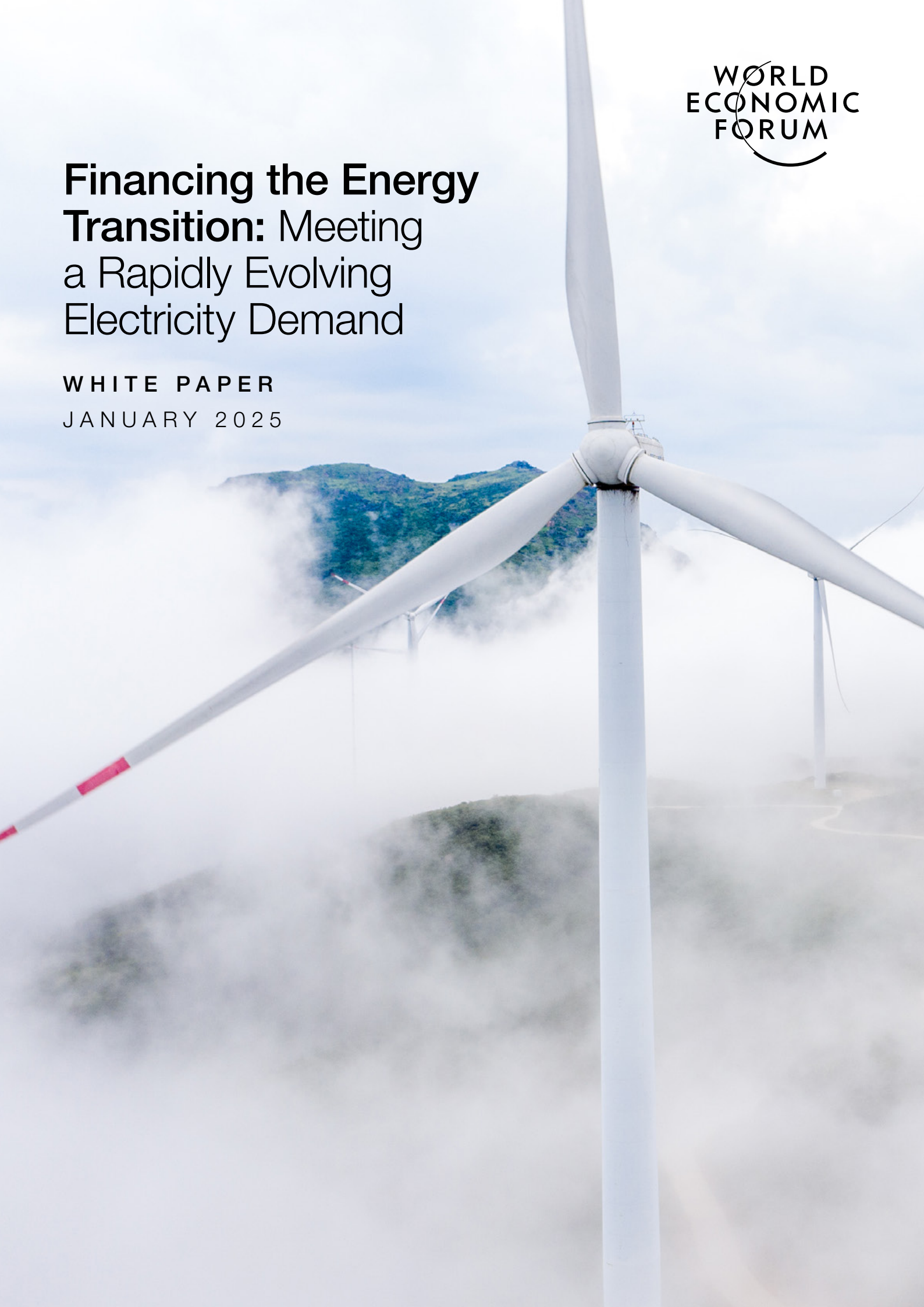

WORLD ECONOMIC FORUM

Financing the Energy Transition: Meeting a Rapidly Evolving Electricity Demand

WHITE PAPER

JANUARY 2025

Images: Getty Images

Contents

Quotes from electricity governors

Anna Borg, Chief Executive Officer, Vattenfall:

> The energy transition is not just a technological challenge; it is a financial one. We must mobilize and channel investments and forge partnerships across regions and sectors. Many options are already available as outlined in this white paper, including Power Purchase Agreements (PPAs) that are a prime example of how industry can collaborate to drive progress, while governments play a crucial role in de-risking through guarantees and maintaining a policy predictability that investments into long-term assets require.

Sumant Sinha, Chairman and Chief Executive Officer, ReNew:

> Mobilizing capital for the energy transition is the cornerstone of a sustainable future. For developing countries, an essential driver of mobilizing investments is decreasing the cost of capital. There are several mechanisms and structures across sectors and geographies that have helped reduce risk. These can be replicated in the clean energy sector and be applied across developing countries. This will not only help in mitigating climate change but also in promoting economic growth and energy security.

Brian Dames, Chief Executive Officer, African Rainbow Energy and Power:

> Achieving the full potential of the developing world is a non-negotiable objective that must be realized in a way that embraces new, cleaner technologies and is driven by the massive investment of smarter grid infrastructure. Meeting this objective will only be possible by attracting greater levels of investment, addressing the risk premium normally associated with investment in developing countries, transferring new technologies and addressing the binding constraints of permitting and investing in new grid infrastructure.

Patti Poppe, Chief Executive Officer, PG&E Corporation:

> New electric load growth offers energy companies and our customers an exciting opportunity, one we're seeing for the first time in decades. Along with key stakeholders, we must remain focused on three things: optimizing the electric grid with technology, fully utilizing existing infrastructure and investing to build what's required for the future powered by clean energy. Done right, new load growth can help us reimagine the electric system for a decarbonized future, benefiting all customers by lowering the cost of energy.

Marco Arcelli, Chief Executive Officer, ACWA Power:

> Over 80% of the new energy and water investments globally are needed in emerging markets. ACWA Power is already investing nearly $25 billion across Africa, Central Asia and Southeast Asia, delivering power and water at the most competitive costs. However, much more remains to be done. We urge multilateral development banks, long-term investors and philanthropists worldwide to join us in empowering emerging markets, where investments are most urgently needed to transform lives.

Andres Gluski, Chief Executive Officer, AES Corp:

> AES has a proven strategy for global renewable energy investments: long-term, dollar-denominated Power Purchase Agreements with investment-grade offtakers. Financing mechanisms, like those outlined in this report, are essential to mitigating risks and unlocking the capital needed to scale renewables across markets.

Paolo Scaroni, Chairman, Enel:

“To promote the energy transition, we need a partnership between the public and private sectors to create the conditions, also with the support of DFIs, to stimulate investments, especially in emerging economies. Gains in productivity and attractive returns will offset the costs associated with these initiatives.

Ignacio S. Galán, Executive Chairman, Iberdrola:

“Clear policy roadmaps that combine energy security, competitiveness, decarbonization, regulatory certainty and incentives to investments are prerequisites to accelerate the energy transition. Collaboration and a forward-looking vision will drive the anticipatory infrastructure investments required to move towards an energy system based on clean electrification.

Gao Jifan, Chairman and Chief Executive Officer, Trina Solar:

“The world is shifting from a “Watt + Bit” era to one of “PV + AI”, calling for targeted investments to drive this transition at speed and scale. Trina Solar leverages its strengths in innovation, brand leadership, digital intelligence, sustainable development and coordinated industry investment to contribute meaningfully to this transition. Through collaboration with partners across sectors, Trina Solar aims to mobilize investments in the sustainable development of global energy.

