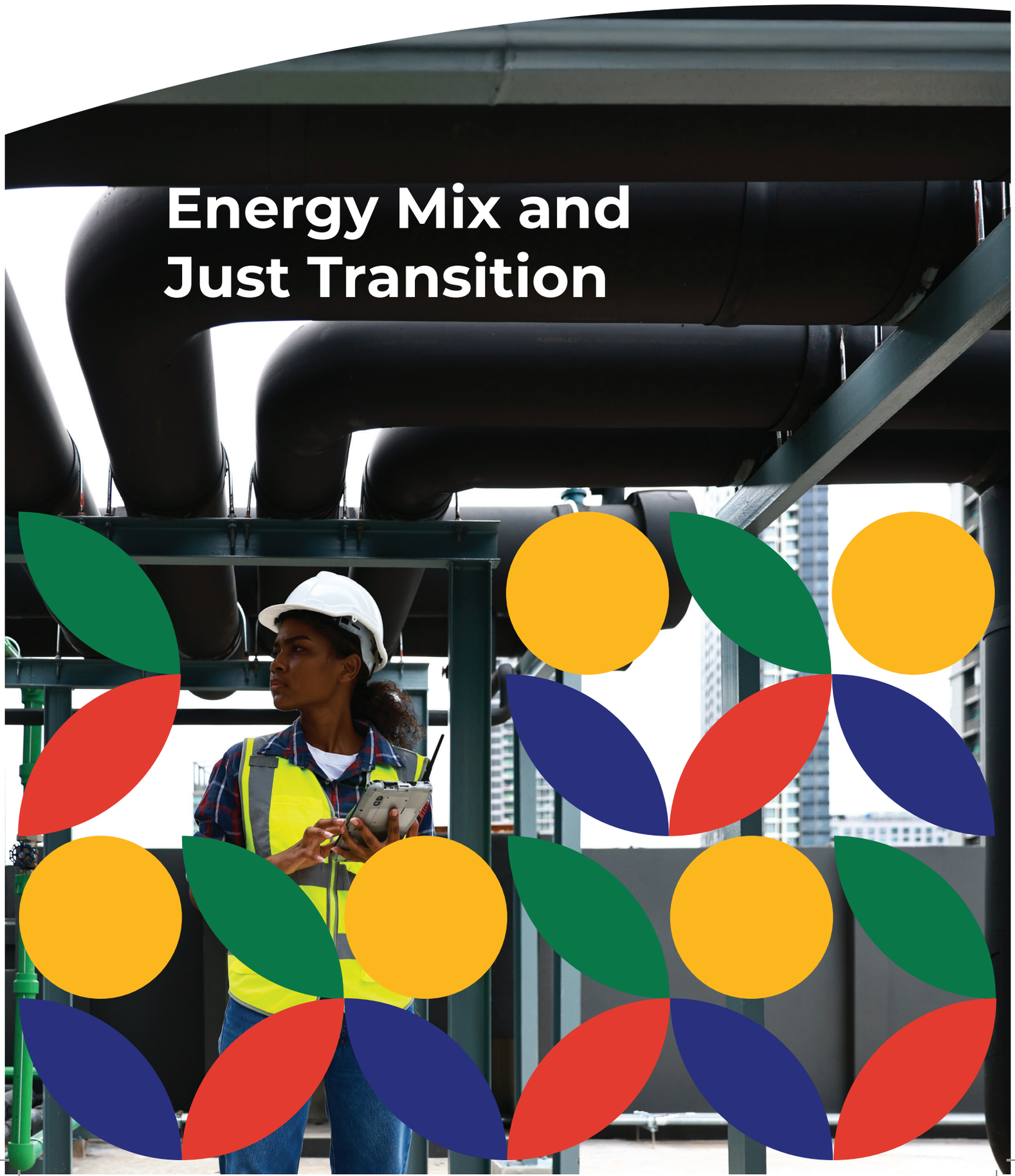
B20 SOUTH AFRICA 2025

Energy Mix and Just Transition



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Daniel Mminele
Chair of B20 South Africa Energy Mix & Just Transition Task Force
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Foreword by the Task Force Chair

We are entering a decisive moment. Energy systems across the world are under strain from widening inequality, volatile resource markets, and urgent calls for transformation. The challenge is not only to reduce emissions but to reshape how energy is produced, delivered, and used in ways that support access, resilience, and long term development. For many countries, especially those in the Global South, the energy transition must serve as a catalyst for inclusive growth and economic renewal.

This begins with financing. Emerging economies continue to face steep borrowing costs and limited access to capital for energy transition projects. What is needed now is a shift toward financial models that are scalable, affordable, and aligned with national priorities. This paper outlines solutions to reduce risk, build investor confidence, and unlock flows into energy systems that are low carbon, reliable, and equitable. Institutions must work together to deliver the right capital at the right time, and on the right terms.

The transition also presents an opportunity to expand industrial capacity. Countries rich in resources and ambition can move beyond extraction into value creation, building local industries in energy technology, processing, and services. With targeted investment in skills, technology, and regional collaboration, this shift can support job creation, economic diversification, and stronger trade participation. But success depends on access. Women, youth, and small enterprises must be empowered to lead and benefit from this change.

Infrastructure is equally vital. Outdated and underbuilt energy systems limit reliability and delay progress. Permitting backlogs, weak coordination, and limited delivery capacity continue to slow implementation. This paper proposes a more agile approach to infrastructure, built on smarter planning, local capability, and investment in systems that are flexible, digital, and resilient. Without infrastructure that works for everyone, the transition will stall.

Finance, industry, and infrastructure are interconnected. Together, they define the pace and fairness of the global energy transition. Progress will not look the same everywhere, but it must be grounded in national context and guided by shared responsibility.

At the center of this work are people. Workers, entrepreneurs, and communities must be supported through the shift. The goal is not only clean energy. It is improved lives, better opportunities, and a future shaped by those it serves.

This paper offers a practical agenda rooted in partnership and purpose. It reminds us that energy systems must do more than generate power. They must generate progress.

I extend my sincere thanks to the co-chairs, task force members, network partners, and knowledge partners whose commitment, insight, and collaboration made this report possible. Their collective efforts have shaped a rich and robust contribution to the global energy dialogue.

Forewords by the co-chairs

Co-Chairs	Forewords
 **Simon Baloyi** President & CEO, Sasol	Energy fuels progress, dignity, and opportunity. The B20 Energy Mix & Just Transition Task Force reframes energy transition as a global business and social imperative. It champions inclusive industrialisation, equitable access, and pragmatic, locally relevant pathways, laying foundations for fair energy systems that uplift communities and drive sustainable global competitiveness.
 **Eng. Peter Njenga** CEO, KenGen	Electricity underpins more than 80% of global economic activity, yet over 675 million people, primarily in Sub-Saharan Africa, remain without access. Tapping into region-specific resources like geothermal energy, especially in high-potential areas like Kenya, is vital. With sustainable financing and capacity building, such investments can lead to developing resilient energy infrastructure that delivers reliable and affordable power. This integrated approach will drive inclusive development and position emerging economies at the heart of a just and transformative global energy transition.
 **Catherine Koffman** Director, Green Climate Fund African Region	Capital deployment remains one of the most decisive factors in advancing Africa's energy transition. Mobilising investment at scale requires not only innovative finance, but the ability to direct capital toward well structured, country driven solutions. Strengthening investment collaboration modalities, early-stage risk capital to develop investable project pipelines to accelerate infrastructure delivery, and expanding inclusive access to technology and opportunity, must go hand in hand with targeted financial flows. When these elements align, catalytic transformation becomes possible.

Co-Chairs	Forewords
 **Leslie Maasdorp** CEO, British International Investment	The climate crisis is the defining challenge of our generation. This policy sets out a bold forward-looking vision for a just transition. It shows how targeted action can unlock a new era of resilience, inclusion, and shared prosperity for South Africa. The path is clear. The time to act is now.
 **Dan Marokane** CEO, Eskom	A Just Energy Transition must balance legacy systems with emerging technologies, tailored to each country's economic and historical context. This paper advocates for context-specific strategies and pathways while implementing reforms to accelerate renewable energy adoption. For Africa and other Emerging Markets and Developing Economies (EMDEs), success hinges on public-private partnerships that unlock investment opportunities, infrastructure modernisation and capacity building to achieve universal access and sustainability.
 **Mandy Rambharos** CEO, Verra	A just energy transition is a development imperative, which simultaneously solves for the climate imperative. It is by no means a panacea, but it comes close as at the heart of a truly just transition lies in a balanced, sustainable energy mix that recognizes national circumstances, leverages affordable technologies that safeguards energy security, while prioritizing socio-economic development and a healthy environment for all. Our decisions now will not only tell the story of our response to the climate crisis but will also tell the story of how we worked to protect the economic futures of future generations. This paper highlights immediate actions to finance a just transition, build resilient infrastructure, and align ambition with equity and growth. Success demands leadership grounded in courage, coherence, and compassion.

Co-Chairs	Forewords
 **Roger Martella** Executive VP & CCO, GV Vernova	The global efforts underway to electrify the planet should enable all people to realize prosperity through access to affordable, reliable, and sustainable energy and all the economic development and opportunities that come with it. At this moment, the B20 is a critical avenue to bring the gravitas of the private sector to partner with the commitments of the public sector in lifting up the planet's people through access to sustainable energy from gas to renewables and a stronger grid - building a stronger future for all.
 **Dipak Patel** Head of Climate Finance & Innovation, Presidential Climate Commission	2025 has been a tumultuous year. One in which geo-politics and regional conflicts have dominated the headlines, and one in which the climate response agenda has faced headwinds. Climate change impacts are manifesting with greater force across the globe. It has never been more urgent and critical to implement appropriate energy pathways that achieve dual outcomes – economic growth and development, and emissions mitigation – through a just transition. This report, based on scientific, empirical and economic analysis, makes far-reaching and implementable recommendations to green the energy system whilst maintaining energy security and increasing access and affordability.
 **Paolo Scaroni** Chairman, Enel	Securing the energy transition depends not only on the quantity of sustainable energy produced, but also on how reliably and efficiently it is delivered. Investments are needed to upgrade and digitise electricity grids to connect and integrate renewable energy resources, enhance resilience, facilitate widespread clean electrification and ensure long-term energy security. This requires clear regulatory frameworks, stable governance and strong public-private collaboration. To attract and sustain investment on a large scale, it is crucial to implement solid guarantee mechanisms that provide investors with the long-term confidence they need to support vital energy infrastructure.

Co-Chairs	Forewords
 **Zhang Zhigang** Executive Chairman, State Grid Corporation of China	In pursuit of climate goals and energy transition, it is imperative to build a new-type power system and a new-type energy system with breakthroughs in key technologies. Collective efforts under a fair energy governance framework such as B20 will navigate us through this crucial transformation period towards a secure, affordable and sustainable energy future.
 **Jean-Pierre Clamadieu** Chairman, Engie	The B20 in South Africa is taking place during yet a new year of uncertainties. Achieving net-zero emissions is more than ever necessary as the effects of climate change intensify worldwide. We must use all available methods at our disposal to transition to sustainable energy: from an enhanced global collaboration that can support the development of renewable power sources, gases, grids, energy efficiency, and flexible solutions to new requirements for an established regulatory framework that includes appropriate policies and financing models. In the context of geopolitical turmoil affecting energy value chains, maintaining economic competitiveness and quality of life remains important.
 **Daniel Godinho** Director of Sustainability & Institutional Relations, WEG	The transition to a cleaner and more efficient energy model is not only an environmental necessity, but also a unique opportunity to boost economic development and ensure energy security. A balanced energy mix, incorporating battery energy storage systems (BESS), is essential to achieve these goals, ensuring the diversification and resilience of the energy sector. Another key area that must be always in the top priority is energy efficiency, which is the easiest, fastest and cheapest path for energy transition and decarbonization.

Recommendations: Executive Summary

The global energy landscape stands at a critical juncture. Geopolitical fragmentation, climate shocks, and rising competition over critical energy resources are straining energy systems and exposing global inequalities. Many countries in the Global South still lack access to affordable, reliable energy. At the same time, climate risks highlight the importance of decarbonising energy systems in a progressive manner that reflects national development priorities. The world needs an energy transition that reduces carbon emissions, expands low-carbon energy access, supports economic development, and protects the most vulnerable groups. This transition must be fair, country-specific, and supported by collaboration across governments, the private sector, and development institutions. Inclusive growth will also require stronger regional coordination on infrastructure, trade, and resource strategies to ensure a secure and sustainable energy mix.

To achieve this energy transition, global efforts must focus on four strategic pillars: strengthening geopolitical alignment, improving energy access and security, ensuring a just and pragmatic transition, and mobilising finance at scale. While all nations are navigating the shift, emerging markets and developing economies (EMDEs) are the most vulnerable to climate impacts, facing disproportionate exposure to extreme weather, resource scarcity, and economic shocks. It is imperative that the G20 approaches the energy transition with both urgency and care, acting swiftly to ensure that decarbonisation efforts are not only timely, but thoughtfully structured to support EMDEs in navigating a just, resilient, and inclusive transition.

The Energy Mix and Just Transition Task Force puts forward three recommendations to galvanise action. These focus on mobilising energy transition finance at scale, supporting industrialisation across the energy value chain, and unlocking investment in critical energy infrastructure. To ensure accountability and measurable impact, the paper incorporates clear milestones and Key Performance Indicators (KPIs) to guide implementation and track progress across all pillars. It also recognises that women, youth, and underrepresented communities must not only benefit from the energy transition but play a central role in leading it. Accordingly, the Task Force advocates for gender-responsive KPIs, support for local entrepreneurship, and universal energy access, not as afterthoughts, but as prerequisites for inclusive and sustainable prosperity.

