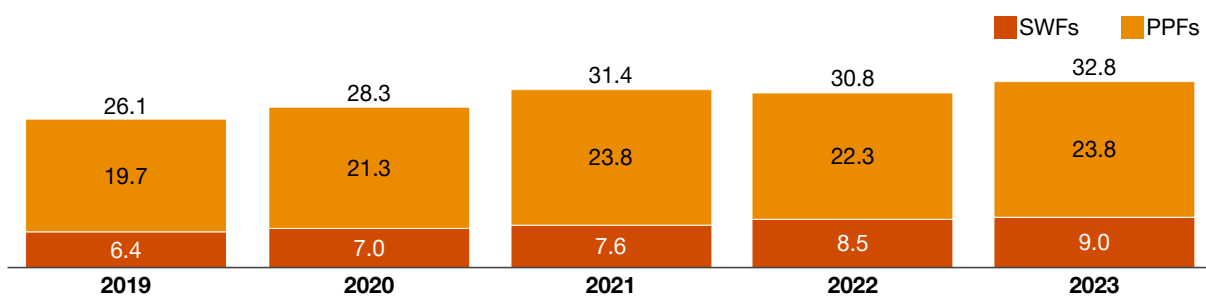
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The current role of long-term investors in the global energy transition

At the end of 2023, the combined assets under management (AuM) of SWFs and PPFs worldwide amounted to US\$32.8 trillion (Figure 4). North America has the largest concentration of PPF assets, with the region's 111 PPFs holding around US\$12.8 trillion in AuM (Figure 5).⁹

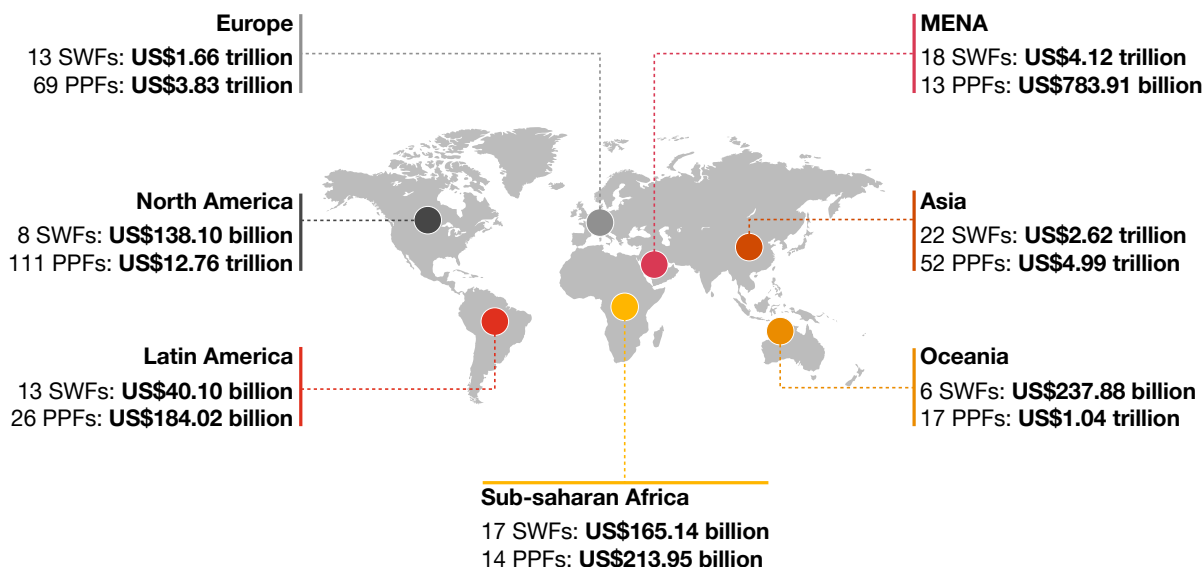
Over the last few years, these long-term investors—particularly the large PPFs—have increased their infrastructure allocations. Indeed, after PPFs from Australia and Canada pioneered pension fund investments in infrastructure in the 1990s,¹⁰ a growing number of PPFs from other advanced economies, such as those in South Korea and the Netherlands, followed suit.¹¹

Figure 4. Sovereign wealth fund and public pension fund global assets under management (US\$ trillion)



Source: PwC's Global AWM & ESG Research Centre. Data for SWFs retrieved from IFSWF's database. Data for PPFs are estimates based on publicly accessible data and documents.

Figure 5. Number of sovereign wealth funds and public pension funds and their estimated assets under management across the world