Nicolas Maes, Chief Executive Officer, Orano:

“Nuclear energy is now fully recognized as an important part of the energy transition, providing a 24/7 low-carbon energy source. Just like for renewables, substantial investments will be needed, along with innovative financing mechanisms to lower financing costs. In this regard, cooperation between public bodies, financial institutions and companies will be key.

Foreword

Gurdeep Singh
Chairman and Managing Director, NTPC Limited

Christian Bruch
President and Chief Executive Officer, Siemens Energy

Francisco Betti
Head, Global Industries Team, World Economic Forum

The energy transition is one of the greatest challenges and opportunities of our time. It demands not only technological innovation but also significant financial investment and international cooperation. This white paper brings together diverse perspectives and comprehensively addresses these needs.

We explore local, regional and global perspectives, offering a thorough overview of the financial requirements of the energy transition from various geographical angles. We highlight the unique challenges and opportunities faced by different regions, emphasizing the importance of tailored approaches. And we examine the necessary investment mechanisms for the energy transition, exploring financial strategies and innovative solutions to bridge the investment gap.

The sheer scale of investment required to modernize grids, integrate renewable energy at unprecedented levels and ensure reliable energy supply calls for creative and adaptable financial strategies. The development of new financing mechanisms that can accelerate the energy transition is central to this effort. The role of regulatory frameworks in creating a conducive environment for these investments to flourish is essential; and it is equally important to engage small and medium-sized enterprises (SMEs), which play a pivotal role in innovation and market development. Their involvement is key to scaling-up new technologies.

The success of the energy transition hinges on our ability to finance the energy systems of the future, ensuring they are affordable, resilient and sustainable. Access to long-term, low-cost financing is crucial to ensuring the viability of this transition, with our primary focus on reducing both capital costs and the cost of capital. Achieving global climate goals will require significant investment and this will only materialize if we focus on innovative financing mechanisms, foster international cooperation and maintain regulatory predictability. Recognizing regional differences, reducing financing costs, supporting SMEs and leveraging philanthropic funds are critical to this endeavour.

We hope this white paper serves as a valuable resource for stakeholders across the world committed to accelerating the global energy transition and building a sustainable, reliable and affordable energy future.

Executive summary

Investment in the net-zero energy transition needs to increase to $4.5 trillion a year. More financing must be channelled to developing countries, which receive just 15% of energy transition investment.

Global investment in the energy transition has seen a significant increase since the Paris Agreement in 2015, with spending projected to reach $2 trillion in 2024. Despite these advances, current investment levels are insufficient to meet the global climate targets outlined by the International Energy Agency (IEA). To align the energy sector with net-zero emissions by 2050, annual investment needs to increase to approximately $4.5 trillion per year, indicating a substantial gap between current and required funding.

This report argues that energy transition financing faces significant challenges, leading to an investment gap that can only be addressed through targeted measures. Challenges facing global investment in energy transition technologies include high upfront costs, increased risks, inflation, supply chain constraints and high interest rates. In addition, regional disparities pose significant challenges, with each region facing its own unique set of barriers to advancing its energy transition goals.

Despite record levels of investment in the energy transition, most regions are falling short of what is needed to meet climate goals. The gap between current investment and required financing is even more pronounced in emerging economies and developing countries, which currently receive only about 15% of global energy transition investment.

Addressing these challenges requires a standardized approach to reducing the cost of financing and mitigating the risks of energy projects. Collaboration between investors, industry executives, policy-makers and financial institutions is essential.

To effectively manage the energy transition, several key issues that impact the financing and deployment of energy transition projects must be addressed:

- **Energy security and affordability:** A successful energy transition requires a delicate balance between energy security and affordability. Energy security ensures a reliable and uninterrupted supply based on strong supply chains and resilient transmission and distribution grids, while affordability guarantees access for all. Both are essential for economic stability and social well-being.

- **Reducing financing costs:** Current funding levels fall short of requirements, even with the high demand for infrastructure investment. To address this, it is important to distinguish between developed and developing economies. In developing countries, enhancing availability of long-term access to low-cost capital is crucial, which can be achieved through concessional

loans, guarantees or subsidies. These tools help make financing more affordable and accessible for critical projects.

- **De-risking innovative technologies:** Innovative technologies with a strong business rationale but limited operational history require risk mitigation measures to become bankable. Governments and financial institutions can play a pivotal role in reducing or reallocating these risks through insurance and guarantee instruments (e.g. export credit agencies (ECAs) offering project-specific guarantees or insurances), thereby encouraging investment in such ventures.

- **Hedging offtaker risk:** Clean energy requires substantial upfront investments, typically recouped over 10 to 20 years. This creates risks associated with market price fluctuations, which affect even mature technologies and pose even greater challenges for early adopters of new products and in emerging markets. To reduce these risks, it is important to ensure that offtake agreement protection is available through financial tools that guard against price swings (e.g. price floors established through contracts for difference (CfD) or hedging instruments such as swap agreements).Fixed interest rates and long-term contracts can also help provide stability. By managing these risks, companies can make their finances more stable and predictable, widening the potential pool of investors.

- **Mobilizing capital to developing countries:** Mobilizing capital for developing countries, on both the debt and equity side, is critical to achieving global energy transition goals. This includes the use of blended finance solutions (e.g. combining public and private funding through development finance institutions (DFIs), concessional debt from governments and philanthropic capital) to fill investment gaps and to make projects more attractive to private investors.

Addressing these challenges requires a standardized approach. Collaborative efforts among investors, industry executives, policy-makers and financial institutions are essential. Implementing these measures can help foster an inclusive and attractive landscape for investors, leading towards a sustainable energy future.

Introduction

Collaboration between industry executives, policy-makers, investors and financial institutions is vital to establish the right mechanisms to boost investment in the energy transition.

Since the signing of the Paris Agreement in 2015, global investment in the energy transition, aimed at limiting temperature rise to 1.5°C above pre-industrial levels, has significantly increased. According to Bloomberg New Energy Finance (BNEF), investments in energy transition projects – including power grids, clean shipping, clean industry, electrified heat, transport, hydrogen, carbon capture and storage (CCS), energy storage, nuclear and renewable energy – have consistently hit record highs.[1]

Global spending on energy transition investments reached around $2 trillion in 2024, nearly double the amount invested in fossil fuels. However, current investment levels are still insufficient to meet climate goals. The International Energy Agency (IEA) states that global annual investment needs to increase to approximately $4.5 trillion per year by the early 2030s to align the energy sector with net-zero targets by 2050.[2]

Significant scaling-up of energy transition technologies is required to build a low-emission energy system, expand global energy access and meet growing electricity demand. The transition has been hindered by supply chain constraints and inflationary pressures following the Covid-19 pandemic. Since 2022, these pressures and high interest rates have increased capital costs for energy transition projects, causing many to be stalled.[3]

The energy transition requires support from industry executives, policy-makers, investors and financial institutions, each with their own constraints. Collaboration is needed to address the following questions:

- Why is there a lack of investment in the energy transition?
- What are the differences globally, regionally and locally?
- What are the challenges to increasing investment in the energy transition?
- How can energy transition investment be made more attractive?

This paper consolidates views from the energy industry, representing utilities, grid operators and technology manufacturers worldwide. It identifies barriers to financing energy transition technologies and proposes solutions to secure investment, examining regional and global situations and exploring ways to lower financing costs and create an attractive investment environment.