Recommendation 1:

Mobilising Sustainable Energy Transition Finance at the Scale and Speed Required to Achieve a Just and Inclusive Global Energy transition

Action 1.1: De-Risk Energy Transition Finance in EMDEs

Increase capital flows for energy transition investments in EMDEs by working with International Development Financial Institutions (DFIs), Local Financial Institutions (LFIs), Multilateral Development Banks (MDBs), Export Credit Agencies (ECAs) and the International Monetary Fund (IMF) to reform deployment rules and expand financing tools that lower perceived investor risks and mechanisms to mobilise institutional capital.

Action 1.2: Enhance Adaptation Finance

Enhance adaptation finance flows by launching a G20 Adaptation Finance Accelerator, setting regional targets, and supporting project pipelines through technical assistance and interoperable global project frameworks, and expanding nature-based solutions for adaptation.

Action 1.3: Institutionalise Country Platforms

Institutionalise country platforms (CPs) by developing integrated national energy transition finance roadmaps, simplifying DFI funding access, legally codifying plans, and expanding participation and local empowerment in designs.

Action 1.4: Improve Private Investment Certainty

Improve private investment certainty by establishing stable revenue and demand signals (e.g., PPAs, CfDs, procurement contracts) and creating enabling regulatory environments through clear incentives and mutually recognised taxonomies.

Action 1.5: Strengthen Domestic Carbon Markets

Enhance the effectiveness and credibility of carbon markets by scaling domestic carbon pricing systems, aligning credit frameworks through mutual recognition and high-integrity standards, and strengthening local capacity to manage market infrastructure.

Medium to long term KPIs (5-25 years):

- Increase international financing for Just Energy Transitions (JET-Ps) by 7x, from USD 45 B to USD 330 B by 2040
- Increase the percentage of energy transition investment needs met in EMDEs to 70-80% by 2040
- Achieve 50% adoption rate for the G20-endorsed country platform framework by 2040

Recommendation 2:

Accelerating Industrialisation Across the Energy Value Chain to Promote a Just Energy Transition Through Skills Development, Supply Chain Resilience, and Global Market Access

Actions:

Action 2.1: Equip Workforces for the Energy Transition

Equip EMDE workforces for the evolving energy landscape by expanding access to future-ready skills training and building integrated training-to-employment ecosystems that support regional job mobility and economic participation.

Action 2.2: Build Sustainable Supply Chains and Market Access

Build resilient energy-sector supply chains and improve market integration by enhancing trade partnerships, offering targeted export incentives, establishing local manufacturing hubs, and advancing critical minerals beneficiation in EMDEs.

Action 2.3: Expand Access to Advanced Energy Technologies

Expand access to energy technologies in EMDEs by scaling open intellectual property platforms, enabling affordable licensing through a G20 patent pool, and promoting voluntary, innovation-friendly licensing frameworks.

Medium to long term KPIs (5-25 years):

- Increase the global value unlocked through industrialisation across sustainable energy value chains by 5x to USD 11 T by 2040
- Increase the percentage of national workforces employed in local sustainable energy industries to 5-10% by 2040
- Facilitate 5 technology transfer agreements p.a. through a G20 Energy Tech Platform by 2040

Recommendation 3:

Accelerating the Expansion and Modernisation of Energy Infrastructure to Increase Energy Efficiency, Access and Reliable Power Supply

Actions:

Action 3.1: Enhance Climate-Resilient Energy Infrastructure

Enhance energy infrastructure resilience to climate shocks by establishing a G20 knowledge hub, supporting global markets through mutually recognised standards for resilient sustainable technologies, and integrating climate risk into infrastructure planning.

Action 3.2: Develop Flexible, Integrated Energy Systems

Build flexible, shock-responsive, and interconnected energy systems by aligning national and regional infrastructure plans, embedding digital and modular design, and expanding regional power markets and cross-border data systems.

Action 3.3: Accelerate Local Energy Infrastructure Delivery

Accelerate infrastructure delivery in local governments by streamlining permitting through centralised digital platforms, fast-track approvals, and targeted technical support to local communities.

Medium to long term KPIs (5-25 years):

- Double global annual investments in grid infrastructure to USD 780 B by 2040.
- Achieve 50% adoption of the G20-endorsed infrastructure development framework by 2040.
- Upgrade 80 M km of grid infrastructure by 2040

Note: While this paper strongly supports the scaling of renewables, it recognises that fossil fuels such as natural gas will remain an important part of the energy mix in G20 economies as they transition. Where necessary, these fuels may provide critical balancing capacity and serve as industrial inputs as renewable systems scale. Over time, they can be gradually replaced by decarbonised alternatives. A just transition must therefore include time-bound, practical pathways that safeguard energy security, jobs, and social stability alongside climate goals.

Introduction

The global energy landscape stands at a critical juncture, where the imperatives of energy access and security, economic equity, and climate responses intersect amid rising geopolitical tensions and developmental disparities. In this paper, we define energy to encompass the full range of sources, carriers, and associated processes and systems, including conversion, storage, transmission, end-use, capture, and recycling, that power economies and societies. This includes electricity (from both renewable and non-renewable sources), fossil fuels (such as coal, oil, and natural gas), critical minerals essential for energy technologies (e.g. lithium and cobalt), and renewable fuels such as biomass, energy crops and emerging fuels like green hydrogen. It also covers the infrastructure and technologies that enable energy production, transformation, and use, such as electricity transmission and distribution networks, electric mobility systems, refineries, fuel storage, industrial processing facilities, and in extreme instances[i], carbon capture, utilisation, and storage (CCUS) networks.

As climate impacts rise and global energy systems evolve, transitioning toward more sustainable and resilient models is becoming an important component of long-term development and economic strategy. Yet this transition is unfolding in a fragmented global context shaped by rising protectionism, resource nationalism, uneven climate commitments, and stark disparities in access to energy and finance. In this environment, international cooperation remains essential for aligning trade, investment, and technology flows, but strengthening domestic, and regional capabilities and alignment across the energy value chain is increasingly vital for ensuring energy security, building long-term economic resilience, and advancing global climate goals.

Geopolitical dynamics play an increasing role in shaping the pace and direction of the global energy transition. The fragmentation of multilateral cooperation and growing competition over critical resources are redefining energy diplomacy and reshaping supply chains. As countries seek to secure access to critical minerals and energy inputs, these assets are becoming key leverage points in a rapidly evolving global order. In this context, supply chain resilience and energy security have emerged as central priorities, sometimes at odds with climate ambitions.

[i] “Extreme instances” in the context of deploying carbon capture utilisation and storage refer to exceptional, often high-risk or high emergency scenarios in which a country or region must rely on CCUS technology to achieve deep decarbonisation of hard to abate industrial sectors such as cement, steel and chemicals. These circumstances typically involve a combination of technical, economic, environmental and geopolitical pressures that make conventional decarbonisation pathways either infeasible or insufficient.

Africa sits at a strategic crossroads in this new order. Its vast reserves of critical minerals, such as cobalt, lithium, and rare earth elements, are central to the technologies underpinning the energy transition. This resource wealth offers African countries a unique opportunity to integrate into high-value global supply chains and accelerate industrial development. At the same time, weak governance, environmental risks, and extractive legacies, among other factors [ii], pose serious challenges. If unaddressed, these could entrench existing inequalities and reinforce a model of external dependence. The geopolitics of mineral supply chains, therefore, presents both promise and peril for the continent, a window of opportunity that must be navigated with strategic clarity and a focus on accessibility.

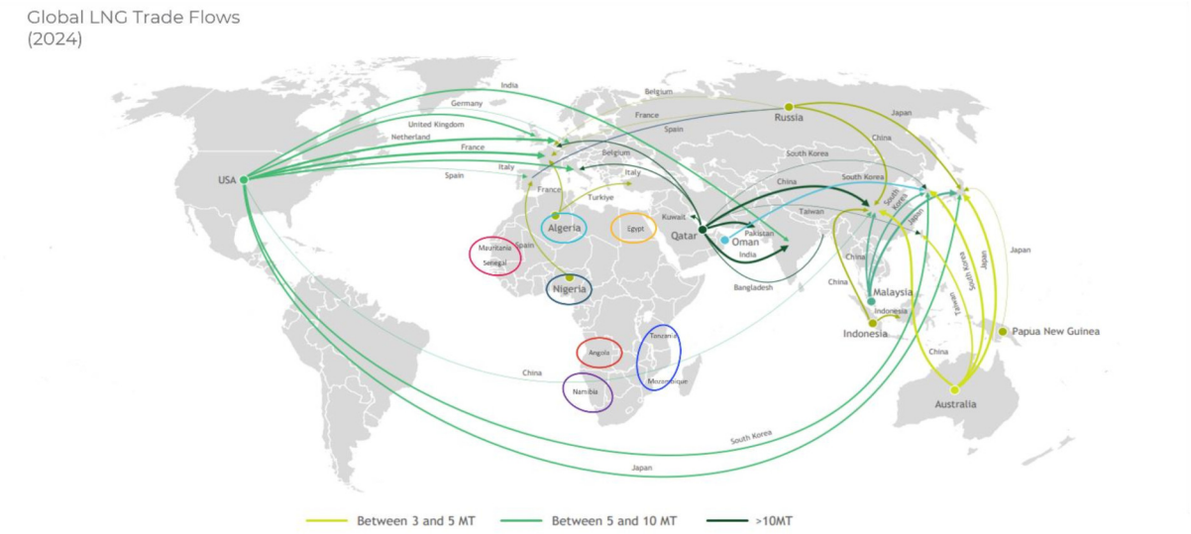
Natural gas and liquified petroleum gas (LPG) play a prominent role in the evolving global energy mix, as lower-emission fossil fuels and designated "transition fuels" in some jurisdictions. Natural gas offers a pathway to expand low-carbon electricity access, particularly through Gas-to-Power initiatives[74]. For many emerging gas producers, monetising domestic reserves through local power generation can support energy access, industrialisation, and economic growth, while reducing emissions associated with coal or diesel[74]. In coal-dependent economies like South Africa and India, repurposing existing coal-fired plants to run on gas can significantly reduce emissions intensity while maintaining grid reliability[74]. These applications reinforce the role of natural gas as a transition fuel, providing flexible, lower-carbon generation while renewables scale[74] and decarbonised sources are gradually deployed. In some instances, LPG can play a role in facilitating energy access and replacing biomass as a cooking fuel. This can help to unlock emissions reductions and raise living standards many low-income and rural settings.

Recent geopolitical disruptions (including OPEC's supply decisions and responsive shifts in international trade measures) have reshaped Liquified Natural Gas (LNG) flows, elevating suppliers like Qatar and Australia. While Exhibit 1 shows that Africa remains underrepresented in current global LNG trade flows, this does not reflect the continent's emerging position. Gas-rich countries such as Mozambique, Nigeria, and Senegal, alongside newer players like Tanzania and Namibia, are developing multiple LNG clusters that are now at or near bankability[79]. As a result of these emerging players, export capacity is projected to rise by up to 69 million tonnes per annum (MTPA) from the current 72 MTPA[79]. If supported by sustained investment, transparent governance, and regional coordination, these clusters could enable Africa to participate more meaningfully in global LNG flows over the coming decade. Cross-border infrastructure, shared logistics, and complementary policy frameworks will be key to unlocking this potential.

At the same time, African countries that are net importers of gas face a different set of risks. Increased dependence on volatile global LNG markets can undermine energy security, strain public budgets, and expose economies to geopolitical shocks. The war in Ukraine highlighted how quickly gas supply disruptions can escalate into broader crises. For African importers without domestic reserves or diversified energy systems, importing LNG may deliver short-term relief but deepen long-term vulnerability. Additionally, domestic gas demand is rising rapidly across the continent, driven by industrialisation and the need to expand electricity access. Policymakers must carefully balance export opportunities with local development[79].

[ii] "Other factors" include technology, economic, social, political, and environmental risks, as well as policy, legislative, skills, market, and infrastructure-related challenges.

Exhibit 1: Major Global LNG Trade Flows & Gas-producing Nations in Africa



Source: GIIGNL, Standard Bank (2025), BCG analysis

For Africa, shifting trade dynamics have further complicated the region's energy and industrial transition. Universal trade measures imposed by the United States, such as the 25% duties on steel and aluminium, have increased infrastructure costs and created new frictions in low-carbon energy supply chains. Continuous policy adjustments have caused the broader trade policy landscape to remain fluid, further contributing to uncertainty for EMDE exporters. In tandem, the EU's Carbon Border Adjustment Mechanism (CBAM) introduces additional trade challenges for African exporters whose industries remain carbon-intensive due to limited decarbonisation finance or technological access. CBAM is a border carbon adjustment (BCA) mechanism designed to price the carbon embedded in imported goods, ensuring that foreign producers face similar carbon costs to their domestic counterparts. To address the practical complexity of measuring emissions at the product level, the typical BCA model adopts a phased implementation. Early coverage focuses on upstream sectors such as cement, electricity, and hydrogen, where emissions are relatively easier to measure. Thus, while CBAM is intended to create a level playing field by ensuring that imported goods face comparable carbon costs to those produced within the EU, its implementation may disproportionately affect countries with constrained transition capacity. Without proactive investment in local manufacturing capabilities, low-carbon energy deployment, and regulatory adaptation, African economies risk becoming further marginalised in global markets.

These geopolitical developments must be understood in parallel with climate risks, which place additional pressure on vulnerable regions such as Africa to adapt and respond, despite their minimal contribution to global emissions.