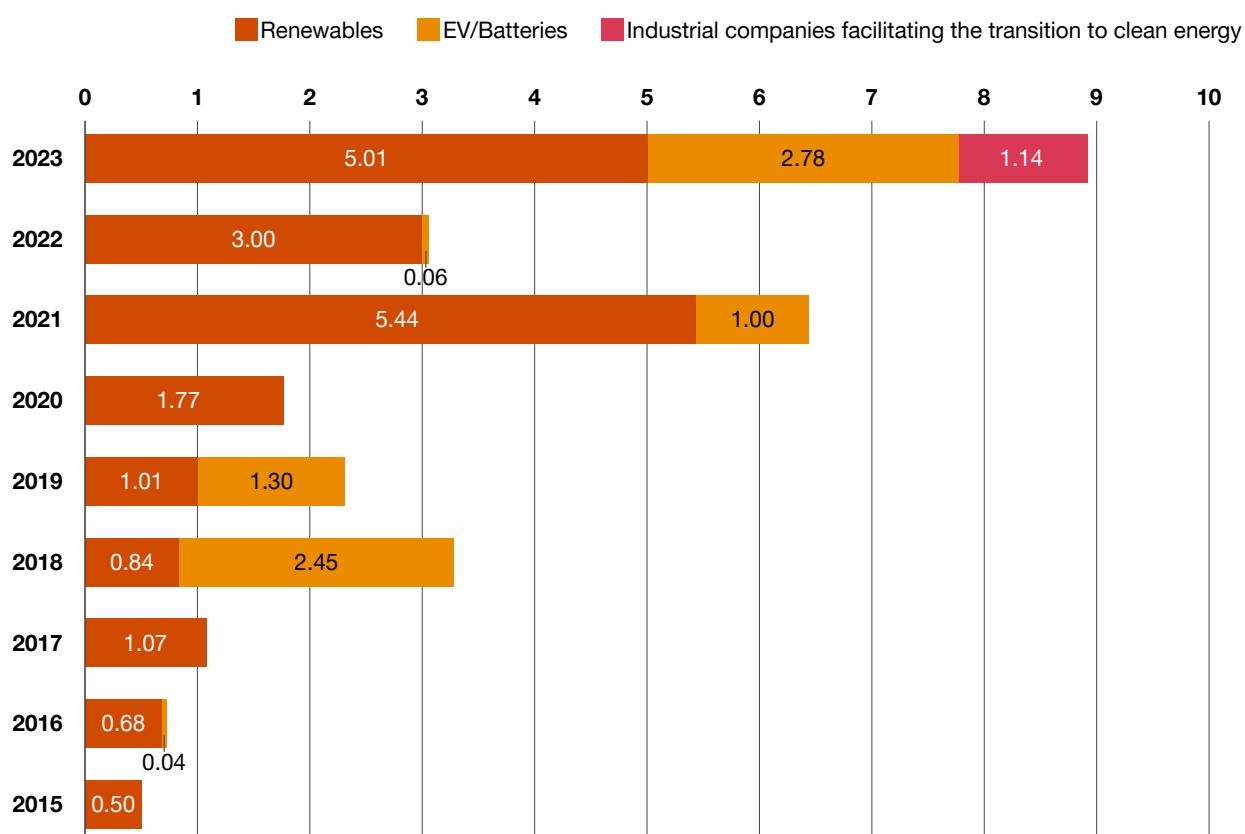


Note: All AuM figures are as of the end of the calendar year 2023. Source: Data for SWFs retrieved from IFSWF's database. PPFs data is based on publicly accessible data and documents.

In its 2022 annual review, the International Forum of Sovereign Wealth Funds (IFSWF) stated, ‘The environment for [renewable energy] projects may be becoming more favourable in the coming years following the passing of the US Inflation Reduction Act [...] and the imminent EU Net-Zero Industry Act.’¹²

This statement proved to be prescient. As Figure 6 shows, SWF investments in renewable energy projects jumped from US\$3 billion in 2022 to US\$5.01 billion in 2023. In addition, investments in other facets of the energy transition—such as companies involved in energy efficiency—reached US\$1.14 billion, while investments in electric vehicles (EVs) and batteries also shot up to US\$2.78 billion, from negligible amounts in 2022.

Figure 6. SWFs’ direct investments in climate opportunities (US\$ billion)



Note: Starting in 2023, the ‘industrial companies facilitating the transition to clean energy’ sub-sector was added, which includes any company within the industrial sector that facilitates the transition to cleaner energy (e.g., companies involved in producing or operating heat pumps, carbon capture technology, etc.).

Source: Data retrieved from IFSWF

34.5%

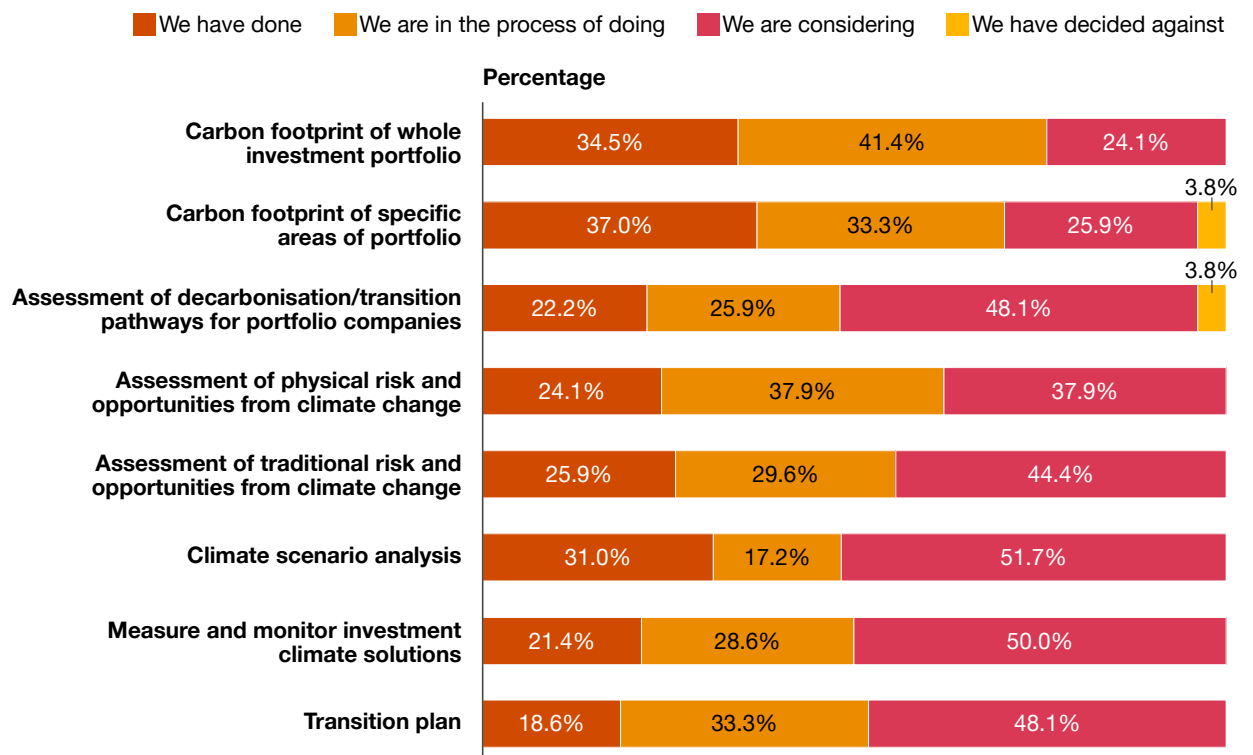
of SWFs have already assessed the carbon footprint of their whole investment portfolio, while 41.4% are in the process of doing so.