1 Risk management as a driver of the energy transition

Reducing the cost of capital by mitigating the risk of energy transition technologies is critical for the success of any infrastructure project, especially for the energy transition.

“ Fossil fuels currently provide over 80% of all the world’s energy supply. Moving to a nearly fossil-free world is a major societal, cultural, economic and political shift.

To manage the global energy transition successfully requires a balanced energy policy that combines renewable energy with flexible assets such as storage technologies and clean fuels. Policy-makers must ensure the transition is sustainable, affordable and secure, even as the world grows. Fossil fuels currently provide over 80% of all the world’s energy supply.[4] Moving from this system to a nearly fossil-free world is a major societal, cultural, economic and political shift, requiring significant effort and investment.

A balanced energy policy should consider the optimal mix of technologies and pathways to decarbonization. This includes promoting renewable energies, electrifying end-uses, enhancing energy efficiency, investing in grid infrastructure and implementing energy storage and flexibility solutions to ensure a secure and reliable energy supply. To do this requires international cooperation and financial resources to foster the global energy transition. This involves mobilizing capital for power generation, grid infrastructure and storage solutions, especially in developing countries where financing costs are higher and government budgets are limited.

In addition to financing renewable energy projects, ensuring a steady supply of materials and equipment is critical for project developers. This extends from securing raw materials for components such as wind turbines and batteries to obtaining highly specialized equipment such as power grid substations. Many countries, including the US and India, are prioritizing the development of domestic supply and value chains to reduce reliance on global markets. However, if required investments fall short, gaps in these domestic supply chains could emerge, creating a significant bottleneck in the deployment of energy transition technologies. Strategic investments in manufacturing and supply chains are therefore essential to prevent supply constraints from impeding the deployment of energy transition technologies.

Due to their innovative nature and cost structure, energy transition technologies require significant upfront investment and risk appetite. Investors such as equity sponsors and lenders – as well as individual investors within these groups – differ in their willingness towards taking risks. Their risk tolerance reflects the return they expect from their investment, with higher risk levels meaning higher cost of capital. While solar and onshore wind are mature in advanced markets, other energy transition technologies, such as floating offshore wind or electrolysers, are seen as riskier due to their lack of operating hours or disruptive nature. Risk is generally even greater in developing countries, where political instability and less-developed financial markets and infrastructure increase the cost of capital.

Finding a way to reduce the cost of capital and mitigate risk properly is crucial for the success of any infrastructure project. Key players include developers, investors, financial institutions, governments, utilities, suppliers and regulatory agencies. The main risks can be categorized as follows:

- Environmental and social: environmental impacts, social opposition.
- Political and regulatory: policy changes, delays in permitting, expropriation, lack of robust regulatory compliance.
- Financial: currency volatility, liquidity issues, interest rate changes, credit risk.
- Project-specific: construction delays, technological challenges, operational issues.
- Offtake: counterparty risks, payment defaults, dispute resolution, market fluctuations.

Effective risk management includes the following options:

- Climate and energy strategies: these form the basis of a low-risk environment by providing a clear long-term direction and rulebook for investments.
- Regulatory and informational instruments that create transparency, ensuring confidence for investors and developers in regulatory certainty.
- Insurance to shift certain risks to insurers or other third parties and allow improved risk hedging.
- Robust network planning and infrastructure: foster investments and reduce risk perception around whether energy produced can effectively be transported where and when it is needed for consumers.
- Strong project management to ensure oversight and accountability.
- Contingency planning, with back-up plans to minimize disruptions.
- Clear contracts, detailing scope of work, payment terms, performance guarantees, dispute resolution mechanisms, termination provisions, force majeure clauses, insurance requirements etc.

Financing remains a common issue for achieving clean, affordable and secure energy supply worldwide. The measures outlined above can help manage risk and secure investment, but challenges and timelines vary by region. The following section examines some of the risks and challenges encountered in specific geographies.

2 Regional perspectives on financing the energy transition

Each region faces its own challenges in terms of policy, economics and geography – but there are common solutions around how to accelerate financing and implementation of energy transition projects.

2.1 East Asia and Southeast Asia

The East Asia and Southeast Asia region is diverse, with varying levels of economic development, energy policies and resources. This analysis focuses on selected countries, acknowledging that overarching statements may not apply across the whole region.

China's rapid shift from a coal-intensive economy to a renewable energy leader showcases its strategic policies and significant investments. Since the early 2010s, China has seen massive growth in energy transition technologies, including wind, solar and battery storage, driven by rapid industrialization. The country is set to surpass its 2030 renewable energy target ahead of schedule. While still reliant on coal for 60% of its power generation,[5] China has taken a leadership role in the manufacture and deployment of energy transition technologies through the following measures:

- Government subsidies for renewable energy technologies.
- Carbon trading mechanisms.
- Renewable Portfolio Standards (RPS), which mandate electricity suppliers to source increasing shares of their electricity supply from renewables.
- Feed-in Tariffs (FITs), guaranteeing producers of renewable energy a fixed price for their electricity production.

These policies have fostered a favourable environment for renewable energy. In 2024, China is expected to lead the world in energy transition technologies investment, with an estimated $675 billion of investment.[6] Demonstration projects, such as the one in Suizhou City, Hubei Province, aim to achieve high renewable penetration rates[7] using storage, smart grids, digitalization and demand-side flexibility. The Suizhou project has demonstrated that a renewable penetration rate of over 85% is achievable and while it requires substantial initial investment, it reduces operating costs and electricity bills in the long run.

Other countries in the region, including Malaysia, Vietnam and Thailand, play a crucial role in the global energy transition as manufacturing hubs and significant energy consumers. However, the region still relies heavily on fossil fuels. Energy demand in Southeast Asia has grown by around 3% annually over the past two decades and is expected to continue.[8] Currently, 72% of electricity in Southeast Asia is generated from fossil sources, with 46% from coal.[9]

The reliance of both East Asia and Southeast Asia on coal is due to its affordability and established infrastructure. The region's vast coal reserves support industrial activities, making the shift to renewable energy challenging without risking economic setbacks. Investment in energy transition technologies varies across the region due to differences in policies, economic development and resources.

Southeast Asia faces the dual challenge of increasing energy sector investment while decarbonizing its energy supply. To meet energy goals, investment in the region (excluding China) needs to double from 2021-2023 levels, with a significant reduction in fossil fuel investment.[10] Renewable energy projects require significant upfront capital and many countries, especially developing ones, struggle to secure financing due to underdeveloped financial markets, limited access to green bonds and a lack of creditworthy offtakers. The absence of mechanisms to address these limitations in most Asian countries creates uncertainties about the financial performance of energy transition projects.

In 2024, China led the world in energy transition technologies investment, with an estimated $675 billion of investment.

For a world map denoting which countries fall within which regions, see Annex.

2.2 South Asia

India, the region's biggest economy, is one of the fastest-growing in the world, with GDP growth projected to exceed 6% per year until the end of the decade.[11] Its population of more than 1.4 billion people ensures that India will remain one of the world's largest energy consumers. Consequently, India's energy transition is crucial given its scale and impact on the global economy and environment.

India's energy mix is heavily reliant on coal, accounting for about 70% of its electricity generation.[12] However, significant transformations have been taking place in its energy systems, with the promotion of renewable energy. Its installed capacity of renewables nearly doubled to 200 GW by October 2024. The country is aiming for 500 GW of non-fossil fuel power capacity by 2030 and net-zero emissions by 2070. The IEA estimates that India needs to invest $160-200 billion every year to meet its targets[13] – two or three times more than the current levels of investment, which reached $68 billion in 2023.