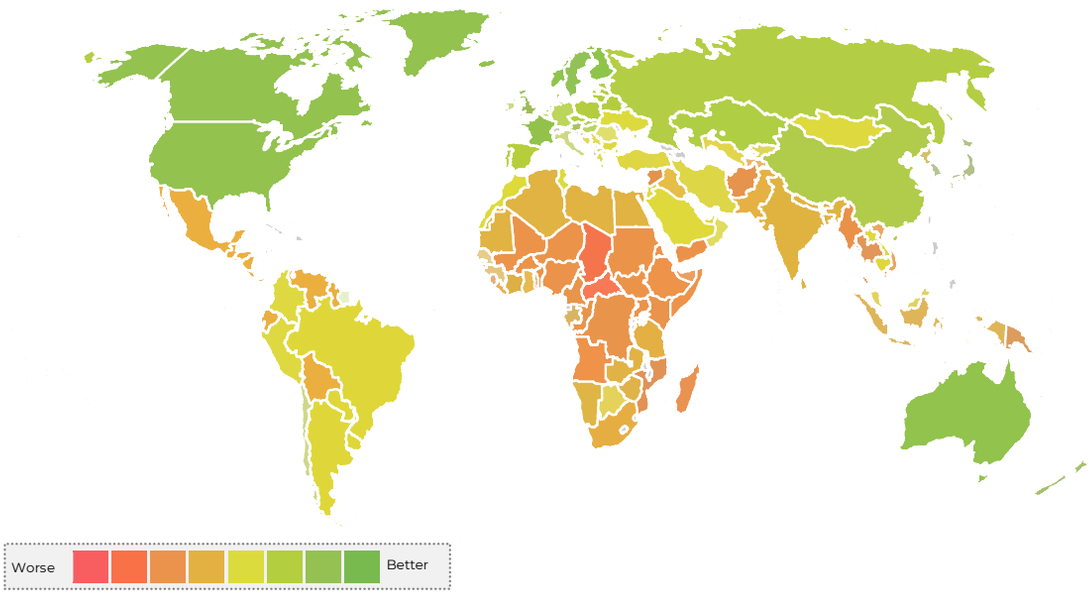
Science confirms that limiting global warming to well below 2°C is essential to avoid catastrophic climate impacts[1]. Yet progress toward this target remains inadequate. This raises the risk of future climate scenarios with severe environmental and socio-economic consequences. Regions least responsible for emissions, like Africa, which accounts for less than 4% of historical emissions, are most vulnerable to these impacts[80], as shown in Exhibit 2.

This climate vulnerability is compounded by energy poverty in emerging economies, particularly in Sub-Saharan Africa, the Middle East, and South Asia. Exhibit 3 shows that

over 600 million people in Sub-Saharan Africa still lack access to electricity[3], and energy infrastructure remains heavily centralised and unevenly distributed. These gaps are worsened by limited affordability and insufficient energy production and conversion capacity, making it difficult for many countries to meet rising demand, exacerbated by current weather-related disasters. Therefore, the energy transition cannot be achieved through emissions reductions alone. In Africa and many parts of the Global South, an energy addition must also be prioritised. Expanding reliable and affordable energy supply is essential to meet rising demand, support industrialisation, and enable inclusive, low-carbon development.

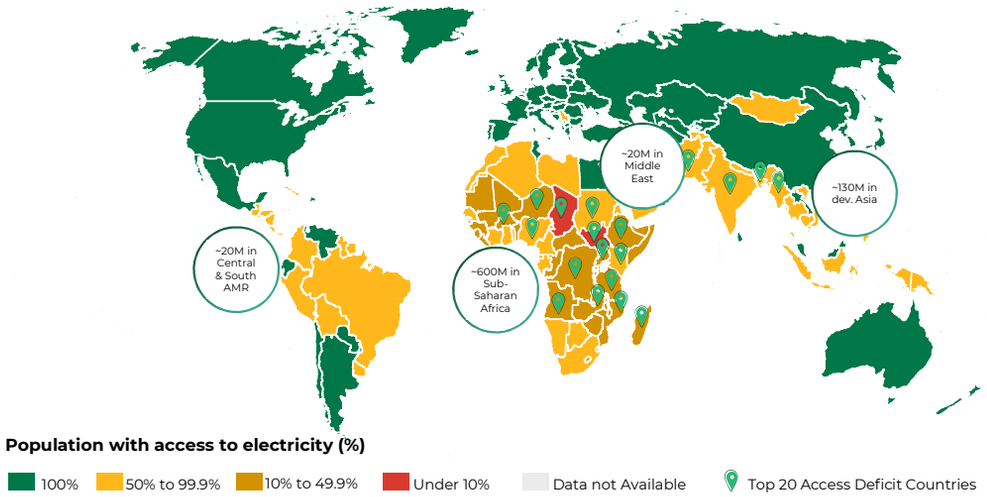
Energy insecurity is not limited to emerging economies. In many advanced economies, outdated infrastructure contributes to transmission losses, inefficiency, and grid vulnerability. These infrastructure limitations, whether due to ageing grids in industrialized nations or underbuilt systems in developing ones, pose a growing threat to global energy security. Infrastructure development, particularly in transmission and distribution networks, has struggled to keep pace with rising energy demand and the rapid integration of new energy sources. This widening gap threatens to delay national deployment targets, increase energy system costs, and undermine the reliability and flexibility of power supply. Without investment and integrated planning, infrastructure bottlenecks will continue to constrain progress toward universal access, energy affordability, and a secure, low-carbon future.

Exhibit 2: Country vulnerability index for risk to climate impact



Source: Notre Dame Global Adaptation Initiative (2024)

Exhibit 3: Global view on electricity access

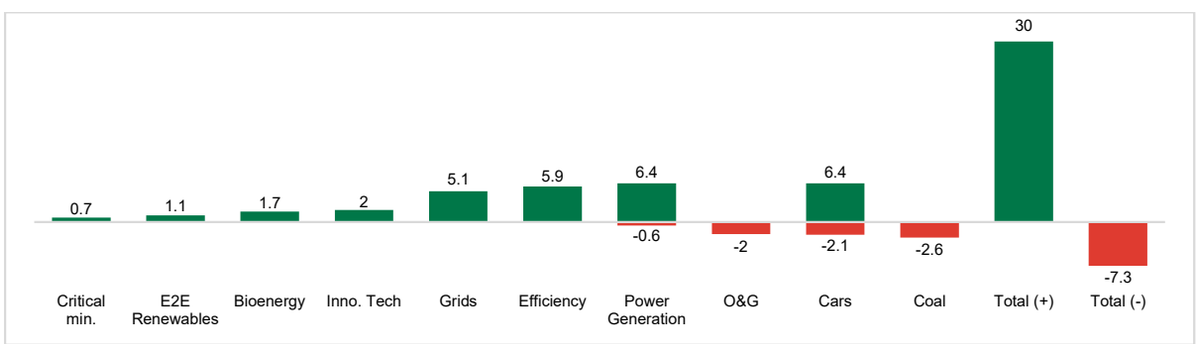


Source: World Bank (2022)

The transition to a low-carbon economy, while essential, carries significant socio-economic risks if not managed with foresight and inclusivity. Without thoughtful planning, rapid decarbonization could deepen global inequalities, particularly in developing countries. Exhibit 4 shows that fossil fuel-dependent sectors, such as coal, are projected to lose over 7 million jobs globally by 2030, according to the IEA's Net Zero Emissions Scenario[4]. However, this is offset by the creation of approximately 30 million new jobs across sectors such as renewable energy, energy efficiency, power generation, and grid infrastructure[4]. While the shift presents a net employment gain, it could still result in widespread job losses, economic dislocation, and social unrest in the absence of deliberate policy action. Countries that lack the institutional capacity and workforce readiness to absorb these changes may be particularly vulnerable, underscoring the importance of integrating job creation strategies and social protection into energy transition planning.

For the Global South, which often relies heavily on fossil fuel exports and industrial structures tied to carbon-intensive energy, the transition poses a dual challenge: pursuing sustainable economic development while transitioning to sustainable fuels. Without deliberate, proactive policy measures, these regions risk premature deindustrialisation and long-term socio-economic instability. Trade policies, such as carbon border adjustments, must also be designed with flexibility and fairness to allow emerging markets the space and time needed to adapt effectively.

Exhibit 4: Change in global low-carbon energy and related industry jobs by 2030 (M) under IEA Net Zero scenario (NZE)



Source: International Energy Agency (IEA) (2021)

Yet alongside these risks lie transformative opportunities. The Global South, particularly countries like the Democratic Republic of Congo, Chile, and Indonesia, holds substantial reserves of critical minerals such as cobalt, copper, lithium, Platinum Group Metals (PGMs), nickel and many more. These resources are becoming increasingly essential to energy transition technologies, surging global demand. While many of these mineral-rich countries lead in raw material extraction, downstream activities such as processing, refining, and sustainable energy technology manufacturing are still concentrated in a few selected regions globally[83]. Such concentration creates vulnerabilities and uncertainties, threatening the affordability and timely deployment of low-carbon energy technologies, causing implications for sustainability and energy security in the energy transition[60].

Against this backdrop, mineral-rich nations in the Global South have an opportunity to move beyond extractive roles and invest in local beneficiation, refining capabilities, and industrial diversification. By doing so, they can capture greater value within global supply chains, drive sustainable industrialisation, and play a more influential role in shaping the future of low-carbon and sustainable energy technologies. Importantly, local value addition of critical minerals would offer mutual benefits for both EMDEs and advanced economies. It could help build stronger, more diversified global supply chains by reducing reliance on single-country suppliers, increasing global production capacity, and enhancing supply flexibility and geopolitical stability. As a result, global energy security would be strengthened.

To seize these opportunities while managing risks, countries must be empowered to develop context-specific, balanced energy strategies aligned with their national pathways. A just and pragmatic transition will require a diversified energy mix in the near term, including transition fuels such as natural gas, low-carbon hydrogen and select biofuels. Alongside renewable energy systems, these fuels will play a stabilising role by providing reliability and, as those systems scale and storage technologies mature. Since sources like wind and solar are intermittent, sustainable dispatchable energy sources and emerging technologies, including storage hydropower, nuclear energy, geothermal, green hydrogen and battery storage, should also be considered in the optimal energy mix[iii] to ensure reliable and resilient energy supply.

This approach must be underpinned by scientific evidence, take place within affordability constraints, and be supported by the development and deployment of technologies that can reduce emissions. Decarbonisation can only be achieved through a technology-neutral approach, one that does not rely on a single solution but applies a mix of technologies based on their effectiveness, maturity, and suitability in different country-specific contexts, while balancing the core dimensions of the energy quadrilemma: sustainability, energy security, affordability, and access. Thus, transition fuels may serve as time-bound solutions in economies that face near-term affordability or reliability constraints, while long-term strategies should focus on enabling a complete transition to sustainable, resilient energy systems.

[iii] The “optimal energy mix” refers to the combination of energy sources — across renewables, transition fuels, and low-carbon dispatchable technologies — that best meets the energy needs of a country or region in terms of affordability, reliability, sustainability, and security. It is shaped by local resource availability, infrastructure capacity, policy goals, and socio-economic priorities.

In this context, biomass and biofuels could represent a viable and context-appropriate element within a diversified transition strategy. These sources can offer low-carbon alternatives to fossil-fuels across sectors such as power generation, transportation, and industry. This is particularly true for countries with strong agricultural sectors and existing feedstock supply chains as these fuels are derived from organic materials like agricultural residues, forestry byproducts, and energy crops. In certain cases, fuels such as biomethane, hydrotreated vegetable oil (HVO), and sustainable aviation fuel (SAF) may offer an immediately deployable, technically mature option to support decarbonisation across a broad range of applications, from light- and heavy-duty road vehicles to aviation and maritime transport[92]. While they are especially important in hard-to-electrify segments, they also offer a near-term pathway to reduce emissions from existing internal combustion fleets and fuel infrastructure. Their integration not only supports emissions reductions but also promotes broader development goals by stimulating rural economies, generating employment, and enhancing energy access[93]. The inclusion of efficient biofuels, alongside other transition options, may help countries bridge near-term implementation gaps while building toward longer-term energy security and resilience.

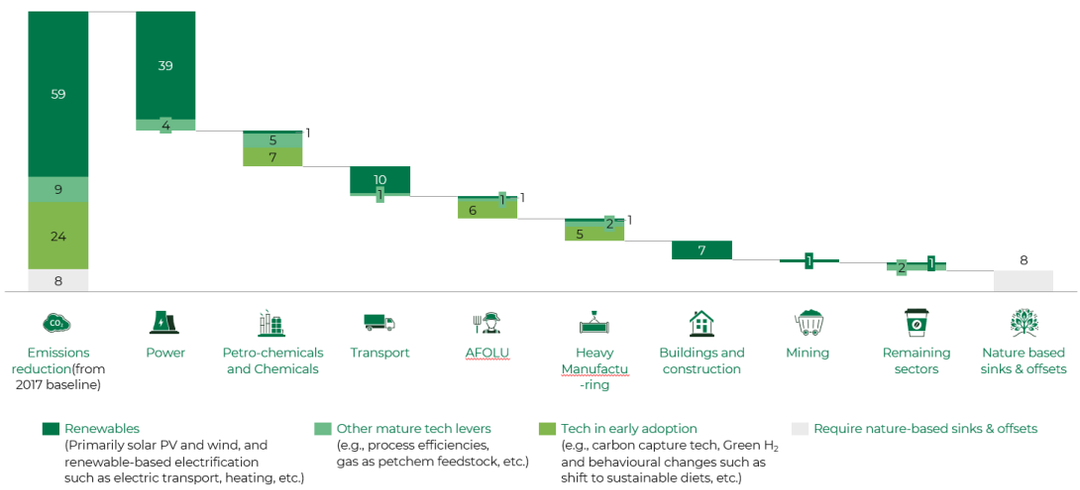
Similarly, geothermal energy holds significant potential as a reliable, low-emission source, particularly in regions like East Africa[100]. With an estimated 15,000 MWe of geothermal capacity in the East African Rift System alone[100], this resource offers a stable, context-appropriate option to support energy security and industrial development, especially in countries such as Kenya, Ethiopia, and Tanzania[100].