Enabling policy and regulatory frameworks are an important factor in propelling the energy transition. Indeed, IFSWF's 2023 annual review states that, following the launch of the Inflation Reduction Act, SWFs showed

'a particular interest in American industrials' and the act was effectively 'a catalyst for many long-term investors to look at the US industrials market, foreseeing significant implications for both the domestic and global economy'.¹³

Moreover, the latest edition of the IFSWF and One Planet Sovereign Wealth Fund (OPSWF) joint annual survey on how SWFs view and address climate change found that SWFs are increasingly paying close attention to climate-related risks and opportunities within their portfolios. Indeed, 34.5% of SWFs have already assessed the carbon footprint of their whole investment portfolio, while 41.4% are in the process of doing so. Meanwhile, almost one in five (18.6%) already has a transition plan, while one-third (33.3%) are in the process of establishing one (Figure 7).¹⁴

Figure 7. SWFs are paying attention to climate-related risks and opportunities



Note: Respondents were asked, 'Have or assessed or are you in the process of assessing the climate-related risks and opportunities in your portfolio?' (multiple-choice question).
 Source: IFSWF and OPSWF, 'Powering Change: Building Resilience in a Transforming Climate,' 2023



The trajectory over the past decade is clear: SWFs are increasingly investing in the energy transition. As per the IFSWF–OPSWF survey, a growing number of them are using tools such as climate-scenario analysis to monitor the impact of their investments on the climate, and they are becoming increasingly sophisticated in understanding climate financing.

This trajectory is echoed in OPSWF’s Framework Companion Document of 2023.¹⁵ The 6th Annual OPSWF CEO Summit in June 2023 highlighted an SWF landscape characterised by ‘visible commitments and results, with efforts and resources scaled up to advance the Framework’s principles and thus the goals of the Paris Agreement’. The high-level summit yielded progress on advancing three priority workstreams directly and

indirectly related to the energy transition, namely: the harmonisation of climate data for private markets; the acceleration of investments toward clean hydrogen; and the acceleration of investments toward renewable energy in emerging and developing economies.

The trajectory over the past decade is clear: SWFs are increasingly investing in the energy transition.

3

Focus areas for long-term investors



There are several factors that long-term investors will need to consider if they seek to be catalysts for change in the energy transition, particularly given the substantial investment gap, which is larger in developing countries than in developed ones.

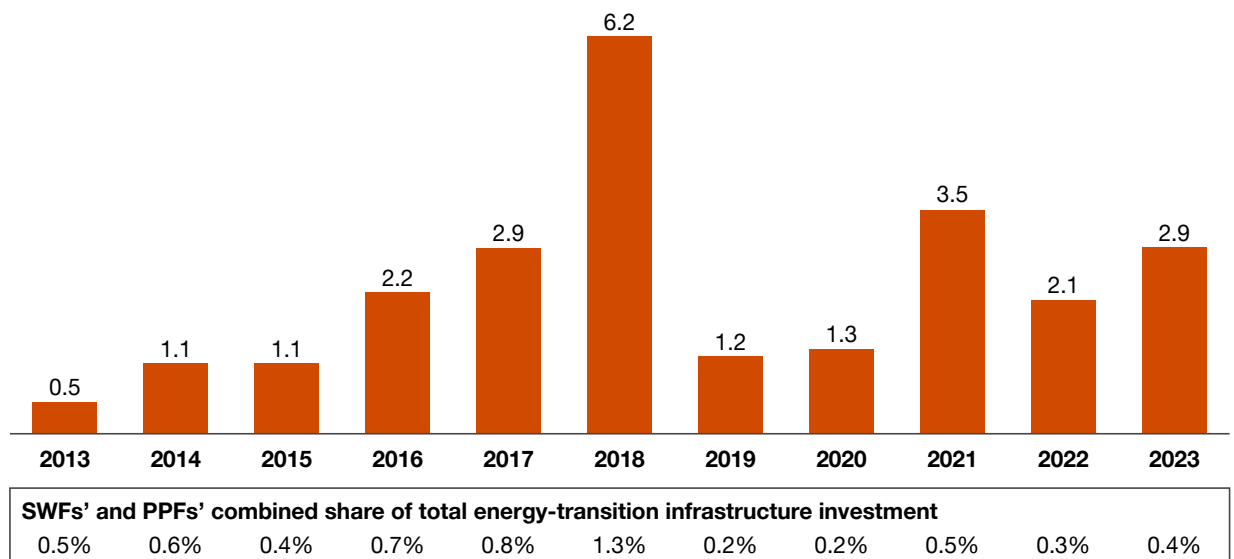
The perceived multifaceted risks of investing in these markets make it difficult for project owners to attract capital, including from long-term investors. Risks include

financial risk, geopolitical considerations, a lack of adequate data and policy limitations.

SWFs' and PPFs' funding gap

In 2023, only 0.4% of global investments in energy-transition infrastructure (US\$2.9 billion out of US\$729 billion) came from SWFs and PPFs (Figure 8).

Figure 8. Global energy-transition infrastructure investments by SWFs and PPFs (US\$ billion)



Source: PwC's Global AWM & ESG Research Centre, IJ Global

Emerging markets

Renewable-energy projects tend to be financed by a combination of debt and equity upfront. Returns only materialise once energy production starts and the facilities are connected to the grid. Consequently, raising debt to finance energy-transition projects in developing economies can be challenging: these countries do not receive the amount of private investment needed due to perceived risks, such as political uncertainty, bureaucratic hurdles, unclear and rapidly changing regulations, financial instability and currency fluctuations.¹⁶