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For a world map denoting which countries fall within which regions, see Annex.

Despite the strong potential for investment, offtake and currency risks hinder adequate investment levels. The higher financing costs related to these risks has resulted in, for example, a cost of capital for utility-scale solar photovoltaic projects in India that is 80% higher than in advanced economies.[14]

The Indian government has taken significant steps to incentivize investments in the energy transition, such as:

- Allowing 100% foreign direct investment (FDI) under the “automatic route” (i.e. not requiring approval from the Government of India for the investment).
- Waiving inter-state transmission charges for solar and wind power sales.
- Implementing a renewable purchase obligation scheme, requiring power distribution companies to purchase a minimum amount of renewable energy on an annual basis.
- Using highly rated central public sector enterprises as offtakers to reduce power purchase agreements' counterparty risk.
- Offering production-linked incentives and viability gap funding.
- Issuing sovereign green bonds.
- Creating a foreign-exchange platform to hedge against currency volatility.

Significant equity investments have come from sovereign wealth funds, global pension funds, private equity, oil and gas majors and Indian conglomerates. From 2019 to 2021, foreign banks and financial institutions provided 50% of the debt for India's renewable energy projects.[15] India entered the green bonds market in 2015, issuing over $10 billion in green bonds for clean energy projects between 2016 and 2021. A green bond framework introduced in November 2022 aims to further mobilize private investors and strengthen the country's green bond market.

2.3 Middle East

> The Middle East's energy sector is dominated by national oil companies (NOCs), but more advanced economies in the region have established ambitious renewable targets set for 2030.

Historically, countries in the Middle East have relied heavily on fossil fuels, with oil, natural gas and coal accounting for about 95% of electricity generated in 2022.[16] However, regional sentiment is changing, with more countries setting net-zero emission targets. In the Middle East, eight countries have set net-zero targets.[17]

The Middle East's energy sector is dominated by national oil companies (NOCs). As a result, 20 cents are invested in clean energy for every dollar spent on fossil fuels.[18]

Fossil fuel revenues are crucial for government budgets, representing nearly 90% of revenues in Iraq and over 70% in Oman and Bahrain.[19] Shifting away from these sources poses significant economic and political challenges for less advanced economies. More advanced economies, such as the United Arab Emirates (UAE) and the Kingdom of Saudi Arabia, have established plans to leverage their resources and implement their vision of increasing non-oil revenues, with ambitious renewable targets set for 2030. However, these diversification plans are heavily dependent on the governments' oil and gas revenues and are therefore vulnerable to shocks in the market, such as the price of oil per barrel.

Political instability in some countries of the Middle East region deters foreign capital and clean energy investment. Investors are cautious about long-term projects in politically unstable areas, with higher returns required to compensate for higher risks. Country risk premiums can be as high as 24% for Lebanon, for example, while politically stable countries such as UAE, Qatar and the Kingdom of Saudi Arabia offer higher investment certainty and associated risk premiums of around 1%.[20]

2.4 Africa

> In North Africa, meeting Nationally Determined Contribution (NDC) targets by 2030 requires around $25.7 billion annually, but current climate-related investments represent just 23% of this amount.

In Africa, 11 countries have set net-zero targets;[21] however it is difficult to mobilize investment at scale to deploy energy transition technologies. In North Africa, meeting Nationally Determined Contribution (NDC) targets by 2030 requires around $25.7 billion annually, but current climate-related investments represent just 23% of this amount.[22]

For Africa, driving investment in the energy transition is a multifaceted challenge that involves addressing economic, social and regulatory factors, among others. Many African countries still face significant energy access challenges. Currently, 600 million Africans lack access to electricity, creating significant barriers to healthcare, education, productivity, digital inclusivity and ultimately job creation.

The continent is naturally endowed with vast renewable energy resources including solar, wind, hydro and geothermal, all of which could be harnessed for both local consumption and export. However, high cost of capital prevents deployment of energy transition technologies, making them too expensive for local consumers.

Strategies to drive the energy transition agenda for Africa include:

- Fostering the continent's abundant natural resources.
- Support from governments to create conducive policy and regulatory frameworks that support the energy transition, such as feed-in tariffs and tax incentives.
- Leveraging both public and private investments and financing mechanisms.
- Enhancing long-term access to low-cost capital.

For a world map denoting which countries fall within which regions, see Annex.

2.5 Europe

The EU ranks second globally in energy transition investment, spending ~$360 billion in 2023 – equivalent to over $10 on clean energy projects for every dollar spent on fossil fuels.

For a world map denoting which countries fall within which regions, see Annex.

The European Union (EU) ranks second globally in energy transition investment, spending approximately $360 billion in 2023, mainly in electrified transport ($150 billion) and renewable energy ($100 billion).[23] Key support mechanisms include the following:

- Emissions trading system (ETS).
- Government subsidies.
- Feed-in tariffs and premiums.
- Contracts for difference (CfD) and carbon contracts for difference (CCfD).
- Sustainable bonds/debt.

European countries are all aiming for net-zero carbon emissions by 2050 or earlier, with detailed plans to achieve these targets. The EU was the world's largest issuer of sustainable bonds in the first half of 2024, reaching a total issuance of $291 billion.[24]

Currently, the EU spends over $10 on energy transition projects for every dollar spent on fossil fuels.[25] In 2022, the cost of capital for renewables in Europe rose slightly due to supply chain and inflationary pressures, but renewable investment remains cost-competitive.

To meet their 2030 climate targets, investments by EU countries in modernizing their energy systems, transport and buildings must double from the €407 billion invested in 2022 to at least €813 billion annually – 5.1% of the EU's GDP.[26]

While some sectors, such as hydropower and battery storage, have exceeded their investment targets, others, such as solar and EV charging infrastructure, show minor deficits. Significant deficits remain in wind power and electricity grids, which need substantial investment to integrate new renewable capacities and support electrification.

An additional €41 billion is needed annually for grid extension and maintenance. Around 40% of Europe's distribution grids are over 40 years old and cross-border transmission capacity needs to double by 2030.[27] Rystad Energy estimates an additional 18 million kilometres of grid network are needed by 2030, requiring up to $3.1 trillion in investment.[28]

2.6 North America

In 2023, the US spent over $300 billion on energy transition investment – the third highest after China and the EU, accounting for 15% of total global clean energy investment. Investments in the oil and gas sector remain significant, with $1.40 spent on energy transition for every dollar spent on fossil fuels, compared to the global average of $1.80.[29] The country is the world's second largest emitter of greenhouse gases and therefore plays a pivotal role in the global goal to reach net zero.[30]

The US is relying on a combination of low-cost loans and grants from the Department of Energy (DOE) and subsidies under the 2022 Inflation Reduction Act (IRA) to accelerate investment into its energy transition. The IRA provides over $370 billion

In 2023, the US spent over $300 billion on energy transition investment, equivalent to $1.40 on clean energy projects for every dollar spent on fossil fuels.

for renewable energy, electric vehicles and other low-carbon technologies, through the following instruments:

- Production tax credits (PTC).
- Investment tax credits (ITC).
- Fuel tax credits.
- Carbon management.
- Transmission loans and grants.
- Community investment and energy justice.

Meanwhile, the bipartisan Infrastructure Investment and Jobs Act (IIJA) of 2021 reserved around $550 billion for energy transition technologies and infrastructure. By the end of 2023, $75 billion had been allocated to the following projects:

- Grid improvement and expansion ($21.3 billion).
- Energy transition demonstration projects ($21.5 billion).
- Energy efficiency ($6.5 billion).
- Clean energy technology manufacturing and workforce development ($8.6 billion).