In parallel, many fossil-fuel dependent EMDEs may face significant constraints in transitioning away from carbon-intensive sources like coal, even with the availability of transition fuels. In such extreme instances, coal may remain economically and socially necessary as part of the energy mix for a longer period, as countries transition toward renewables. In some cases, coal may also be needed as a transition technology to maintain system stability, especially where alternatives are not yet technically or financially available. Therefore, emerging technologies to mitigate coal emissions, such as CCUS, could be developed in advanced economies and shared with EMDEs. For example, Italy's Ravenna CCS project, a large-scale initiative that captures CO_2 from industrial sources and stores it offshore using repurposed infrastructure, demonstrates how mature, high-efficiency CCUS can support the decarbonisation of hard-to-abate sectors while preserving jobs and leveraging local expertise[102]. In Saudi Arabia, the Aramco CCS hub in Jubail is designed to support the capture and sequestration of 9 $MtCO_2$ emissions per year in the first phase of the project, which is planned to be operational by 2027. The hub aims to help meet the country's interim sequestration target, announced at COP26. The emergence of such technologies can help enable decarbonisation at a pace that safeguards energy security, social stability, and economic resilience which are core pillars of a just transition.

In the long term, renewable energy will likely prevail in parts of the world and dominate the global energy mix. Renewables have the potential to lead the way in achieving sustainability, affordability, and energy security. Solar and wind are now more cost-competitive than fossil fuels in many countries[85]. These sources are also quicker to deploy and bring fewer social and environmental risks[85]. The decentralised nature of renewable energy also offers a unique opportunity to improve access in underserved areas, reduce transmission losses, and support environmental outcomes. As renewables slowly outpace fossil fuels in modern electricity generation capacity across global markets[85], they have emerged as a forward-looking option for governments, contributing to energy resilience, economic development, and financial stability.

South Africa offers a compelling example of how targeted, sector-specific approaches could align national development goals with climate objectives. National emissions data as shown in Exhibit 5 highlights significant abatement potential in power, petrochemicals, and transport sectors. By pursuing tailored policies that reflect local conditions, countries can reduce emissions while promoting sustainable economic growth and job creation.

Exhibit 5: South Africa case study – National direct annual emissions[1] abatement potential by decarbonization lever category (percent)



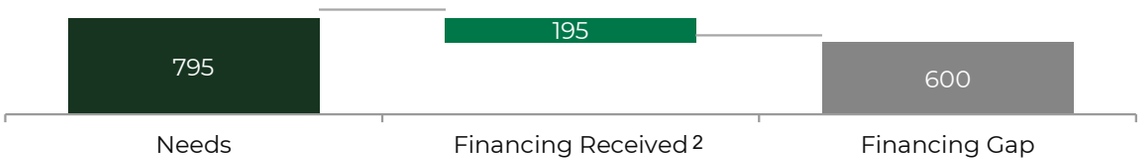
1. Direct emissions refer to scope 1 emissions
Source: GHGI (2017), IEA (2015), WEO (2019); CDP (2015), GHGI (2015), CAT, NBI-BCG Project team

While national policy alignment is critical, the success of transition strategies also depends on how well they address the needs of people and communities most affected by change. It is important to ensure that the energy transition is fundamentally people-centred. This includes a particular focus on women and Micro, Small and Medium-sized Enterprises (MSMEs), alongside other vulnerable groups [iv]. MSMEs employ a large share of the workforce[94] and are uniquely positioned to contribute across the energy value chain, including in sectors such as biofuels, waste management, maintenance, and decentralised energy services[95]. Women, too, are central to climate and development outcomes, yet continue to face systemic barriers to financial access and participation in energy markets, despite growing evidence that investing in women enhances innovation, resilience, and job creation in sustainable energy industries[96]. However, both groups continue to face systemic barriers that limit their participation in the transition. Access to finance remains a primary constraint[97], alongside persistent challenges related to skills development constraints and limited access to opportunity[95]. A just transition must therefore go beyond technological deployment and decarbonisation metrics to include deliberate efforts to expand opportunity, reduce exclusion, and support locally rooted economic resilience.

[iv] "Other vulnerable groups" include youth, workers affected by the phaseout of high-emission sectors, and communities at risk of exclusion from the social and economic benefits of the energy transition — particularly those in underserved or marginalised areas.

Despite growing ambition and policy progress, financing remains a critical constraint to large-scale implementation. In 2023, global sustainable energy finance[v] was estimated to exceed $ 1.5 trillion[10], from finance sources including public actors (e.g., governments and development finance institutions) and private actors (e.g., corporations and commercial financial institutions). This is still far short of the $ 4.5 trillion needed annually by the early 2030s, to support the energy transition to net zero emissions by 2050[13]. Exhibit 6 shows that Africa alone is estimated to face a USD 600 billion shortfall in adaptation and resilience funding through to 2035[8], receiving only a small share of total global climate finance, despite facing the gravest threats[10]. Bridging this gap through equitable and timely financing mechanisms is essential to achieving a just transition.

Exhibit 6: Estimated Africa Adaptation Finance Needs vs. Received1 (US $Bn) through 2035



1. Over 95% of current adaptation finance flows to Africa come from public sources, including 63% from multilateral DFIs, and 30% from governments and bilateral DFIs; 2. Finance needs and received are extrapolated estimates assuming 2021-2022 averages are maintained through to 2035
Source: Climate Policy Initiative (CPI) & Global Center on Adaption (GCA) (2024)

Encouraging signs of progress are emerging. The European Union's investment in low-carbon development, record levels of climate finance, and increased commitments and investment from traditional energy sectors toward low-carbon solutions (LCS) signal a growing alignment with climate goals. Africa's greenfield potential, enabled by abundant renewable resources and the ability to build modern energy systems from the ground up, presents an unprecedented opportunity to build sustainable, resilient energy infrastructure[9].

As the world navigates this defining transition, it is essential to adopt a balanced approach that integrates energy security, geopolitical cooperation, and socio-economic equity. Successfully navigating the global energy transition demands a coordinated strategy, one that strengthens international cooperation, expands electrification and energy access, mobilises sufficient finance, and champions a just and inclusive transition. The energy transition is not simply about replacing fossil fuels with renewables, it is a fundamental economic transformation, reshaping entire systems of production, industrial processes, and value chains across all sectors (a materials transition), while creating opportunities to uplift vulnerable communities and drive inclusive, sustainable development. Through strategic policy design, robust financing mechanisms, and international solidarity, we can unlock the full potential of a global energy transition that works for all. Across three recommendations, this policy paper explores these interconnected imperatives in depth, with exhibits throughout highlighting critical challenges, trends, and opportunities for shaping a more resilient and equitable global energy future. While the paper takes a comprehensive view of energy systems and technologies, it places particular focus on electricity infrastructure, with an emphasis on transmission and distribution in Recommendation 3, reflecting its critical importance for expanding electrification, integrating renewables, and ensuring reliable power delivery across sectors.

[v] In this context, "sustainable energy finance" refers to primary financing directed to real economy sectors that actively contribute to reducing GHG emissions and enhancing climate resilience, as defined by Climate Policy Initiative (CPI) (2024).

Recommendation 1

Mobilising sustainable energy transition finance at the scale and speed required to achieve a just and inclusive global energy transition

Recommendation 1:

Mobilising Sustainable Energy Transition Finance at the Scale and Speed Required to Achieve a Just and Inclusive Global Energy Transition

Actions:Action 1.1: De-Risk Energy Transition Finance in EMDEs

Increase capital flows for energy transition investments in EMDEs by working with International DFIs, LFIs, MDBs, ECAs and the IMF to reform deployment rules and expand financing tools that lower perceived investor risks and mechanisms to mobilise institutional capital.

Action 1.2: Enhance Adaptation Finance

Enhance adaptation finance flows by launching a G20 Adaptation Finance Accelerator, setting regional targets, and supporting project pipelines through technical assistance and interoperable global project frameworks, and expanding nature-based solutions for adaptation.

Action 1.3: Institutionalise Country Platforms

Institutionalise country platforms (CPs) by developing integrated national energy transition finance roadmaps, simplifying DFI funding access, legally codifying plans, and expanding participation and local empowerment in designs.

Action 1.4: Improve Private Investment Certainty

Improve private investment certainty by establishing stable revenue and demand signals (e.g., PPAs, CfDs, procurement contracts) and creating enabling regulatory environments through clear incentives and mutually recognised taxonomies.

Action 1.5: Strengthen Domestic Carbon Markets

Enhance the effectiveness and credibility of carbon markets by scaling domestic carbon pricing systems, aligning credit frameworks through mutual recognition and high-integrity standards, and strengthening local capacity to manage market infrastructure.

Milestones and KPIs

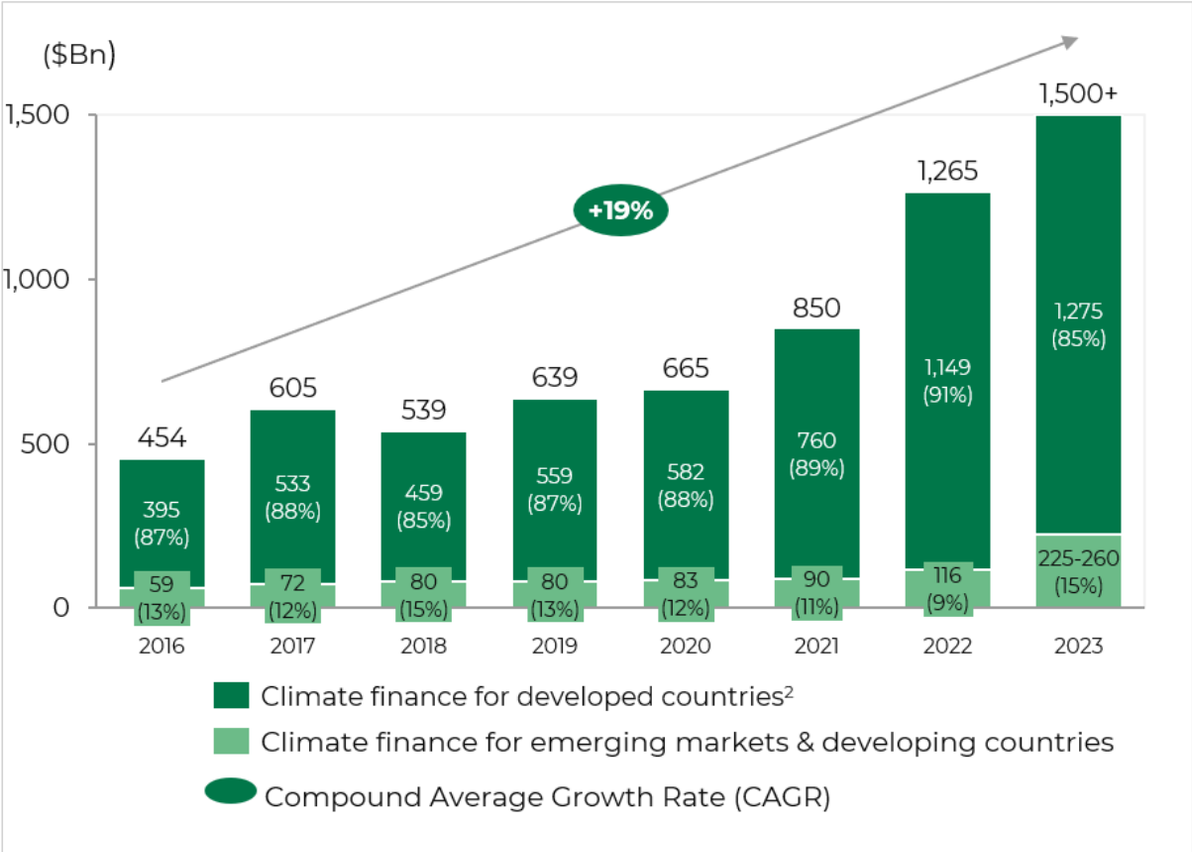
Short-term Milestone: 6-18 Months	Tracking Institution	Champion Institution
Develop and execute an action plan to align MDBs, DFIs, and institutional investors around scaling climate finance instruments for EMDEs — including de-risking mechanisms, blended finance solutions, and SDR-based tools, by coordinating an initiative between the G20 Sustainable Finance Working Group (SFWG) and the Climate Sustainability Working Group (CSWG)	OECD Centre for Green Finance and Investment, IMF, World Bank Group	**World Bank Group**, G20 Presidency, SFWG, CSWG
Launch a G20 Adaptation Finance Accelerator by COP31 (2026) through an agreement among G20 member states on its design and mandate, to establish a shared agenda for mobilizing adaptation finance, setting global and regional targets, and improving delivery for EMDEs	GCF, GEF, UNFCCC Standing Committee on Finance, Adaptation Fund	**Global Centre on Adaptation (GCA)**, G20 Presidency, UNDP
Develop a G20-endorsed joint framework for Country Platforms (CPs), to position CPs as the central mechanism for aligning finance, investment, and policy, including guidance on national investment roadmaps and DFI coordination, led by the G20 Sustainable Finance Working Group **Note:** Under this framework, countries should be encouraged to establish G20-B20 partnerships platforms for the rollout of CPs, promoting private participation and co-delivery	G20 Presidency, UNDP, JET-PMU South Africa, World Bank IFC, OECD	**UNDP**, World Bank Group