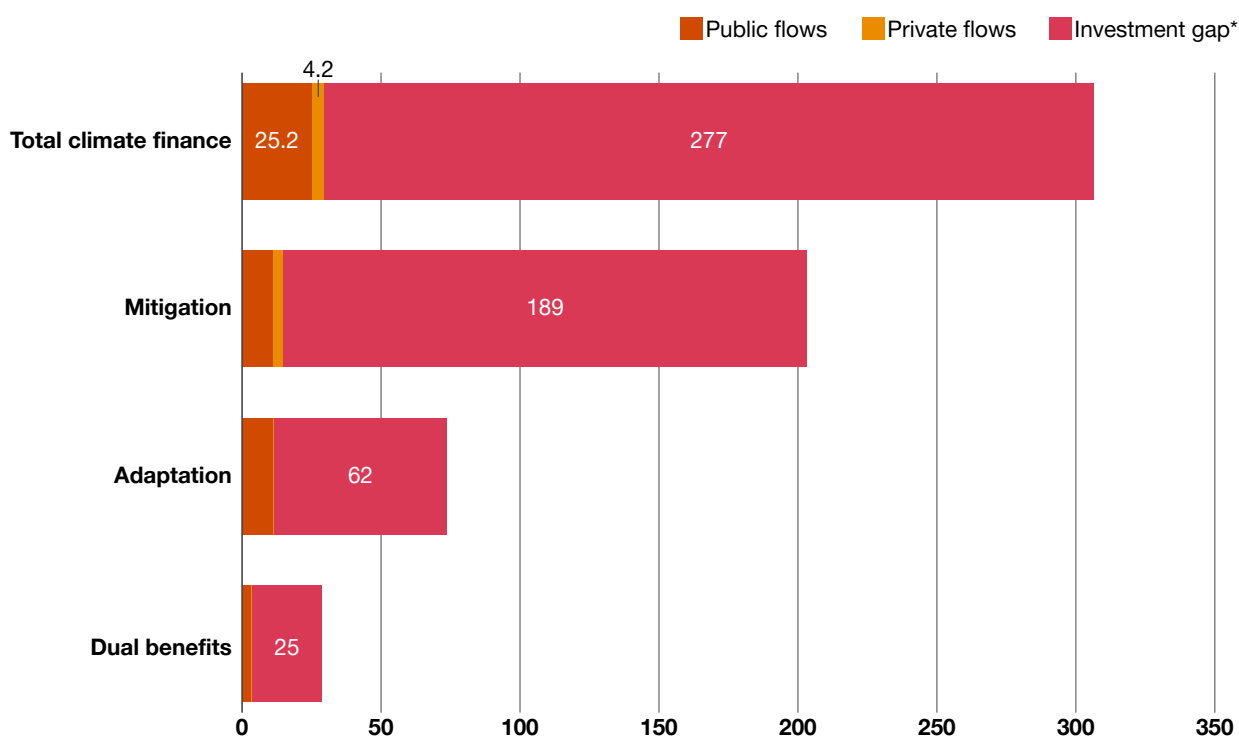
Sustainable infrastructure in developing economies is a potential missed opportunity for long-term investors. A March 2022 study by the IEA and Imperial College London found that the financial performance of unlisted renewable-energy assets in emerging markets and developing economies was higher than for those in global markets. Whereas unlisted renewables in emerging markets and developing economies saw a total return of 299% over a nine-year period, those in global markets saw a total return of 277% over a ten-year period. However, during the same time, the former showed higher annualised quarterly volatility (19.7%) than the latter (10.9%).¹⁷

Developing economies (not including China) will need between US\$1.4 trillion and US\$1.9 trillion per year by 2030 to follow the net-zero-by 2050 trajectory.¹⁸ However, only around US\$236 billion of the total US\$1.7 trillion in energy-transition-related investments in 2023 went to emerging markets and developing economies besides China.¹⁹ These figures quantify the investment gap in these countries, highlighting the need for more large-scale financing directed to clean energy.

Africa is one of the regions with a significant investment gap. Together, all the countries on the continent need US\$277 billion each year until 2030 to meet their nationally determined contributions under the Paris Agreement. However, Africa receives only US\$30 billion in investment a year, mostly from public sources (Figure 9).²⁰

Without substantial international financial support, African countries struggle with the upfront costs of the energy transition, often paying more for electricity and lacking access to energy-efficiency projects. A vicious cycle ensues where they remain reliant on costly, economically volatile and ecologically harmful fossil fuels.²¹

Figure 9. Private and public climate-finance flows in Africa vs. total cost by climate use (US\$ billion)



Note: 'Investment gap' refers to the costs of nationally determined contributions under the Paris Agreement.
Source: PwC's Global AWM & ESG Research Centre; Climate Policy Initiative, 'Landscape of Climate Finance in Africa'.

Box 1. The untapped potential of the energy transition in West Africa

According to the International Renewable Energy Agency (IRENA), West Africa alone is estimated to have a potential of '1,956 GW for power, 106 GW for wind, and 162 GW for hydropower, with peaks in Mali for solar and in Nigeria for hydropower'.²² Such capacity 'could meet the basic energy needs of [the region's] population' but its renewables-based installed capacity stands close to just 7 GW.²³

By investing in low-carbon infrastructure projects from inception and acting as a bridge between the private and public sectors, long-term investors such as SWFs and PPFs can use their government connections to become early investors in renewable-energy projects in developing countries.

This connection to governmental bodies is crucial as it signals that public sector support for energy-transition

projects is available, which contributes to making these projects less risky in the eyes of private-sector investors. In addition, the substantial initial capital inflows from SWFs and PPFs, coupled with the fact that they tend to have advanced risk-management processes, can encourage other investors to see the projects in a more favourable light.

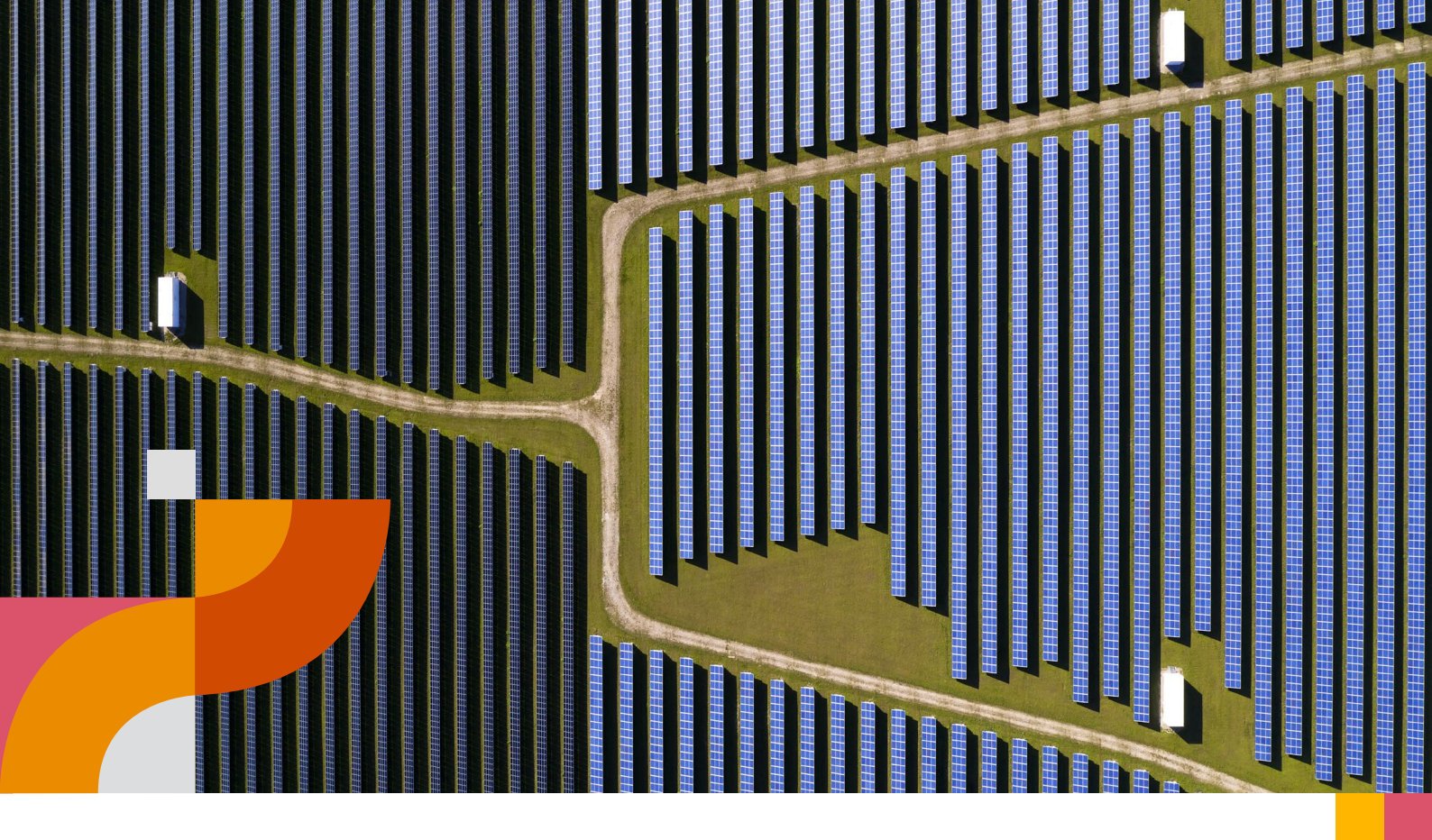
Box 2. The Asian Development Bank's Energy Transition Mechanism