Other initiatives in the US include the Renewable Portfolio Standards (RPS) and Clean Energy Standards (CES) programmes, which set goals for energy producers to supply low- to zero-carbon energy. RPS accounted for 30% of all US renewable capacity additions in 2022. Many developers enter tax equity partnerships or sell the tax benefit to third parties in order to reduce their capital requirements.

Challenges include high financing costs due to elevated interest rates, permitting issues, an ageing grid and extended connection queues, regulatory uncertainty and rising demand linked to advances in artificial intelligence (AI) and associated data centre power consumption. In addition, political swings, such as during the US presidential election in November 2024, could negatively impact the availability of governmental funds or increase the regulatory scrutiny developers must follow.

2.7 Latin America

For a world map denoting which countries fall within which regions, see Annex.

Almost half of Latin American (LATAM) countries have net-zero pledges by 2050. Energy transition investments reached ~$68bn in 2024 and are rising slightly faster than overall energy investments, which will reach $185 billion in 2024. However, achieving climate targets requires a fourfold increase in annual energy transition investment between 2026 and 2030. Around 55% of 2024's energy investments are in fossil fuel supplies, with 35% in the power sector and 10% in end-uses.[31]

Fossil fuels account for 65% of LATAM's total energy mix, below the global average of 80%.[32]

Within the electricity sector, renewables make up 60% of total installed capacity, mainly due to hydropower.[33] However, growth prospects for hydropower are limited, as available sites for new dam installations are limited and infrastructure maintenance is required.

In terms of the current pace of deployment, solar PV is the leading renewable technology across the region. Storage investment is accelerating and less-mature technologies such as offshore wind are also starting to attract investment in key markets such as Brazil and Colombia.

Energy transition investments reached ~$68 billion in Latin America in 2024 – however, a fourfold annual increase is needed between 2026 and 2030 to achieve the region's climate targets.

Investment priorities for realizing the region's climate pledges include power transmission and distribution, as well as renewable generation capacity.[34] Investment in the end-use sector to increase energy efficiency is low, with few countries having energy performance standards or mandatory building codes; improving end-use efficiency would help decrease investment needs in new generation assets and the energy transition overall.

LATAM faces high inflation, debt, fiscal issues and weak currencies, leading to slow growth and low levels of investment in the energy transition. The region's investment environment will remain challenging while high cost of capital and high levels of macroeconomic risk persist.

Raising funds from external sources is crucial due to financial constraints across the region, with most countries having less-developed financial markets that cannot yet provide enough capital at attractive rates to finance the region's transition. In 2020, FDI in Latin America was $105 billion, while green finance was only $22.9 billion.[35] Expanding green finance by promoting private sector investment is essential. In July 2023, the UN Environment Programme's Finance Initiative established a Common Framework for Sustainable Finance Taxonomies for Latin America and the Caribbean to ensure a high level of transparency and interoperability. The aim of this voluntary framework is to unlock financing and facilitate cross-border capital flows for social and environmentally sustainable investments.[36]

2.8 Regional disparities and common financing challenges

This chapter has demonstrated that the starting points, pathways and timelines for energy transitions vary across regions. Many countries are starting to accelerate their adoption of clean energy sources, but the pace of this shift varies significantly due to differences in policy, economic capabilities and geographic characteristics.

Despite these differences, financing remains a common challenge for all countries in achieving clean, affordable and secure energy supply. Countries on track to meet their decarbonization targets potentially need to maintain or even increase their investment levels, while keeping costs under control to keep energy affordable. Countries that are under-investing must find ways to raise funds, often within the constraints of limited government and private budgets.

This underscores the global need to create an ecosystem that supports efficient and cost-effective investment in energy transition assets. Mobilizing the public and the private sectors can address the funding gaps and promote the timely deployment of energy technologies.

Given the different conditions that each market or country operates under, investment mechanisms must be tailored to fit local requirements. There is no one-size-fits-all solution and it is essential to address the key issues that affect the financing and implementation of energy projects in each jurisdiction. These issues include reducing financing costs, de-risking innovative technologies, hedging offtake agreements and mobilizing capital for developing countries by creating an enabling environment for investments.

3 Investment mechanisms for the energy transition

Tools to improve the investment attractiveness of energy transition projects include government subsidies, regulatory certainty, offtake agreements, export-import guarantees and philanthropic support.

Robust mechanisms are needed to mitigate the risks and improve the financial performance of energy transition projects. These measures will help shift the global energy landscape towards low-carbon technologies and fuels, while maintaining resilience and affordability. Banks consider several factors when deciding on project finance and interest rates, including the project's ability to repay the loan, technical feasibility, demand and risk management.

Interest rates are determined by adding a margin to the base market rate and by adding ancillary fees, influenced by risk, market conditions and competition. Greater competition or better risk management can reduce interest rates, while projects in higher-risk areas face elevated rates to account for the additional risk. This chapter outlines several strategies that regional policy-makers and stakeholders can take to attract investment and reduce financing costs for energy transition projects.

3.1 Government support and regulatory certainty

Government support, through measures such as tax incentives, grants, loan guarantees and performance-based incentives, is crucial for energy transition projects. This support helps bridge the cost and risk gaps between fossil fuel and renewable energy projects, aligning the goals of equity sponsors, lenders, insurers and governments.

In addition, dedicated government funds that provide financing for technology demonstration and deployment projects can have a major positive impact on the commercialization of innovative energy technologies. The primary goal of these funds should be to strengthen SMEs and promote new technologies and innovations to maintain the country's economic competitiveness.

To ensure long-term regulatory and revenue certainty, while limiting the costs of state support for public finances, governments can select the beneficiaries of their support via auctions. These allow selection of the most cost-competitive projects – among other criteria such as environmental impact, job creation and supply chain benefits – and provide long-term certainty over operating conditions and revenues. Governments can define in advance how much funding is available over the lifetime of the assets.

A strong track record of regulatory certainty and a clear visibility over government support enable significant reductions in financing costs and incentivize investment.

3.2 Revenue guarantees

Offtake agreements are crucial for the bankability of energy transition projects, guaranteeing a market for the output and reducing financial risk. Indeed, electricity and certain clean fuels, like green hydrogen generated with renewable power, are constrained by local market conditions as the infrastructure to transport them across continents has not been built yet. Conventional fuels such as oil or natural gas, benefit from a fully integrated global market, so they can more easily find back-up offtake solutions outside the country or region if they face issues with local offtake.

Offtake agreements create contractually or legally guaranteed revenues and provide steady cash flows that support the overall case for project financing. They can be government-backed, such as CfDs, FITs, feed-in premiums (FIPs) and utility rate-based tariffs,[37] or private contractual arrangements such as long-term PPAs.

Once technologies are proven and markets established, financial institutions are more willing to offer support due to the decreased risk profile. This shift is being seen in the US with the transition from long-term to short-term PPAs for wind and solar projects, facilitated by tax-equity partnerships and equipment guarantees.

The counterparty to the offtake agreement needs to have a high credit rating, or investors will not consider the revenue as guaranteed. Where traditional offtakers, such as distribution grids, do not have the credit rating level required, public finance can step in. In India, for example, the state-owned Solar Energy Corporation of India (SECI) acts as an intermediary, using risk-mitigation tools such as letters of credit, payment guarantees and escrow accounts to secure payments for generators and maintain project viability. SECI also requires performance guarantees from generators to protect offtakers from non-performance risks. These mechanisms facilitate project financing and scaling-up of energy transition projects.