Medium-to-long KPIs: 5-25 years	Baseline Metric	Target Metric	Sources	Tracking Institution	Champion Institution	Classification
Increase international financing for just energy transition (JET-Ps) by 7x **Note:** Countries are encouraged to monitor the accessibility of funding for women, MSMEs and other community-based enterprises to ensure broad-based and inclusive transition outcomes	$45 B [2023][1]	$330 B [2040][1]	1. Bloomberg (2022); JETP Indonesia (2023); CPI (2024); The African Climate Foundation (2023)	OECD, JET-PMU	**Intl. Partners Group (IPG)**	✓ Fully aligned with India 2023
Increase the average percentage of energy transition investment needs met in EMDEs **Note:** Countries are encouraged to monitor the accessibility of funding for women, MSMEs and other community-based enterprises to ensure broad-based and inclusive transition outcomes	15%-20% [2022][3]	70%-80% [2040]	3. IEA (2023)	IEA, IRENA, OECD	**IEA**, Int. Finance Corporation (World Bank)	✓ Partially aligned with Brazil 2024
Achieve 50% adoption rate for G20-endorsed CP framework	n.a. [2025]	50% [2040]		CPI, UN, JET-PMU	**UNDP, Green Climate Fund (GCF)**	☆ New Indicator

Context

Mobilising finance at the necessary scale and speed remains one of the most critical challenges in achieving a just and inclusive energy transition. Encouragingly, global climate finance flows have grown to unprecedented levels, expanding at a compound annual growth rate (CAGR) of 19% since 2016, as shown in Exhibit 7. In 2023 alone, sustainable energy finance was estimated to exceed USD 1.5 trillion[10], driven in part by landmark commitments like the Baku Pledge, which tripled annual climate finance commitments from developed to developing countries, from $100 billion to $300 billion per year. The Baku Pledge sets a broader target of mobilizing $1.3 trillion annually for developing nations by 2030, which would cover more than half of their projected annual climate finance needs[11].

Exhibit 7: Historic sustainable energy finance commitments[1]

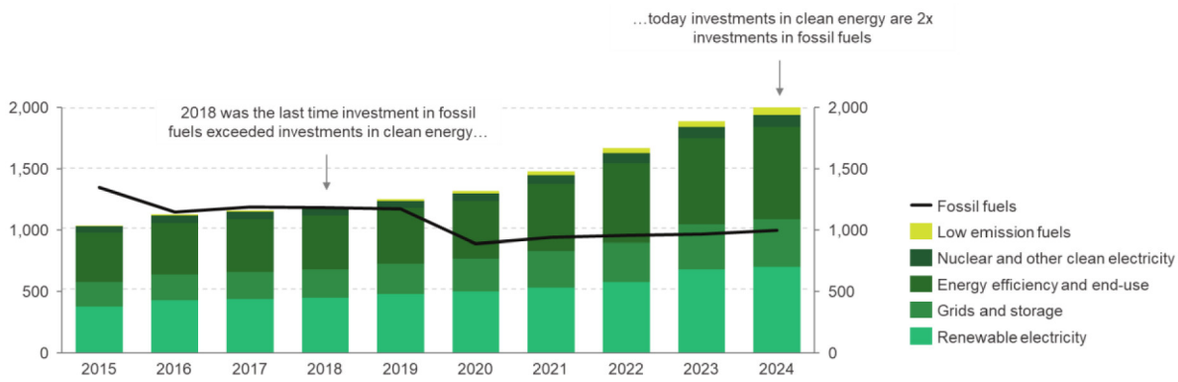


1. Figures represent climate finance commitments, including both pledges and actual disbursements;
2. Computed by deducting sustainable energy finance for developing countries from total climate finance as provided by Climate Policy Initiative (CPI)
Note: Due to differences in the scope of sustainable energy investments across various sources, it is estimated that current investment flows to EMDEs lie within the range of USD 225 -260 billion
Source: CPI (2024); OECD (2024); World Economic Forum (WEF) (2025); IEA (2023)

In parallel, innovative mechanisms such as the IMF's Resilience and Sustainability Trust (RST) are channelling unused Special Drawing Rights (SDRs) from wealthier nations to provide affordable, long-term financing to climate-vulnerable countries. Notably, over 80% of RST's approved support has been directed to Sub-Saharan Africa, Latin America and South Asia, regions that are both highly climate-exposed and underfunded.[12]

Moreover, global investment in low-carbon energy has not only remained resilient but reached unprecedented levels. Exhibit 8 shows that 2018 marked the last year in which investment in fossil fuels exceeded that in low-carbon energy[81]. Since then, the gap has widened significantly, and by 2024, investments in low-carbon energy were more than twice those in fossil fuels[81]. Globally, around 74% of low-carbon energy investment is financed by commercial sources like private equity and bank debt, 25% from public finance, and 1% from DFIs[81]. In EMDEs, public finance, including from state-owned enterprises (SOEs) and DFIs, accounts for a larger share of low-carbon energy investment than in advanced economies, reflecting higher risk profiles and more limited access to private capital[81]. Investment structures vary by technology maturity: equity is more common for high-risk or emerging technologies, while debt instruments, such as loans and green bonds, typically support mature sectors like power generation and grids[81]. Recent investment surges have spanned a broad spectrum of technologies, including renewable electricity, grids and storage, energy efficiency, electrification of transport and industry, and nuclear power[81].

Exhibit 8: Global investment[1] in low-carbon energy and fossil fuels 2015-2024 ($M)

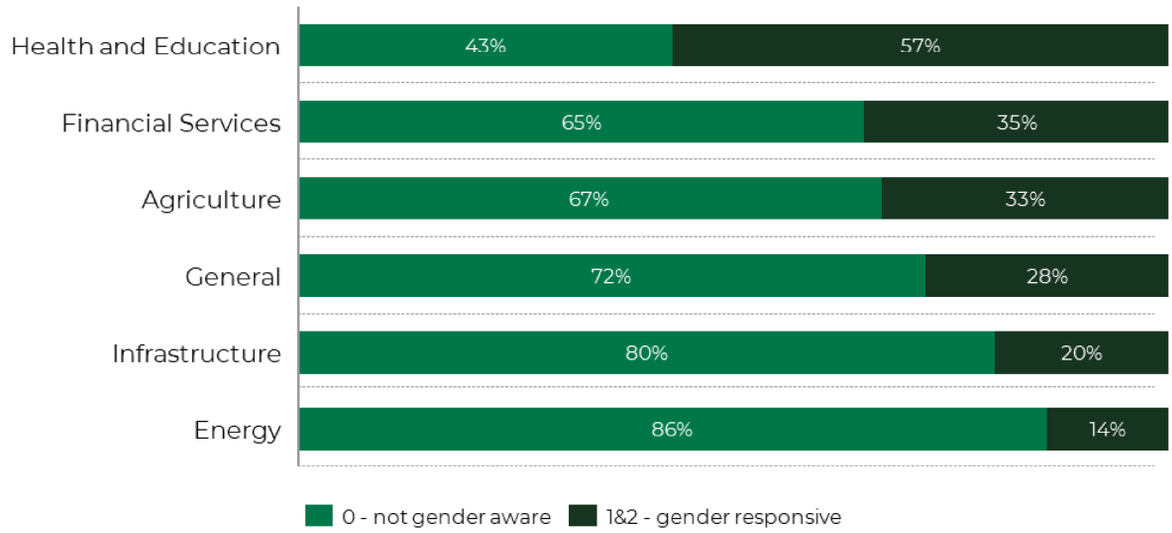


1. In this context, "investment" refers to the amount spent on fossil fuel and low-carbon energy technologies by corporates, households and governments. It does not refer to finance mobilised for investment.
Source: IEA (2024); BCG analysis

These trends signal growing momentum, but significant barriers remain, especially for EMDEs. By the early 2030s, the world must mobilise $4.5 trillion annually to support the transition to a low-carbon, climate-resilient economy. Yet current financial flows cover less than half this need, creating a staggering $2.5 to $3 trillion shortfall[13]. This financing gap undermines the speed, scale, and effectiveness of climate action globally.

The financing gap may be especially acute for vulnerable groups like women and MSMEs in EMDEs. Broadly speaking, MSMEs in EMDEs face a financing gap of approximately USD 5.7 trillion, with 40% of formal MSMEs credit constrained[94]. Women-owned MSMEs account for a USD 1.9 trillion share of this gap[94], and gender inequalities in financial access persist across nearly all markets and instruments[97]. In parallel, gender-responsive climate finance remains scarce, particularly in the energy sector. Exhibit 9 shows that only 14% of energy-related transactions incorporate a gender lens, the lowest share among all major sectors[96]. Yet, research shows that the energy sector also holds the largest absolute opportunity for gender-responsive climate investments, with USD 13.6 billion already deployed[96]. Addressing these financing gaps is not only a matter of equity but a catalyst for unlocking climate resilience, innovation, and job creation at scale.

Exhibit 9: Share of gender-responsive finance by sector

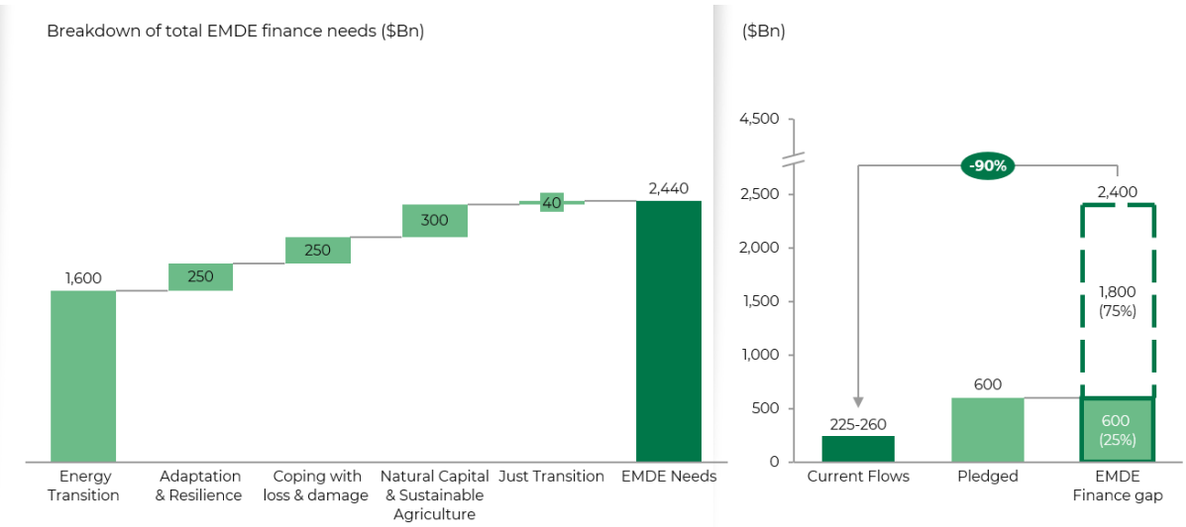


Note: Gender-responsive finance refers to financial solutions that intentionally aim to advance both gender equality and climate mitigation and/or adaptation. 0 indicates no gender awareness; 1 reflects limited integration of gender considerations; and 2 denotes a strong, intentional gender lens with clear links between the transaction's design and positive gender outcomes.
Source: Catalytic Climate Finance Facility (CPI & Convergence) (2024)

Despite the persistent finance gap, the economic case for low carbon energy remains strong and increasingly compelling. We are moving toward a more electrified world, driven by the superior efficiency and performance of electric technologies. Electric vehicles, for example, can be up to four times more operationally efficient than internal combustion engine (ICE) vehicles and electric heating solutions can be up to six times more efficient than gas-fired systems. These gains can translate into real economic advantages as costs decline and efficiency scales. Even accounting for recent global challenges, forecasts suggest that renewable energy capacity may quadruple by 2050, reinforcing its long-term viability. In this context, the continued shortfall in finance is increasingly difficult to justify.

The burden is especially acute for EMDEs as shown in Exhibit 10. These countries, excluding China, require approximately $2.4 trillion per year by 2030 to align with the Paris Agreement goals, including USD 1.6 trillion for the energy transition[7]. Despite this, only 25% of required funding has been pledged[7], and actual disbursements are even more modest, approximately 10% of the necessary flows are reaching these regions[10].

Exhibit 10: Breakdown of EMDE[1] finance needs and current flows



1. EMDE figures exclude China; these figures are annual
Note: Due to differences in the scope of sustainable energy investments across various sources, it is estimated that current investment flows to EMDEs lie within the range of USD 225 -260 billion
Source: CPI (2024); Independent High Level Expert Group (IHLEG) (2023); WEF (2025); IEA (2023)

The situation is even more alarming in the domain of adaptation and resilience (A&R), where financing is critically low. Global adaptation finance currently stands at just 50% of the annual levels required by 2030. Flows to EMDEs, which include many of the world's most climate-vulnerable nations, represent only 5% to 10% of the needed capital. As a result, communities on the frontlines of climate risk remain exposed to increasingly frequent and severe environmental shocks.