The Asian Development Bank (ADB) is a multilateral development bank established in 1966. Its flagship Energy Transition Mechanism (ETM) is 'a scalable, collaborative initiative' that leverages 'a market-based approach to accelerate the transition from fossil fuels to clean energy'. By leveraging investments from public and private sources, including long-term investors, the ADB finances 'projects and country-specific ETM funds to retire coal power assets' and promotes 'a just energy transition to protect the livelihoods of workers and communities affected by the shift to clean energy'. Ultimately, the ETM seeks to accelerate the energy transition in the APAC region by unlocking a host of investment flows.²⁴

Box 3. The Indo-Pacific Economic Framework for Prosperity

The Indo-Pacific Economic Framework for Prosperity (IPEF) was launched by the United States in May 2022. It aims to enhance economic cooperation and foster sustainable growth across the Indo-Pacific region. It has been designed to address pressing global economic challenges while promoting inclusive development and regional stability. The framework emphasises innovation, infrastructure development and sustainable practices, reflecting the diverse economic landscapes of its member states.²⁵

The IPEF operates through a multifaceted structure designed to facilitate seamless cooperation among its member countries through policy dialogue, collaborative projects, research and development, and regulatory harmonisation. By leveraging strategic collaborations with entities such as private equity firm KKR and Singapore's Temasek Holdings,²⁶ the IPEF aims to raise capital to foster inclusive growth, drive innovation and sustainability, and enhance economic integration within the Indo-Pacific region.



Box 4. The Mission 300 Initiative

The Mission 300 (M300) is an initiative championed by the Rockefeller Foundation that was launched in 2024 and backed by the World Bank and the African Development Bank. The initiative aims to bring electricity access to 600 million people in sub-Saharan Africa, with approximately half connected to the electricity grid by 2030.²⁷

However, the scale of this challenge should not be underestimated, given that development banks in the region are unable to provide all the necessary financing. As the initiative is targeting a US\$90 billion investment, the participation of private-sector investments will be instrumental to its success.²⁸

Box 5. Bloomberg Philanthropies Foundation

Bloomberg Philanthropies is a foundation that supports both developed and developing economies in the areas of arts, education, public health, government innovation and the environment.

In the past few years, this foundation has announced several initiatives aimed at decarbonising the global economy, including funding energy transition projects in emerging markets. One is the Climate Innovation and Development Fund (CIDF), which was launched with the Asian Development Bank in 2021 and led to US\$500 million of investments in sustainable and low-carbon solutions across South and Southeast Asia.²⁹

Barriers that deter energy-transition investments

While many policy and macroeconomic changes could help long-term investors in their energy-transition-related endeavours, they are not the focus of this paper. Instead, this paper summarises the potential challenges that SWFs and PPFs face when investing in the energy transition. The most common include the following:

- **Financial risks.** The cost of capital for the energy transition varies significantly between advanced and emerging economies, which makes it difficult for capital from risk-averse long-term investors to flow towards the energy transition in emerging economies.
- **Geopolitical considerations.** The rise of trade barriers and international decoupling over the past decade has had destabilising effects on the world economy, and long-term investors must account for the geopolitical impact of their investments.
- **Policy factors.** Government policies and requirements (e.g., lengthy and complex permitting procedures that significantly delay projects) can inadvertently hinder long-term investors' energy-transition endeavours.
- **Data issues.** The lack of standardised data on energy-transition metrics makes it difficult for institutional investors to measure the climate impact of their investments accurately. Without data, SWFs and PPFs may be reluctant to allocate substantial resources to the energy transition, fearing that they cannot adequately gauge the risks and returns involved.

Box 6. OPSWF's One Planet Climate Disclosure Guidance for Private Markets

According to State Street Global Advisors, SWFs owned 'roughly 16% of global [private equity] assets under management' in 2020.³⁰ Given this volume, SWFs are well-positioned to play a key role in promoting ESG principles in private markets to manage risks and unlock value-creation opportunities.

OPSWF acknowledges this opportunity and has developed the One Planet Climate Disclosure Guidance for Private Markets to address specific data gaps that hinder energy-transition investments. This guidance, designed to complement existing climate-reporting frameworks, is tailored to asset managers operating within private markets. OPSWF ultimately aims for this guidance to foster and accelerate climate-data disclosures across private markets: 'Increased disclosure will enable and increase market integration of quantitative climate analysis into investment processes and drive more informed decision-making.'³¹

4

Investment approaches for the energy transition



Despite the challenges, there are also many opportunities that the energy transition brings. This chapter discusses the investment approaches in detail.