“Electricity and certain clean fuels, like green hydrogen generated with renewable power, are constrained by local market conditions as the infrastructure to transport them across continents has not been built yet.

3.3 Export-import guarantees

Export credit agencies (ECAs) are crucial for enabling companies to participate in international energy transition projects. These government-backed institutions provide financing for exports by domestic companies through export credit guarantees (ECGs), which protect exporters from non-payment risks by foreign buyers. Essentially, ECGs act as insurance policies covering exporters' losses if buyers fail to pay. Although ECAs have reduced financing for fossil fuel projects since COP26, the increase in renewable energy investment has not kept pace.[38]

Lenders are more likely to support projects with ECGs due to reduced default risk, significantly lowering the cost of financing ECA-backed capital and extending payback periods. A number of ECAs already offer special conditions for energy transition projects, offering lower fees, high coverage and flexible loan conditions allowing investment management optimization.[39] ECGs therefore have the double benefit of increasing revenue certainty and fostering trade and technology adoption across markets and in countries with higher risk profiles.

3.4 Blended finance and philanthropy

Combining philanthropic funding with commercial investment ensures financial viability, by de-risking corporate investments for technologies, sectors and geographies that are currently underfunded.

Philanthropic funds are an underutilized resource for targeted support to energy transition investments. Philanthropy can take on greater risks in financing unproven technologies, acting as a catalyst for additional investment by absorbing first loss. These so-called concessional funds typically provide capital through equity, grants and project-specific support, including funding project preparation studies and support with just transition planning.

By combining concessional finance from philanthropic sources with commercial investment, blended finance ensures financial viability, by de-risking corporate investments for technologies, sectors and geographies that are currently underfunded.

Other sources of concessional financing such as low-interest loans, public grants and guarantees can be used to reduce risks or improve returns for private investors, enabling funding for innovative or high-risk technologies.

Blended finance is a dynamic and transitional tool that steps in before private markets can work effectively. So it is vital that, in addition to larger corporations, developers and SMEs are also able to leverage these funds.

In addition to direct funding, philanthropies can play a catalytic role by providing a range of non-financing support (see Figure 1). Creating the right conditions to activate this support requires coordinated efforts and strategic initiatives, such as the World Economic Forum's Giving to Amplify Earth Action (GAEA) initiative.

FIGURE 1: **The catalytic role of philanthropies**

Source: Giving to Amplify Earth Action (GAEA), World Economic Forum

3.5 Sustainable bonds and loans

Innovative financial instruments specifically aimed at driving scale and impact for energy transition technologies are also crucial in addressing the financing gap. Sustainable bonds are an instrument already widely used. However, their impact can be significantly increased when they do not require underlying assets: instead of being linked to a specific project, they can then be backed by an issuer's entire balance sheet. As a result, these sustainability-linked bonds are considered low-risk and can be issued at large amounts and with longer tenors than project-specific instruments. To ensure their climate impact, they can be linked to existing sustainability pledges, such as SBTi (Science Based Targets initiative) targets to guarantee the issuers' accountability.

The use of sustainable finance instruments can be linked to the user's stage in the energy transition and follow several steps: starting with specific-purpose instruments such as green bonds for isolated assets and activities within generally accepted impact categories (a wind energy project or a project to electrify industrial operations for instance), evolving towards general-purpose and performance-based instruments such as sustainability-linked bonds. A final stage, when a company's projects are all in line with the energy transition would involve unlabelled instruments, which validate the transition journey and represent the user's overall strategy, quality and maturity.

One such example is the sustainability-linked bonds that ENEL has been issuing since 2019 on international capital markets for a total of €32 billion. In addition, since 2022, the European Investment Bank – as well as ECAs from Italy, Denmark and Finland – have started issuing multi-country, multi-business and multi-currency sustainability-linked loans with ENEL linked to the company's greenhouse gas emissions reduction key performance indicators (KPIs).[40]

4 Enabling an attractive investment environment

Measures to improve project bankability include: insurance, guarantees and loans backed by DFIs and governments, integrated infrastructure planning, clarity on global standards and carbon pricing, and engaging with SMEs.

Infrastructure and energy transition projects are typically financed by large corporations or through project finance. Using a company's own balance sheet to fully finance a project is more efficient from a cost and time perspective, but the investment is often too expensive for smaller companies and refinancing can introduce additional risk. Flagship projects signal corporate commitment to energy transition goals, but stand-alone projects may lack sound economics and bankability.

Project finance, which relies on the project's cash flows, indicates a technology's readiness for commercial application. The success and bankability of a project depend on effective risk mitigation and allocation among investors, lenders, contractors, governments and other stakeholders. Meanwhile, blended finance combines public and private capital to fill investment gaps, attract private investment and make otherwise non-bankable projects viable.

This chapter explores tools and solutions for investors and governments to enable investment and advance the energy transition.

4.1 Development finance institutions

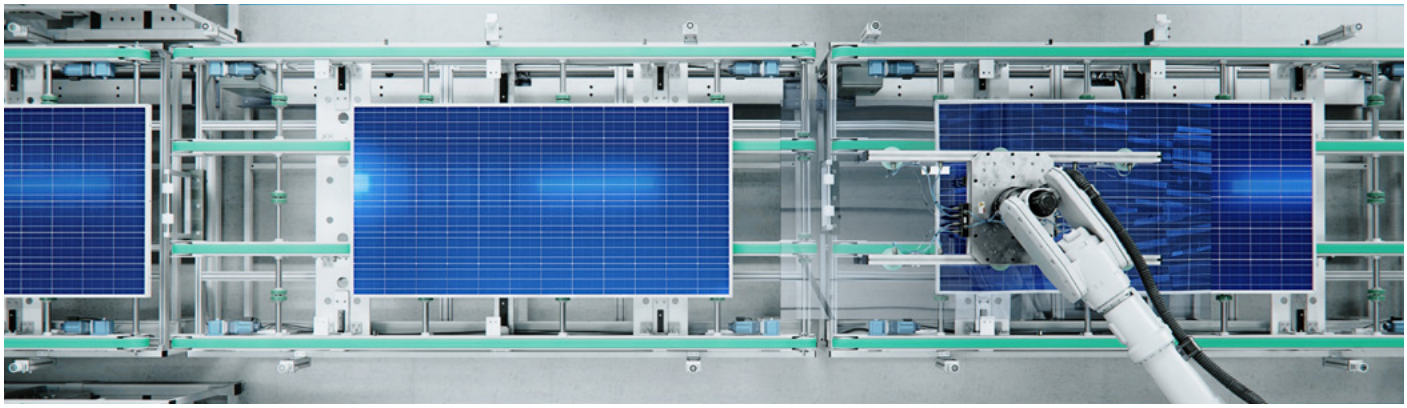
Development finance institutions (DFIs) provide risk mitigation instruments such as insurance and guarantees, as well as capital through concessional loans, loan guarantees and bonds to support international development. Thanks to their high credit-worthiness, DFIs are able to raise funds in the capital markets before lending on to promoters. DFIs are willing to take risks that private investors avoid, such as political and foreign exchange risks. They work closely with governments to ensure projects meet strict environmental and social standards.

DFIs can work with companies of all sizes and offer loans, equity investments and guarantees to banks and other lenders. However, their longer decision-making processes and stringent terms can limit business flexibility. Governments and other stakeholders should work to ensure that DFIs have the agility required to support all types of players in the energy transition.