To bridge this gap and better coordinate financing efforts across stakeholders, integrated approaches such as country platforms can play a catalytic role, aligning national investment plans with international support, and channeling finance toward coherent, scalable, and transition-aligned strategies. However, mobilizing finance at scale will require more than capital, it demands systemic change. Transformational shifts in policies, fiscal and non-fiscal incentives, and investment frameworks are essential to trigger self-reinforcing cycles of sustainable finance. Once a critical threshold is crossed, these shifts can create tipping points[vi] where sustainable investments become the default, unlocking exponential capital flows and accelerating the transition. To be effective, these financial strategies must prioritise regionally appropriate solutions that reduce emissions while also expanding energy access and advancing broader development goals.

[vi] Tipping points are critical threshold where small changes trigger self-reinforcing dynamics that lead to a fundamental and irreversible shift in financial markets e.g., climate policy certainty is a positive tipping point that reinforces investment climate action (Source: Driving sustainability transitions through financial tipping points (Nadia Ameli et al.))

To trigger these tipping points and mobilise sustainable finance, especially in EMDEs, **targeted action is needed in five key areas**:

- **Reducing the Cost of Capital in Developing Markets**: High interest rates remain a significant barrier to climate investments in EMDEs. Expanding de-risking mechanisms, concessional funding, grant funding and blended finance instruments is essential to improve the bankability of energy transition projects.
- **Scaling Adaptation Finance**: Mobilizing greater resources for adaptation and resilience is a moral, economic, and developmental imperative. Unlocking finance for Adaptation and Resilience (A&R), where private investment remains scarce, will be crucial to protecting communities and economic systems.
- **Creating Policy and Market Certainty**: Stable, predictable policy environments are necessary to unlock private capital. Strengthening regulatory frameworks and clarifying future directions of carbon policies, alongside clear investment roadmaps, will help financial institutions scale allocation toward energy-transition-aligned assets.
- **Building a Robust Pipeline of Investable Projects**: Many EMDEs lack the institutional and technical capacity to structure projects in a way that meets investor standards. Scaling up project preparation facilities and technical assistance will be key to generating a pipeline of bankable, high-impact climate investments.
- **Coordination & Efficiency in Climate Finance Mechanisms**: Enhance collaboration among multilateral development banks (MDBs), development finance institutions (DFIs), and private investors. Streamline financing channels, simplify concessional finance access, and improve execution efficiency to reduce time-to-impact.

Energy transition finance must evolve from a collection of disparate efforts into a systemic transformation, one that unlocks exponential capital flows, drives sustainable development, and builds global resilience. When effectively mobilised and aligned, climate finance can close the transition gap.

Action 1.1: De-risk Energy Transition Finance in EMDEs

Increase capital flows for energy transition investments in EMDEs by working with International DFIs, LFIs, MDBs, ECAs, and the IMF to reform deployment rules and expand financing tools that lower perceived investor risks, e.g., local currency and insurance instruments, blended finance, Special Drawing Rights (SDRs), and mechanisms to mobilise institutional capital such as pension funds.

Executive Summary

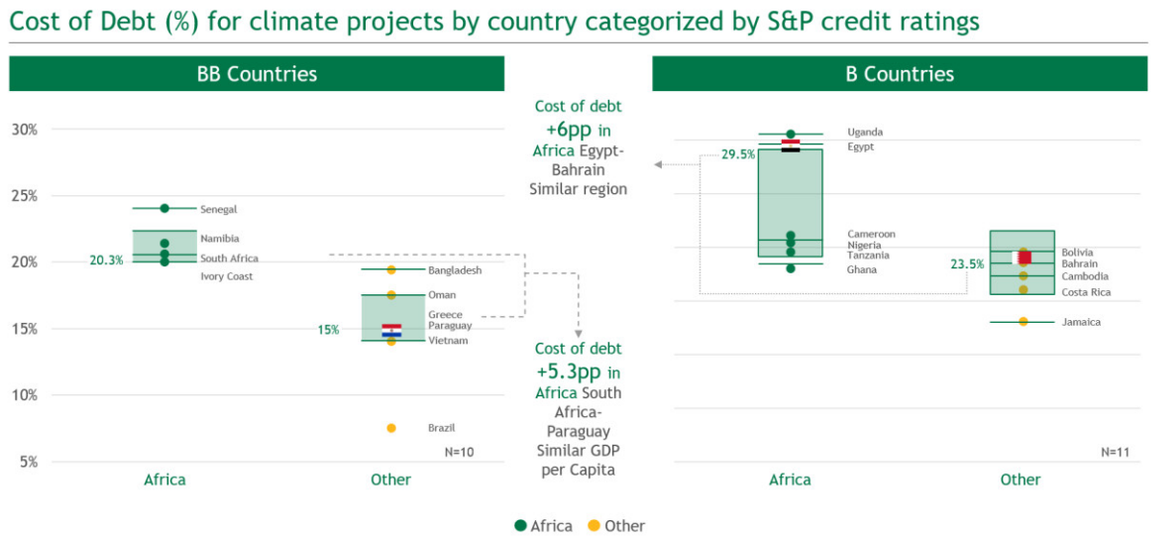
High financing costs, driven by perceived risk and structural barriers, and limited access to concessional capital, continue to hinder low-carbon energy investment in EMDEs, especially in Africa, where borrowing costs remain elevated, even when credit profiles are comparable.

Action 1.1 supports the scaling of de-risking instruments and local capital mobilisation, expanding blended finance, and optimising the allocation of Special Drawing Rights (SDRs) to unlock long-term affordable finance and accelerate private capital flows for the energy transition.

Background & Context

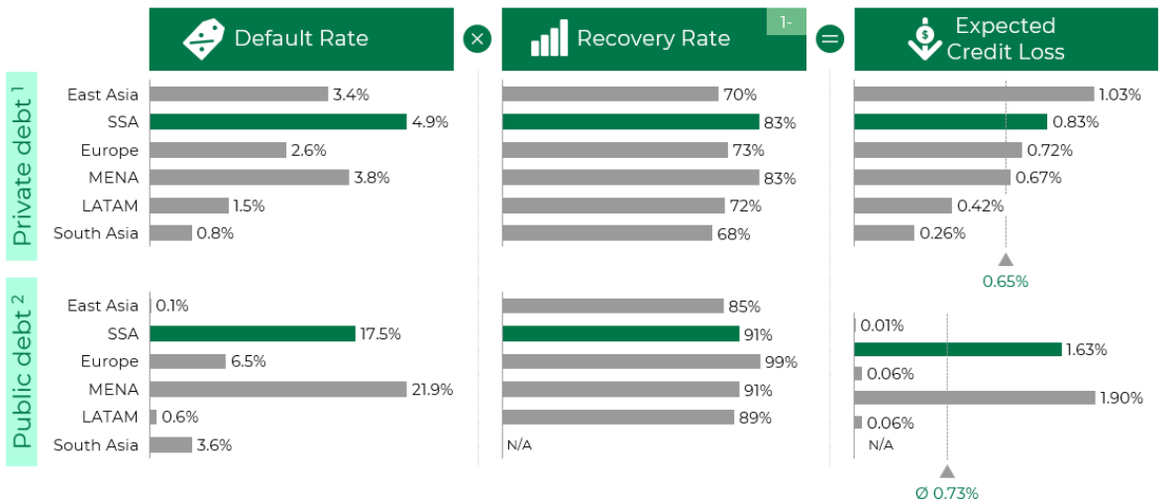
High financing costs continue to pose a significant obstacle to advancing the energy transition in EMDEs. African countries particularly, face inflated borrowing costs for climate projects, even when compared to countries with similar credit ratings. These projects typically include investments in renewable energy, sustainable power infrastructure, and other low-carbon technologies that contribute to emissions reductions and climate resilience. Risk premiums are often tied to perceptions of high default rates, yet actual expected credit losses remain in line with global averages. For instance, as shown in Exhibits 11 and 12, while the cost of debt for projects in countries like South Africa and Egypt is 5 to 6 percentage points higher than that of comparable nations, the underlying risk is often overstated. In Sub-Saharan Africa, private debt defaults average around 5% and public defaults up to 18%, but strong recovery rates, typically 60% to 70% for private debt and 50% to 60% for sovereign defaults, help mitigate investor exposure. Additional factors that shape high risk perceptions in EMDEs include limited financial transparency, regulatory uncertainty, and grey listing by the Financial Action Task Force (FATF).

Exhibit 11: Cost of debt (%) for climate projects by country categorized by S&P credit ratings



Note: Calculated using risk–free rate (10–yr US Treasury rate), emerging market beta for RE, Climate Investment Risk Premium, and local government 10–yr bond yield
Source: CPI; IMF; GCF; Expert interviews; Government publications; BCG insights

Exhibit 12: Public and private debt default rates, recovery rates and ultimate expected loses by region



1.Private debt expected credit loss is calculated using IFC default statistics and GEMS recovery data.
2. Public debt expected credit loss is calculated using BoC-BoE default data, World Bank debt data, and GEMS recovery data
Note: The default rates shown in this exhibit reflect aggregate corporate and sovereign debt portfolios. However, other sources such as Moody's (2020) show that Africa had one of the lowest cumulative default rates in project finance loans — suggesting a more favourable risk profile in structured infrastructure finance.
Source: IFC portfolio default rate analysis (2024); BoC-BoE Sovereign Default Database; World Bank International Debt Statistics; GEMS recovery statistics (2022); BCG analysis

These high borrowing costs are compounded by structural barriers: limited concessional financing, currency volatility, and underdeveloped financial markets. Together, these challenges render many low-carbon energy projects in EMDEs financially unviable without external support.

Addressing this issue requires deeper and sustained flows of blended and concessional finance mechanisms, that expand the quantity of financial flows, reduce borrowing costs, and unlock private capital to accelerate the energy transition in these economies, underpinned by stronger alignment among multilateral development banks (MDBs), regional financial institutions and global financing initiatives. Long-term institutional investors such as pension funds, insurance providers, and sovereign wealth funds can also play a vital role, provided appropriate de-risking mechanisms are in place to align their capital with long-duration energy transition investments. Local financial institutions (LFIs), also have a critical role to play in channelling energy transition finance at the national level. Strengthening their capacity, capital base, and networks (alongside multilateral and regional institutions) can help position them as engines of the just transition, particularly in supporting small- and medium-scale projects that often fall below the radar of international finance.

De-risking mechanisms including local currency borrowing, blended finance, and guarantees have proven to be critical tools in reducing the cost of capital in EMDEs:

Local currency instruments: Tools like currency swaps and local currency bonds help reduce exchange rate risks. Notable implementation examples include India's Masala bonds and BRICS's New Development Bank (NDB) Rand-denominated bond in South

Africa. These illustrate how local currency instruments can attract foreign investment while reducing currency risk and strengthening local markets.

Blended finance: These strategies combine concessional funds with private capital, improving the risk-return profile of projects. The CrossBoundary Access Energy platform, Africa's first mini-grid financing facility, uses blended capital to scale low-carbon energy access. It had mobilised over USD 30 million by 2023, aiming to reach 1 million people with reliable electricity through a replicable, investment-ready model[57].

Guarantees: Instruments like first-loss protections and partial credit guarantees can lower perceived investment risks, thus reducing borrowing costs and extending maturities. The Green Guarantee Group's (GGG) InfraCredit Nigeria initiative is a domestic guarantee programme that strengthens the credit quality of local currency infrastructure bonds.[105] By providing financial guarantees that raise project bonds to investment grade, InfraCredit has mobilised long-term financing from local pension funds and insurance providers.[105] This has helped reduce the cost of capital and extend loan tenors. The GGG highlights this approach as a model for attracting private investment in sustainable infrastructure across EMDEs.[105]

Institutions like the Green Climate Fund (GCF) and Global Infrastructure Facility (GIF) are essential to scaling these tools. The GCF deploys concessional finance, grants, equity, and guarantees to support climate mitigation and adaptation efforts in developing countries, while the GIF provides technical assistance and transaction support to structure bankable infrastructure projects. Together, they offer critical de-risking and project preparation capabilities essential to scaling private investment.

Beyond expanding finance instruments, greater impact can often be achieved by restructuring how available instruments are deployed. Many existing financial instruments remain underutilized, not for lack of capital, but due to restrictive deployment rules such as rigid covenants, narrow eligibility, and complex disbursement procedures. Reforming these constraints is essential to unlocking idle resources and accelerating impact, often more effectively than committing new capital.

Export Credit Agencies (ECAs) represent an underutilised yet powerful financing vehicle to support energy transition investments in EMDEs. These institutions provide government-backed loans, guarantees, and insurance to domestic companies for international business activities. By offering such risk-mitigation tools, particularly in countries where commercial capital is constrained by high-risk premiums, ECAs can help reduce financing costs and mobilize private sector capital for projects that may not yet be commercially viable. A notable example is the support provided by UK Export Finance (UKEF) for Turkey's largest solar project, the 1.35GW Karapinar solar farm. UKEF guaranteed a £217 million Buyer Credit Facility, enabling the deployment of advanced solar technology and supplying energy to 2 million homes[67]. The project demonstrated how ECAs can play a pivotal role in advancing large-scale low-carbon energy initiatives in emerging markets.

Special Drawing Rights (SDRs) are another critical but underutilised tool for financing the energy transition in EMDEs. Although over SDR 650 billion have been allocated globally[68], most remain with high-income countries and lack effective reallocation mechanisms. The IMF's Resilience and Sustainability Trust (RST) channels unused SDRs to climate-vulnerable nations, but uptake remains limited. Although it aims to mobilise ~$45 billion through Special Drawing Rights (SDRs), current commitments stand at only SDR 6 billion[12]. As of 2024, less than 20% of committed funds and under 4% of total pledged resources have been

disbursed[12]. With over 80% of approved allocations directed to Sub-Saharan Africa, Latin America, and South Asia[12], expanding the RST's scope is critical to meeting climate finance needs. To improve the effectiveness of SDR reallocation, governance reforms are needed to enhance transparency, streamline disbursement processes, and ensure greater accountability from both contributing and receiving countries. This includes clearer eligibility criteria, simplified access procedures, and stronger coordination among IMF member states.