Investment approach 1: Trailblazer

In the **trailblazer approach**, long-term investors use their depth of human and technical resources alongside their capital to think differently about problems and pioneer new and innovative investment theses and solutions. In the context of the energy transition, this would entail analysing issues such as regulatory risk, country risk and market risk in a way that would encourage long-term investors to assess the risk and return characteristics of an investment more favourably.

For example, they could consider investing in energy-transition projects in emerging economies where governments are encouraging such investments through regulatory and policy changes, but which private investors have avoided due to perceived risks.

Unrestricted by their investment horizon, long-term investors such as SWFs and PPFs can gain the first-mover advantage. An energy-transition project successfully delivered in an emerging economy would have a triple benefit: increased probability of hitting a

higher return quicker; ability to sell down in the future at a gain; and, more broadly, the capacity to trailblaze a path to show others how to do it. These long-term investors can then continue to shape new markets and investment theses to push forward the energy transition.

These investors' government relationships and backing help increase cooperation with other investors, MDBs, DFIs and philanthropies. This is key to de-risking and advancing energy-transition infrastructure projects, particularly in emerging economies: private investors would view such collaborations with esteemed global institutions in a positive light and feel encouraged to embark on such projects themselves.

This approach allows trailblazing long-term investors such as SWFs and PPFs to unlock new opportunities and potentially reap higher initial returns. In addition, they chart a path forward for other long-term investors who might be wary of (or might not have considered) investments in the energy transition, in both advanced and emerging economies.

The Masdar case study shows how long-term investors can use the trailblazer approach to stand out from the pack and mobilise different partners and investors to advance the energy transition worldwide.

Case study: Masdar

In 2006, the government of the United Arab Emirates (UAE) founded the **Abu Dhabi Future Energy Company (Masdar)**, a long-term investor with a mandate to diversify the UAE's economy away from fossil fuels by developing and investing in the energy transition, both at home and abroad. Today, its three shareholders are UAE state-owned companies: the Abu Dhabi National Oil Company (ADNOC), the Mubadala Investment Company and the Abu Dhabi National Energy Company PJSC (TAQA).

Masdar has been among the first movers for several renewable technologies, including Scotland's Hywind, the world's first floating offshore wind farm, and Spain's Gemasolar, the only utility-scale solar power plant in the world to combine a central tower receiver system and molten-salt-storage technology. Masdar has also invested in London Array, the world's largest wind farm (as measured by number of turbines), and has invested in and developed the first wind farms in countries such as Serbia, Jordan, Senegal and Uzbekistan.

Projects in Indonesia

Masdar has invested in and developed Indonesia's Cirata Floating Photovoltaic (FPV) plant, the largest such plant in Southeast Asia. Floating solar plants are an attractive proposition for countries like Indonesia, the world's largest archipelago, with expanding populations and scarce land resources. However, the 145 MW Cirata plant presented several challenges. The reservoir has a depth of up to 110 meters with extreme slopes of as much as 40 degrees. Alongside its partner, PT PLN Nusantara Renewables, Masdar had to develop separate anchoring systems for areas with steep slopes and those with less-steep slopes.

The process was a learning experience for both the companies and the Indonesian government. The project helped create a blueprint for the government to upgrade regulations and introduce new laws for more solar-power plants. This included a regulatory change from the Ministry of Public Works and Housing that allowed up to 20% of water surface coverage to be used for renewable-energy purposes. This has enabled Masdar and PLN to move ahead with plans to triple the Cirata plant's capacity, which would make it the largest floating solar plant in the world. The project also inspired a floating-solar guidebook produced by the government.

Projects in Uzbekistan

Masdar took the knowledge it gained in more mature markets, with more advanced deployment of renewable energy, and applied it to the development of the Shams concentrated solar power plant in Abu Dhabi, the largest renewable energy project in operation in the Middle East at the time of its launch in 2013. Since then, Masdar has successfully replicated this blueprint across other markets and territories, marrying sovereign wealth with an entrepreneurial approach and a willingness to adopt innovation.

In 2019, Uzbekistan announced plans to develop 5 GW of renewable energy by 2030 to diversify the country's energy mix. Of this, up to 1 GW would be solar power. Masdar's first step in supporting this strategy was to design, finance, build and operate the 100 MW Nur Navoi solar plant. By that point, Masdar had also signed a Power Purchase Agreement (PPA) and Investment Agreement to design, finance, build and operate the 500 MW utility-scale Zarafshan wind farm, the largest in the region. In closing the US\$275 million financing for Zarafshan, Masdar was able to arrange a financing solution not just with DFIs but also, thanks to the support of Etihad Credit Insurance, with commercial banks such as First Abu Dhabi Bank and Natixis.

This was the first time commercial banks participated in financing a greenfield renewable-energy project in Central Asia, a unique achievement with the potential to be a game-changer, enabling access to commercial lending in other developing markets around the globe.

Masdar continues to play a role as a catalyst for renewable energy development. For example, it signed an agreement with Kazakhstan at COP28 in 2023 to develop a 1 GW wind and 300 MWh battery energy storage system (BESS) project.

Investment approach 2: The whole-of-life

Asset managers run a set of funds and portfolios, each of which may have different investors, target markets and return profiles. It can be challenging for managers to move assets between different portfolios since investors vary in terms of capital allocation, investment preferences and risk profiles, and they may perceive that doing so may not be at fair market value.

When it comes to energy-transition assets, different risks can materialise throughout an asset's life cycle, which further complicates matters for asset managers. For instance, in the early stages, the risks would be similar to those faced by private equity or venture capital investors, such as risks linked to early-stage technology (e.g., green-hydrogen assets) or other risks generally associated with the early stages of an asset (e.g., acquiring land suitable for a solar photovoltaic project).

But over the course of their life, energy-transition assets generally become less risky. The planned solar photovoltaic project could successfully move through development or the technology underpinning an asset could mature. The risk-return profile of these assets would then be more appropriate for an infrastructure fund

rather than a private equity or venture capital fund that would incubate them. However, moving assets between funds can be a very challenging and cumbersome procedure for asset managers.

Conversely, long-term investors such as SWFs and PPFs generally do not have specific mandates beyond the requirement to generate strong returns over the long term and often do not face restrictions around which investments are suitable.

In the **whole-of-life approach**, long-term investors such as SWFs and PPFs think differently to asset managers: they assess an energy-transition asset throughout its life cycle in search of risk-adjusted returns. In other words, the constraints that private-equity, venture-capital or infrastructure funds might face when investing in the energy transition may not apply to a SWF or a PPF. Additionally, these investors may recognise the long-term growth and revenue potential of these assets, which can span the entire energy-transition supply chain.