4.2 Performance guarantees

Performance guarantees – provided by the engineering, procurement and construction (EPC) contractor or by an insurance company – are crucial for providing certainty and risk mitigation to investors and operators, ensuring technology performs as expected. They incentivize operational excellence through proper maintenance and optimization, which is especially important for newer energy transition technologies with limited operating data. These guarantees encourage investment in otherwise risky projects.

Lessons learned from solar and wind development can accelerate emerging technologies. Debt and equity partners often require performance guarantees for critical equipment to ensure reliability and mitigate financial risks. However, manufacturers of less mature technologies may hesitate to provide these guarantees due to operational uncertainties. Governments can help by providing insurance to original equipment manufacturers (OEMs) and EPCs, supporting performance guarantees, spreading risk and facilitating wider adoption. This approach shortens the learning curve, lowers costs and improves bankability.



4.3 Integrated infrastructure planning

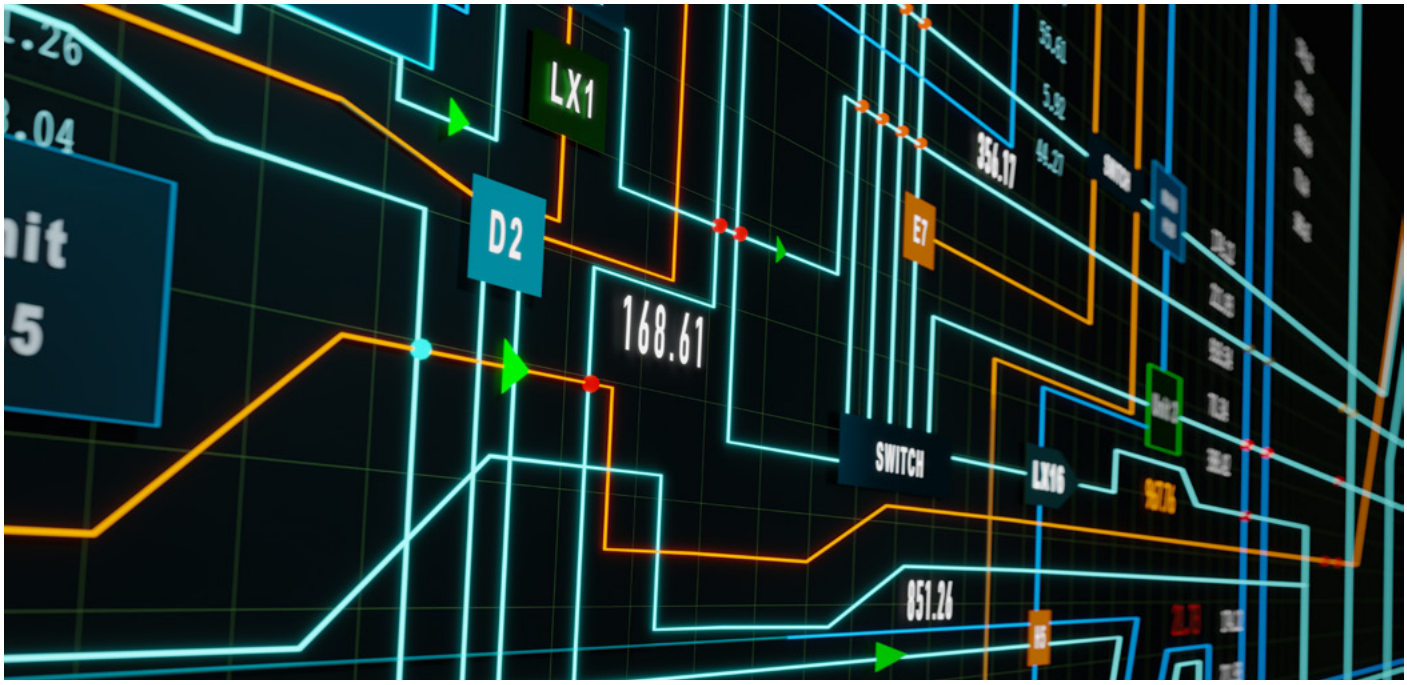
> Integrated infrastructure planning improves the economic viability and bankability of energy projects by enhancing cost efficiency, mitigating risks, attracting investment and providing regulatory certainty.

The energy transition requires rapid development, making it essential for governments and utilities to consider the entire energy system holistically. For example, governments can identify and designate land areas available for renewable projects to increase certainty and speed up project development, as is the case in Central Asia and in Gulf Cooperation Council (GCC) countries. In addition, advance investment can be made in transmission and distribution networks to ensure system integration of future power generation and demand, avoiding bottlenecks in grid connection and transport.

Integrated infrastructure planning considers the entire energy infrastructure, including transmission capabilities, storage systems and system load demands, to ensure efficient energy planning. This approach improves the economic viability and bankability of energy projects by enhancing cost efficiency, mitigating risks, attracting investment and providing regulatory certainty.

By connecting the grid more effectively, governments can share generation capacity across regions, reducing the need for additional capacity and accommodating future demand more efficiently. Increasing population growth and rising energy demand from technologies such as artificial intelligence add pressure to the system. Leveraging interconnected grids to diversify renewable energy supply sources allows for more efficient energy distribution, helping to meet future demand without immediately requiring additional large-scale infrastructure.[41]

Failing to account for these interconnected elements can lead to inefficiencies and undermine the overall stability and reliability of the power grid.



4.4 Fostering international cooperation

Effective implementation of energy transition projects requires a consistent framework for defining energy transition. Clear standards for emissions and energy benchmarks are essential to ensure all regions work towards the same sustainability goals. Governments must collaborate with industry to establish laws and regulatory frameworks that reduce uncertainty, such as global emissions standards, carbon pricing mechanisms and benchmarks for renewable energy and energy efficiency.

International cooperation is crucial for adopting energy transition technologies in developing countries, providing training and supporting project development. Currently, there is no universally accepted definition for many aspects of the energy transition, nor consensus on which industries need to reduce emissions. For example, the EU's programme for blending sustainable aviation fuel (SAF) with conventional jet fuel is not universally adopted or enforced. Establishing well-defined and stable criteria can reduce uncertainty and create a clearer path for investment.

4.5 Involving and stimulating SME participation

SMEs play a crucial role in the energy transition due to their agility, innovation and ability to reach underserved markets. While large corporations have the budget to develop and test new energy technologies, SMEs can move more quickly, helping to accelerate the commercialization of these technologies. They also have the flexibility to focus on smaller markets that large corporations may overlook and can be more responsive to local needs and priorities. This includes initiatives such as electrifying remote areas, thereby providing energy access to regions that are often energy deficient.

However, SMEs face several challenges, such as limited access to financing, regulatory barriers, lack of manpower and technological constraints. Governments can support SMEs by offering innovation funds and access to subject-matter experts to assist in the development of new technologies. One example is the Danish Energy Technology Development and Demonstration Programme (EUDP), which "funds work by enterprises and universities on demonstration of new green technologies."[42] The programme also provides development support in the form of expertise, project management, engineering and other resources.

> Governments can support SMEs by offering innovation funds and access to subject-matter experts to assist in the development of new technologies.

Another example comes from India, where the government has taken a significant step to increase SME participation in renewable energy projects by mandating that insurance security bonds (ISBs) be treated as equivalent to bank guarantees for all government procurements. ISBs are provided by insurance companies and act as a guarantee that contractors will fulfil their obligations. They are similar to traditional bank guarantees but do not require collateral. The use of ISBs is relatively common in other industries, such as construction and machinery. By not tying up a company's credit line with a bank, this mechanism frees up liquidity, allowing renewable energy companies to participate more actively in government auctions and projects.