Implementation approach

To unlock affordable and scalable financing for energy transition projects in EMDEs, G20 nations should work with the Multilateral Development Banks (MDBs) and the IMF to scale existing de-risking tools, expand the use of blended finance, and optimize the strategic allocation of Special Drawing Rights (SDRs). Specific actions include:

1.1.1 Scale Existing De-risking Mechanisms and Local Capital Mobilisation

- Encourage Multilateral Development Banks (MDBs) to scale up loan guarantees, credit insurance mechanisms, and first-loss capital to reduce risk premiums on EMDE projects
- Expand local currency financing instruments: Work with MDBs to develop and scale foreign exchange hedging facilities and encourage foreign capital flows in domestic currency. Support the issuance of locally indexed instruments through domestic stock exchanges, backed by guarantees or pooled risk funds provided by institutions such as the NDB
- Establish regional blended finance vehicles: Partner with the Green Climate Fund (GCF) and Global Infrastructure Facility (GIF) to develop regional programmes, providing blended finance, targeting high impact sectors like renewable energy, climate adaptation and resilient infrastructure, to attract private sector investment through improved financial viability of projects.
- Mobilise long-term institutional capital leveraging pension funds, insurance companies and sovereign wealth funds: Encourage MDBs and G20 governments to create tailored risk-mitigation instruments and regulatory frameworks that enable the mobilisation of long-term capital from pension funds, insurance companies, sovereign wealth funds (SWFs), and other domestic and international savings institutions. These mechanisms should address currency, policy, and liquidity risks, while aligning returns with long-duration transition infrastructure projects in EMDEs.
- Strengthen and capitalise local financial institutions: Support targeted investments, technical assistance, and capacity-building programmes to enable LFIs and DFIs to play a more active role in mobilising and deploying climate finance. Help connect them with international climate finance initiatives and risk-reduction tools provided by MDBs, to position them as national vehicles for scaling and improving the delivery of finance to energy transition projects.

1.1.2 Leverage Export Credit Agencies (ECAs)

- Integrate ECAs as energy transition financing vehicles: Encourage G20 countries to expand the strategic use of their export credit agencies to provide guarantees, insurance, and concessional terms that unlock additional investment for energy transition projects in EMDEs.

1.1.3 Optimise SDR Funding

- Enable SDR reallocation to regional MDBs: Support governance reforms that allow regional MDBs, such as the African Development Bank and Inter-American Development Bank, to hold and leverage SDRs for transition-aligned lending. This would enhance institutional accountability while expanding access to concessional finance for energy transition and resilience projects aligned with local priorities and delivery systems.
- Scale RST disbursement: Work with and encourage the IMF to disburse 50% of pledged funds by 2030 to incentivise additional pledges, scaling the RST programme
- Enable MDBs to Leverage SDRs for Green Bonds: Encourage reforms allowing MDBs to use SDRs as capital backing for issuing green bonds with low interest rates targeted at EMDEs. For example, establishing SDR-backed first-loss tranches to de-risk private investor participation.

By expanding the deployment of financing tools and de-risking mechanisms for energy transition projects in EMDEs, G20 economies and companies stand to gain from enhanced global investment opportunities, greater market stability, and increased demand for transition-aligned technologies and services, while unlocking new export and investment channels for firms in energy, infrastructure, and finance.

Action 1.2: Enhance Adaptation Finance

Enhance adaptation finance flows by launching a G20 Adaptation Finance Accelerator, setting regional targets; and supporting project pipelines through technical assistance and interoperable global project frameworks, and expanding nature-based solutions for adaptation.

Executive Summary

Adaptation finance remains critically underfunded, with EMDEs receiving just a fraction of the resources needed to address rising climate impacts, despite being among the most vulnerable regions globally.

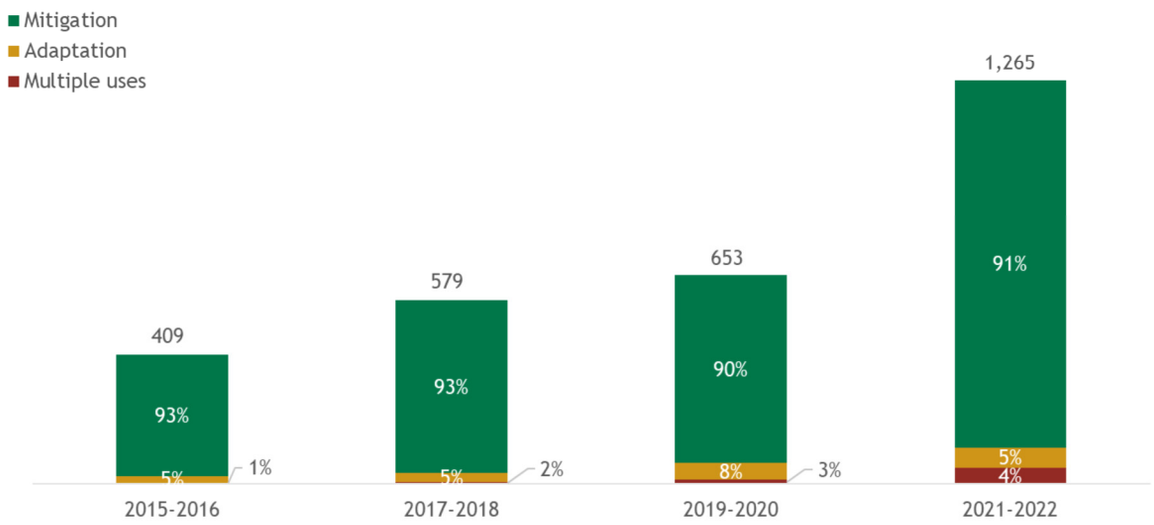
Action 1.2 supports the launch of a G20 Adaptation Finance Accelerator to scale funding for multilateral channels, set global and regional targets, and build capacity for bankable adaptation projects through harmonised project frameworks and technical assistance to implement National Adaptation Plans (NAPs).

Background and Context

Historically, global climate finance has been heavily skewed toward mitigation, with adaptation receiving only marginal support. As shown in Exhibit 13, since 2015, more than 90% of total climate finance has been directed toward mitigation efforts like emissions reductions and low-carbon energy deployment[10]. This disproportionate focus has left many countries, particularly those most vulnerable to climate impacts, highly underprepared for the accelerating frequency and severity of climate shocks. To build climate resilience and meet global goals, adaptation and mitigation finance must advance in parallel, recognising that one cannot succeed without the other. Adaptation finance can generate resilience dividends and social returns, such as reduced disaster recovery costs, improved public health, food and water security, and job creation. It must therefore be viewed not only as a climate imperative, but also as a strategic enabler of economic and social stability.

To address this adaptation finance gap, global and regional initiatives have been established with the goal of increasing adaptation flows. Globally, initiatives like the Adaptation Fund and the Global Environmental Facility's (GEF) Least Developed Countries Fund (LDCF) and Special Climate Change Fund (SCCF) dedicates 100% of resources to fund adaptation projects, particularly to climate vulnerable, developing countries, while the Green Climate Fund (GCF) has a mandate to balance adaptation and mitigation funding by allocating at least 50% of its resources to adaptation projects[89].

Exhibit 13: Climate finance by segment ($Bn)



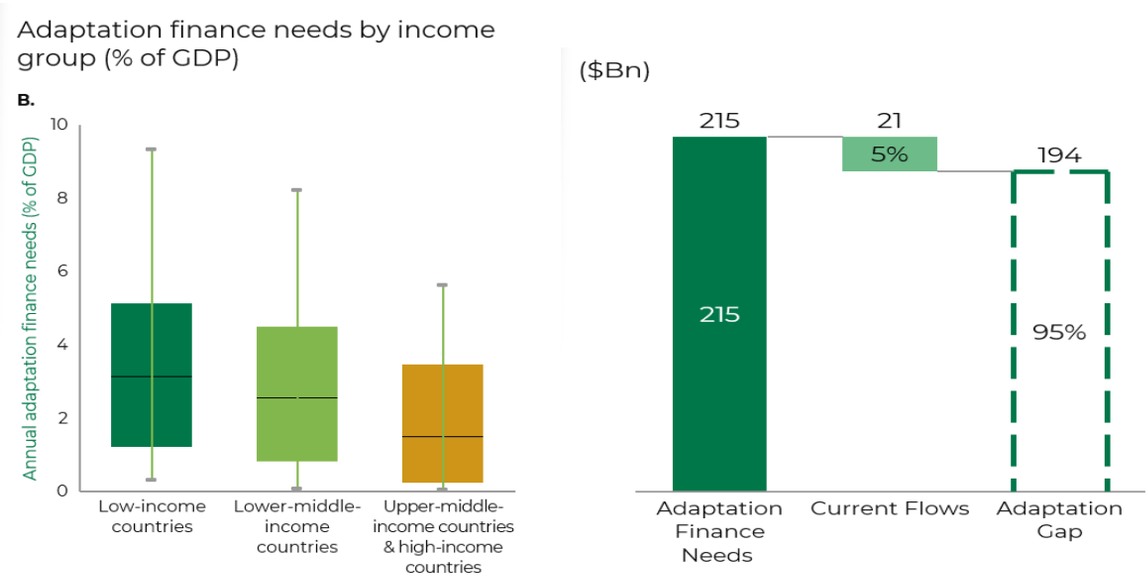
Source: BCG analysis, Climate Policy Initiative (CPI) (2023)

These global initiatives also provide technical assistance to EMDEs for building capacity to access adaptation finance and formulate National Adaptation Plans (NAPs). Adaptation finance accelerators are increasingly recognised as platforms to help scale and fast-track funding for climate adaptation projects. One such programme is the Africa Adaptation Acceleration Program (AAAP), a joint initiative by the African Development Bank and the Global Center on Adaptation, which aims to mobilise $25 billion to scale adaptation projects across Africa[8]. It focuses on key pillars including resilient infrastructure, innovative adaptation finance, and youth entrepreneurship[8]. AAAP's structure demonstrates how targeted funding, and strategic partnerships can effectively address regional adaptation needs. Global adaptation accelerators such as UNDP and UNEP-CTCN's Adaptation Fund Climate Innovation Accelerator (AFCIA) provide small grants to enhance climate resilience in vulnerable communities[75], while the UNFCCC's Adaptation Pipeline Accelerator (APA) seeks to transform adaptation priorities from National Adaptation Plans (NAPs) into investable project pipelines[76].

Despite these global and regional efforts, adaptation and resilience (A&R) finance remains critically underfunded, especially in EMDEs. Despite being among the most climate-vulnerable regions globally, these countries receive only a fraction of the resources needed to prepare for and respond to environmental disruptions. According to the United Nations Environment Programme (UNEP), EMDEs, especially lower income countries, face the highest adaptation finance requirements when measured as a percentage of their GDP. Exhibit 14 shows that adaptation finance needs in EMDEs are estimated USD 215–387 billion annually, yet actual flows remain far below these targets[19]. Current flows cover just 5–10% of the estimated adaptation finance needs, resulting in a shortfall of USD 194–366 billion per year[19].

This gap also reflects limited investment in nature-based solutions (NbS), which are increasingly recognised for their role in reducing climate risks such as flooding and drought, while delivering co-benefits for ecosystems and local communities[98]. Despite their potential, NbS continue to receive a small share of total adaptation finance, partly due to valuation and integration challenges within national planning and finance frameworks[99].

Exhibit 14: Adaptation finance for EMDEs[1]



1. These figures represent the lower-end estimates of the range USD 215 billion to USD 387 billion for adaptation finance needs and USD 194 billion to USD 366 billion for the adaptation finance gap in EMDEs (excluding China)
Source: UNEP (2023)

Despite the growing need, adaptation funding through key multilateral channels - including the Adaptation Fund, the Global Environment Facility (GEF), and the Green Climate Fund (GCF), - has stagnated below $550 million annually for over five years[19]. A lack of mutually recognized frameworks, definitions, and benchmarks continue to slow capital mobilisation and impede cross-comparison of projects.

This challenge is further compounded by the absence of clear, binding adaptation finance targets across global and regional frameworks. For example, the IMF's Resilience and Sustainability Trust (RST) currently lacks a defined target for adaptation-specific allocations. While trends suggest that approximately 25% of approved RST funding goes toward adaptation, 24% supports mitigation, and nearly 50% is directed toward projects with overlapping adaptation, mitigation, or transition objectives, the absence of a specific benchmark weakens strategic alignment[17]. Similarly, regional development banks providing climate and energy transition finance often fail to set adaptation targets aligned with regional vulnerability and need. According to the Climate Policy Initiative (CPI), adaptation accounts for 24% of Africa's total climate finance requirements, compared to 66% for mitigation and 10% for dual-benefit projects, yet adaptation finance remains disproportionately low[20]. In addition, while National Adaptation Plans (NAPs) are essential for tailoring investments to country-specific priorities, their development and implementation are frequently hindered by limited technical capacity among planners, policymakers, and workforces. Without targeted funding and capacity-building support, many countries struggle to translate NAPs into effective, investment-ready frameworks.

Closing the adaptation finance gap will thus require a significant scale-up of global and regional adaptation funding initiatives, the establishment of clear and realistic adaptation finance targets that reflect both global and regional needs, and substantial investment in capacity-building to support the formulation and effective implementation of NAPs.