The following two case studies present examples of how risk-adjusted returns can be considered throughout an asset's life cycle.





Case study: GIC

Founded in 1981, **GIC** is one of Singapore's two SWFs. GIC has a broad investment scope in terms of asset classes and geographies. In recent years, it has carried out several energy-transition-related investments in both developed and developing countries:

- In 2016, GIC acquired a majority stake in **Greenko Energy Holdings**, a renewable energy company in India, with an initial capital injection aimed at supporting the development of new renewable-energy projects, such as low-risk expansions to existing wind farms.³² Today, Greenko has assets across 14 Indian states and, with a 57.1% stake, GIC holds several seats on the company's board of directors. It is heavily involved in the company's strategy, investment plans, risk management and operations.³³
- In 2020, GIC began acquiring a minority stake (17.5%) in **ACEN Corporation**, a renewable energy platform owned by the Ayala Group, one of the largest conglomerates in the Philippines. With the company's 'geographically diversified portfolio of renewable energy assets and proven track record of profitable growth', alongside the fact that it 'is well-positioned to capture the shift from fossil-based to clean and sustainable energy in [Southeast Asia]', GIC's investment seeks to support the company in its 'journey to build one of Southeast Asia's leading renewable platforms'.³⁴ ACEN operates solar plants and wind farms in the Philippines, Australia, Vietnam, India, Indonesia and the United States, with a total capacity of 4.8 GW. It recently set an ambitious target of 20 GW by 2030.³⁵
- In July 2021, GIC announced it would invest US\$240 million in **Arctic Green Energy**, an Iceland-based firm focused on decarbonising the building sector through geothermal energy.³⁶ GIC considers this as setting the stage for 'an ambitious strategic alliance set to drive the uptake of zero-carbon district heating in Europe and Asia', which will support the expansion of the company in these regions.³⁷ Arctic Green Energy had already formed a joint venture with state-owned China Petroleum & Chemical Corp (Sinopec) called **Sinopec Green Energy**, focused on geothermal heating and cooling across Chinese cities and municipalities,³⁸ in which GIC acquired a minority stake in late 2020.³⁹
- In March 2023, GIC committed to investing over US\$1 billion in Spain-based **EDP Renovaveis (EDPR)**, the renewable-energy company within the Portuguese electric utilities firm EDP. The acquisition aims to support EDPR's energy-transition objectives across Europe via new solar and wind projects.⁴⁰ This investment 'aligns with GIC's commitment to enable the global transition to a net-zero economy', particularly given EDPR's 'global presence, strong project development capabilities and diversification across renewable technologies'.⁴

Case Study: Canada Pension Plan Investments

The Canada Pension Plan is a PPF with assets that have been managed by the **CPP Investments** since 1997. As part of its mandate, CPP Investments seeks to maximise the value of the Canada Pension Plan in the long term while taking on ‘an appropriate amount of risk to benefit from global economic growth and other return generators’.⁴²

According to CPP Investments’ 2024 Policy on Sustainable Investing, one of its guiding principles in climate change includes ‘accelerating the global energy transition’ which ‘requires a sophisticated, long-term approach rather than blanket divestment’.⁴³ This language demonstrates how CPP Investments is pursuing active energy-transition-related investments as part of its strategy.

At the end of March 2023, it held around US\$57.5 billion (C\$79 billion) in energy-transition assets, and it plans to increase this figure to US\$94.7 billion (C\$130 billion) by 2030.⁴⁴ This is a significant chunk of CPP Investments’ total AuM, which stood at US\$467 billion as of August 2024.

In recent years, CPP Investments has made several energy-transition-related investments, which are geared towards the long term and are expected to generate risk-adjusted returns throughout the holding period. These investments include:

- In May 2024, CPP Investments and Global Infrastructure Partners (GIP) partnered together to acquire **ALLETE**, a US energy provider headquartered in Minnesota ‘focused on driving the clean-energy transition by expanding renewables, reducing carbon, enhancing grid resiliency, and driving innovation’. The total transaction value is estimated to be US\$6.2 billion and will help the company realise its clean-energy ambitions and energy-transition plans. Moreover, it will contribute to the company’s long-term strategy of emerging as a leader in clean-energy solutions with a commitment to a clean-energy future.⁴⁵
- In 2023, CPP Investments invested US\$40 million in **Redwood Materials Inc.**, a US company developing circular supply chains for batteries. The company believes that, ‘In the coming decades, all transportation will be electric and all electricity will be sustainable,’ which is why it is ‘creating a closed-loop supply chain for electric vehicles and energy products, making them truly sustainable and continuing to drive down the costs for batteries’.⁴⁶ In total, CPP Investments has invested US\$150 million in Redwood Materials.
- In September 2022, IKAV, a German asset-management firm focused on renewable energy investments, announced that it sought to acquire **Aera Energy LLC**, an energy company in California. In February 2023, CPP Investments agreed to purchase 49% of the company from IKAV. While Aera Energy is the second-largest oil and gas producer in California, CPP Investments’ purchase seeks to support that state’s transition to renewable energy while simultaneously delivering long-term risk-adjusted returns. Ultimately, CPP Investments and IKAV seek to balance Aera’s energy-transition efforts with conventional energy demands of California ‘by investing in a renewable energy portfolio that will power Aera’s existing operations’. Over the coming years, the company’s legacy oil and gas infrastructure will be repurposed for carbon capture and storage.⁴⁷
- In May 2024, CPP Investments invested US\$135 million in **Enfinity Global**, a US-based renewable-energy company that develops, finances, builds, operates and owns renewable-energy assets in Europe, Asia and the United States. The investment seeks to help the company install solar farms in five Indian states to produce a total of 1.2 GW of power. These projects are already ‘in advanced stages of development and are expected to be commissioned between 2025 and 2026’. According to CPP Investments, ‘solar and wind power are two vital renewable energy sources and India offers a strong pipeline for such opportunities’, and the partnership with Enfinity Global ‘will provide a promising source of long-term returns for the CPP Fund’.⁴⁸



Investment approach 3: Blended finance

Blended finance structures emerged in the mid-2000s to jointly mobilise private capital and financing from MDBs, DFIs and other foundations and philanthropies to further socioeconomic-development objectives while providing returns.