Expanding support for energy transition projects and specifically targeting SMEs can help build a more diverse and resilient energy sector. To create a more inclusive and sustainable investment ecosystem, export credit agencies should focus on increasing their support for projects in least developed countries (LDCs) and low-income countries, while ensuring that SMEs have greater access to these opportunities.

Conclusion

Access to long-term, low-cost capital is crucial to ensuring the viability of the energy transition, with a primary focus on reducing both capital costs and the cost of capital.

Despite significant progress in global investment in the energy transition since the 2015 Paris Agreement, the world continues to face substantial challenges that could lead to a major climate crisis if urgent action is not taken. While investment levels have increased and are projected to reach $2 trillion by 2024, they remain insufficient to meet ambitious climate goals. The IEA estimates that investment will need to increase to $4.5 trillion annually by the early 2030s to meet net-zero targets by 2050.

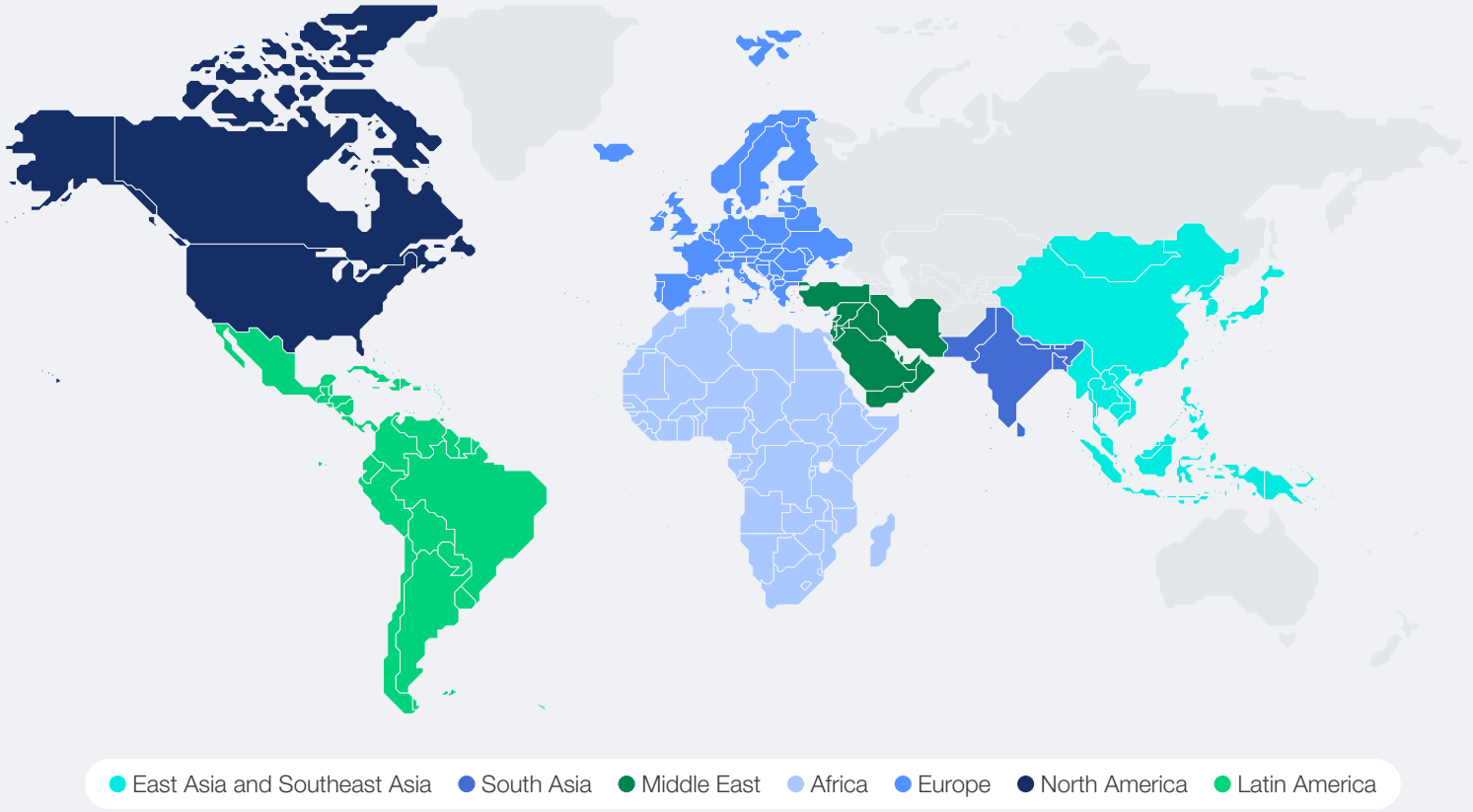
Regional analysis shows that the energy transition is progressing at different rates across Asia, Africa, the Middle East, Europe, the Americas and other regions. Although the challenges are common to all regions, their impact may vary depending on local conditions. Key challenges affecting projects include technical, economic, socio-political and regulatory factors.

To achieve a sustainable future, business leaders and policy-makers must urgently address the barriers to accelerating investments and scaling-up initiatives. Reducing the financial burden on the clean energy industry is imperative. This can be achieved by properly allocating risk among stakeholders, lenders, offtakers, contractors, equity sponsors and government agencies, and further alleviating financial constraints by leveraging blended financial solutions such as government support, philanthropic funds, development finance institutions (DFIs) and export-import guarantees. Access to long-term, low-cost capital is crucial to ensuring the viability of this transition, with a primary focus on reducing both capital costs and the cost of capital.

Creating an attractive investment environment requires international cooperation, clear standards and robust financial support. Whole-system planning and streamlined implementation timelines will reduce grid congestion and attract investors. Encouraging the participation of small and medium-sized enterprises (SMEs) can significantly contribute to technological advancement and industry growth. Ultimately, a global effort is needed to accelerate investment in energy transition technologies, reduce financing risks and create a sustainable pathway or future energy systems.

Annex

Map denoting which countries fall within the regions covered in Chapter 2



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Acknowledgments

The World Economic Forum would like to thank the Electricity Industry Chief Strategy Officers' community for their valuable ideas, contributions and feedback provided during the drafting of this report, as well as the Electricity Industry Governors' community for their direction, guidance and feedback.

In addition, the Forum would like to acknowledge the following experts, without whose contributions this white paper would not have been possible. Nevertheless, the paper does not necessarily reflect the views of these individuals or their companies. Expert advice is purely consultative in nature and does not imply any association with the takeaways or conclusions presented within this paper.

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37 Notes:

- A contract for difference (CfD) is a long-term contract between an electricity generator and low carbon contracts company (LCCC). The contract enables the generator to stabilize its revenues at a pre-agreed level (the strike price) for the duration of the contract.
- A feed-in tariff (FIT) provides a guaranteed, long-term price for renewable energy that is at or above current market rates. This guaranteed price reduces the risk and uncertainty associated with new renewable energy installations, thereby encouraging new producers to make initial investments.
- Under a feed-in premium (FIP) scheme, electricity from renewable energy sources (RES) is typically sold on the electricity spot market and RES producers receive a premium on top of the market price for their electricity production.
- Utility rate-based tariffs are documents that dictate how utility companies charge customers for their energy use. Tariffs are made up of two main costs: unit rate (the price per unit of energy) and the standing charge (a daily fee that covers the cost of supplying energy, regardless of how much energy is used).

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