For instance, in a blended-finance debt fund, riskier funding would be provided by the MDBs and DFIs, alongside other public entities. These investors would provide concessional financing as part of the capital stack to get the project off the ground.⁴⁹ This would then be blended with other private capital to complete the funding.

Long-term investors such as SWFs and PPFs have not made much use of blended finance, which is a missed opportunity as it offers an avenue for them to collaborate with MDBs, DFIs and private capital to simultaneously mobilise financing for the energy transition and earn potentially attractive returns.

Blended finance can thus ‘align the interests of public and private sectors and allocate risks to each party according to their ability to manage and mitigate them’⁵⁰ and it offers several benefits for addressing the energy transition. These include:

- **Mitigating risk.** Certain long-term investors can absorb initial losses through subordinated tranches in investment structures, enhancing the risk-adjusted returns for non-concessional capital. This approach helps mitigate apprehensions regarding early-stage technologies.
- **Leveraging public funds.** Limited public resources can be leveraged by attracting a larger proportion of private investment, which could help advanced economies fulfil their climate-related commitments to emerging and developing economies. This is particularly relevant given that a growing number of developed countries are making pledges to support emerging economies financially in their climate-change mitigation and adaptation efforts.
- **De-risking developing markets.** Energy-transition investments from governments, MDBs, DFIs, foundations and philanthropies through blended-finance structures can lessen the perceived risk of these projects in emerging economies, encouraging private investors to participate. This de-risking function is crucial to addressing the investment gap in these regions.

The following case study demonstrates how a long-term investor uses blended finance structures to invest in and advance the energy transition.

Case study: Temasek Holdings

Established by the Singaporean government in 1974 to manage state-owned corporations, Temasek is a single-asset class long-term investor, investing only in equity.

In December 2023, Temasek established a green investment partnership with Allied Climate Partners (a philanthropic investment organisation), the International Finance Corporation (part of the World Bank Group) and the Monetary Authority of Singapore (the central bank of Singapore). The partnership aims to increase the amount of energy-transition investment in Asia, particularly Southeast Asia.

Temasek strongly advocates using blended-finance structures to finance the energy transition and attract private investors, and has several investment platforms aimed at providing such solutions.⁵¹ These include:

- **Pentagreen Capital** is a sustainable infrastructure debt-financing platform jointly established by Temasek and HSBC. Its primary goal is to provide blended-finance solutions to de-risk sustainable infrastructure projects in Asia. In September 2023, it signed an agreement with Citicore Renewable Energy Corporation, a Philippines-based power generation company, to close a US\$30 million funding gap needed to install solar farms in the Philippines with an output of 490 MW. It did so by structuring a US\$100 million mezzanine green loan for construction; the initial tranche was worth US\$30 million. Through this project, Temasek hopes to attract US\$300 million of additional funding to the project and increase Citicore's power output to 1 GW.⁵²
- **Clifford Capital Holdings (CCH)** is a company that aims to secure debt financing for the infrastructure and maritime sectors. Temasek is one of its largest shareholders, alongside Canadian insurance firm Manulife and the Asian Development Bank. In July 2024, CCH and Pentagreen agreed to provide US\$30 million in loans to BECIS Bioenergy, an energy-as-a-service provider based in Singapore, to finance agricultural installations in Indonesia, Thailand, Cambodia, the Philippines and India.⁵³ The project converts agricultural waste into livestock feed, avoiding over 114,000 tons of CO₂ emissions a year.



Conclusion

As the impacts of climate change become increasingly apparent, the global energy transition is a critical challenge and opportunity for long-term investors, particularly SWFs and PPFs. The shift from using energy generated by fossil fuels to using renewable energy sources is an environmental imperative and a key driver of economic growth, technological innovation and geopolitical realignment.

Government spending alone cannot build a low-carbon energy system. Despite considerable advances in renewable-energy availability, there is a pressing need for more coordinated and substantial funding efforts. Public-private collaboration, alongside innovative financing mechanisms, will be essential to mobilise resources and drive the energy transition effectively.

While long-term investors such as SWFs and PPFs have consistently made strides to support the global energy transition, the amount of financing they are allocating to the energy transition—particularly towards bridging the energy-infrastructure gap—falls significantly short of what is required. However, with their strategic long-term investment horizon and ability to de-risk projects in emerging economies, long-term investors are well-positioned to attract additional private investors and bridge the financing gap.

From making direct infrastructure investments in emerging markets to supporting early-stage technological solutions and collaborating with international development banks, long-term investors have a wide array of strategies at hand. Existing examples illustrate these investors' substantial potential to drive progress in the energy transition, particularly in emerging economies.

The alignment of long-term investors' investment strategies with international climate goals can set a precedent for other financial institutions, encouraging them to prioritise environmental sustainability in their portfolios. This agreement can help maintain the momentum of the global energy transition, especially in regions where private investment is hesitant due to perceived risks.

The social and economic benefits of investments in the energy transition should also not be overlooked. Funding energy-transition projects can contribute to job creation, technological advancements and improved energy security. The role of long-term investors thus extends beyond mere financial support: these institutions are essential in driving a holistic transformation towards a sustainable and equitable global energy landscape.

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About us

About PwC

At PwC, our purpose is to build trust in society and solve important problems. We're a network of firms in 149 countries with more than 370,000 people who are committed to delivering quality in assurance, advisory and tax services. Find out more and tell us what matters to you by visiting us at www.pwc.com.

About IFSWF

The International Forum of Sovereign Wealth Funds (IFSWF) is a global network of sovereign wealth funds (SWFs) established in 2009 to enhance collaboration and dialogue between members, to promote a deeper understanding of SWF activity and to raise the standard for SWF best practices and governance. The Santiago Principles are central to the IFSWF. They consist of 24 generally accepted principles and practices voluntarily adopted by IFSWF members. The Principles endorse transparency, good governance, accountability and prudent investment practices.

About OPSWF

Championed by President Emmanuel Macron, the One Planet Sovereign Wealth Fund (OPSWF) network was launched as a working group of five founding sovereign wealth funds. OPSWF has since expanded to include private investors and asset managers, with plans to become a permanent network and incorporate as an association under French law. As of November 2023, the OPSWF network includes 47 total members, comprising 18 sovereign wealth funds, 18 asset managers, and 11 private investment firms, which collectively have more than \$ 37 trillion in assets under ownership and management. Members commit to collaborate actively to implement the principles of the OPSWF Framework, published at the Élysée Palace in 2018.

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Thank you