Implementation approach

To effectively close the adaptation finance gap and promote climate resilience in EMDEs, G20 countries should prioritise enhancing adaptation finance flows through scaling existing programmes, encouraging adaptation finance targets and transparency, boosting bankable adaptation projects, and expanding dedicated support for nature-based solutions as core components of adaptation infrastructure. Specific actions include:

1.2.1 Establish a G20 Adaptation Finance Accelerator

- Expand funding to existing multilateral adaptation channels: Establish a programme to expand funding and political support for existing global adaptation finance channels, including the Adaptation Fund, GCF, and GEF. This programme must ensure that adaptation finance is transparent, trackable, and accessible to climate-vulnerable nations. Work with and learn best practices from existing adaptation finance accelerators like AAAP, AFCIA and APA.
- Promote region-specific adaptation finance targets: Encourage regional MDBs like the African Development Bank (AfDB) to define regional adaptation finance goals, such as committing ~25% of climate funding to adaptation projects in Africa, to ensure alignment with local vulnerability profiles and development needs.
- Strengthen project bankability: Scale and enhance regional adaptation initiatives like AAAP. This includes providing technical assistance, training and project preparation support to help EMDEs formulate and execute NAPs. These capacity-building programmes should be structured as a "Phase 0" framework, conducted prior to financing, to ensure investment-readiness.

- Develop interoperable global adaptation project frameworks: Work with the Global Center on Adaptation, the Adaptation Fund and the UNFCCC Standing Committee on Finance to develop common adaptation project and finance frameworks, including mutually recognised taxonomies and standards. Encourage regional and national development banks to align local adaptation investments with set global standards to enable greater access to adaptation finance.
- Scale financing for nature-based adaptation solutions: Establish dedicated funding windows within global adaptation finance programmes for nature-based solutions, including forest restoration and wetland rehabilitation. Treat these as core adaptation infrastructure by integrating them into NAPs, investment pipelines, and project preparation facilities to improve valuation, visibility, and bankability.

Boosting adaptation finance in EMDEs helps reduce climate-related risks that can disrupt G20 trade and supply chains. This can also create new opportunities for G20-based firms to provide adaptation-focused solutions such as climate-resilient infrastructure. Shared frameworks and clearer targets improve investment clarity, supporting a more stable and resilient global economy.

Action 1.3: Institutionalise Country Platforms

Institutionalise country platforms (CPs) by developing integrated national energy transition finance roadmaps, simplifying DFI funding access, legally codifying plans and expanding participation and local empowerment in designs.

Executive Summary

Country Platforms (CPs) in EMDEs remain underutilised despite their potential to align energy transition finance with national priorities. This is due to fragmented planning, weak institutional coordination, limited stakeholder engagement, and poor access to early-stage finance.

Action 1.3 supports the institutionalisation of CPs by developing national energy transition finance strategies, harmonising DFI requirements, codifying plans into law, and embedding inclusive mechanisms to expand participation and local access, especially for women, and MSMEs.

Background and Context

Country Platforms (CPs) serve as nationally-led frameworks that coordinate government, country donors, development institutions and the private sector. They aim to align climate finance with development priorities and just transition imperatives[21]. These are increasingly being recognized as transformative instruments for delivering climate and development outcomes at scale. This global momentum reflects the need for integrated approaches to overcome fragmented finance and governance, capacity bottlenecks, and institutional silos that hinder climate and energy transition progress in EMDEs. Experiences from countries such as South Africa, Indonesia and Brazil showcase how countries are aligning climate action with national long-term development plans, fostering cross-sectoral collaboration and leveraging innovative finance approaches, with South Africa and Indonesia's Just Energy Transition Partnerships (JET-Ps) considered "first generation" CPs[21].

South Africa: Targets six priority areas including electricity, electric vehicles (EVs), green hydrogen, and municipal capacity. Focus is on public-private coordination and driving key reforms[21].

Indonesia: Aims to decarbonise its power grid and increase renewable capacity through stakeholder alignment across and beyond governmentt[21].

Brazil: A "recent generation" CP developed in partnership with its national development bank (BNDES) and the GCF, prioritising green hydrogen and nature-based solutions[21].

These examples highlight the potential of CPs to bridge global capital with national development but also expose many gaps. Key challenges for established CPs include securing early-stage financing, aligning ministries, lack of policy consistency, and balancing different types of finance[21]. Many platforms remain stuck in the planning phase, constrained by limited fiscal space, weak project pipelines, and fragmented institutional capacities[21].

To address these issues, CPs must move from fragmented, project-based models to strategic national investment platforms with embedded roadmaps and financing strategies. They must shift from concept to execution by securing early-stage funding, strengthening institutional coordination, and developing standardised pipelines of investment-ready projects. Critically, CPs also require better integration with local development finance institutions (DFIs), ensuring harmonised application processes, lower transaction costs, and aligned disbursement mechanisms. Local enablement of development finance is essential. Thus, DFIs must take a proactive leadership role in translating national priorities into investable opportunities by expanding in-country presence, supporting local intermediaries, and guiding project preparation. To deliver capital at scale, DFIs should work in close partnership with MDBs, climate funds, and advanced economy donors to coordinate efforts, mobilise and disburse finance more efficiently, reduce risk, and crowd in private investment.

This also includes embracing innovative financial solutions that enable effective cooperation with the private sector. For example, platform-based and general corporate purpose facilities allow for flexible allocation of funds across countries, sectors, or currencies, bypassing rigid project-specific constraints. A notable case is the €600 million facility signed in 2022 by Enel, the European Investment Bank (EIB Global), and SACE (Italy's export credit agency). This sustainability-linked facility supports sustainable energy investments in Latin America through a multi-country, multi-business, and multi-currency structure, demonstrating how strategic partnerships can unlock scalable private investment for energy transition goals[66]. Similarly, Italy's Snam has embedded a €26 billion transition strategy into its 10-year long-term infrastructure plan for hydrogen, biomethane and carbon capture and storage, together with maintaining world-class reliability and resilience of current assets while reducing their carbon footprint[101]. Furthermore, its use of green and sustainability-linked bonds illustrates how credibility on capital markets can reinforce transition strategies, at the same time facilitating a progressive alignment between financial strategy and Group's strategy and sustainability goals[101].

Carbon markets offer an additional source of transition-aligned finance. In countries where these markets are well-established, CPs can integrate them into platform frameworks to mobilise funding for energy transition priorities. This applies to both compliance and voluntary markets, particularly where crediting systems are well-regulated and aligned with national mitigation and broader transition targets.

Importantly, CPs must be anchored in Nationally Determined Contributions (NDCs). These are national action plans submitted under the Paris Agreement, outlining each country's emissions reduction targets. Aligning CPs with NDCs ensures that transition-related finance and investments directly support nationally defined transition goals. This enables coherence between policy planning, financing, and implementation. Global development organisations, climate funds, and MDBs play a critical role in helping countries align climate action with development goals. They provide technical assistance, early-stage funding, and capacity-building. For example, Rwanda's Green Growth and Climate Resilience Strategy, supported by the World Bank, UNDP, and GCF, integrates climate finance into national planning and improves access to global investment[22]. The UNDP supports NDC development[23] while the GCF's Country Programme and Readiness Programme assist in strengthening policy frameworks, investment pipelines, and coordination. These efforts enhance the effectiveness of country platforms[59].

There is a clear consensus that CPs must become core components of the global climate finance architecture. They must deliver investment at scale, support long-term fiscal sustainability, and embed just transition principles at their core. Doing so will require stronger domestic governance and technical capacity, as well as a reconfiguration of how DFIs, MDBs, and philanthropic actors engage with national platforms.

To be truly effective, CPs must adopt a people-centred approach that includes women, MSMEs and other vulnerable groups like the youth and transitioning workers. Embedding inclusive design through stakeholder engagement, targeted funding, and local capacity-building can ensure CPs support both decarbonisation and just transition outcomes. Emerging models like the World Bank's Global Financing Facility (GFF) show how structured engagement with civil society and marginalised groups can be integrated into platform design[77].

Implementation approach

To strengthen the effectiveness of country platforms (CPs) and scale their impact on energy transition-aligned development, G20 members should support country-led investment planning, harmonise national development finance access, embed CPs in national systems, and promote inclusive participation and local financial empowerment. Specific actions include:

1.3.1 Strengthen National Climate Finance Strategies and Investment Roadmaps

- Support the development of country-specific energy finance strategies: Engage MDBs (e.g., World Bank) and UNDP to support governments in designing comprehensive national energy finance strategies and investment roadmaps. These must integrate NDCs and Just Energy Transition strategies into a single, implementable platform.
- Create sector-specific investment guidelines and pipelines: Support countries in developing detailed investment frameworks for key transition sectors, in partnership with business associations. These partnerships ensure private sector perspectives are integrated into CP designs. Frameworks must include joint planning mechanisms, project preparation assistance, feasibility studies, and access to blended finance.

1.3.2 Harmonise DFI Access and Requirements

- Standardise and simplify DFI access across platforms: Harmonise DFI funding requirements under a unified country platform, including application processes, reporting standards, and compliance frameworks. The requirements should be harmonised by instrument type and sector, while also accommodating innovative solutions. These solutions may include platform-based facilities and general corporate purpose facilities. This approach reduces administrative burdens and enhances access, particularly for countries with limited institutional capacity.
- Position DFIs as delivery vehicles of development finance: DFIs should collaborate to develop shared access protocols and invest in joint technical assistance teams embedded within country platforms to support project preparation, pipeline development, and compliance.

1.3.3 Codify Plans into Law or National Policy

- Embed Plans in Law or Policy: Transform country platform plans into formal legislation or national policies to ensure long-term regulatory certainty and political continuity
- Strengthen national implementation structures: Encourage MDBs and DFIs to channel capital through national development banks and local institutions, while establishing dedicated coordination and delivery units aligned with national strategies. These should include the private sector and feature mechanisms for enforcement, regular updates, and stakeholder accountability.

1.3.4 Promote Local Empowerment through Country Platforms

- Incorporate stakeholder engagement mechanisms: Embed structured consultation processes within CP development to ensure participation from marginalised groups, including women, MSMEs and youth. These mechanisms should inform sector priorities, investment pipelines, and policy reforms.
- Establish inclusive finance windows under CPs: Work with the World Bank and other MDBs to create dedicated financing windows under CPs, in partnership with established MSME funds, innovation hubs, micro-lenders, and specialised impact investment funds. These platforms can serve as trusted intermediaries to disburse capital to youth-led and community-based enterprises, while providing tailored support to enhance project bankability, innovation, and long-term impact.
- Collaborate with MDBs and DFIs to design and scale financing instruments under CPs that intentionally target women-led enterprises and gender-inclusive climate solutions. This includes integrating gender-responsive criteria into funding windows and supporting women's participation across project design, delivery, and governance, accelerating the momentum of the B20's SheLeads initiative to advance women's leadership in the energy transition.

Strengthening CPs enhances investment-readiness and coordination in EMDEs, creating clearer pipelines for G20 firms in energy, infrastructure, and finance. National strategies backed by law can reduce risk, transaction costs, and policy uncertainty for advanced economy investors. Inclusive design and local empowerment further support market stability and unlock long-term commercial opportunities aligned with just transition goals.

Action 1.4: Improve Private Investment Certainty

Improve private investment certainty by establishing stable revenue and demand signals (e.g., PPAs, CfDs, procurement contracts) and creating enabling regulatory environments through clear incentives and mutually recognised taxonomies.

Executive Summary

Persistent policy uncertainty, inconsistent regulations, and weak market signals continue to undermine investor confidence in low-carbon energy infrastructure, particularly in EMDEs where long-term project bankability is crucial to scaling private capital.

Action 1.4 supports investment certainty by implementing long-term PPAs and CfDs, encouraging energy procurement, and establishing mutually recognised sustainable finance taxonomies and incentives.

Background and Context

Private capital will be critical to closing the multi-trillion-dollar investment gap required for a successful global energy transition, particularly in EMDEs. However, persistent policy and market uncertainty are a major barrier to unlocking this financing at scale. Unstable regulatory environments and inconsistent market mechanisms cause hesitance among private investors to commit capital to long-term energy projects.

One of the key levers to improving investor confidence is creating stable, investable project environments through mechanisms like predictable revenue streams and well-structured public-private partnerships (PPPs) for energy developers. Tools like PPAs offer price certainty and long-term security for investors, utilities, and developers alike. Evidence from South Africa's Renewable Energy Independent Power Producer Procurement Programme (REIPPPP) shows how government-facilitated, fixed-term PPAs with creditworthy off-takers can successfully attract private investment while lowering technology and financing costs[24]. Italy offers a compelling example of a public-private model for energy project investment. In 2024, the Italian multinational energy technology company, Eni, secured $210 million in blended finance from the International Finance Corporation (IFC) and the Italian Climate Fund to expand the production of advanced biofuels in Kenya[76]. The project supports transport decarbonisation and 200,000 small-scale farmers, demonstrating how climate finance can deliver both environmental and socio-economic returns[76].

Similarly, low-carbon procurement mandates from governments and corporations help create consistent market demand for low-carbon products, enabling scale and de-risking early-stage investment. Canada's Greening Government Strategy includes a mandate for federal departments to implement low-carbon operations by using 100% clean electricity.[25] This creates stable, large-scale demand for carbon-free electricity, helping to drive investment and market growth in renewable energy.

A strong enabling regulatory environment, built on stable policy frameworks coupled with consistent finance taxonomies and incentives, helps reduce ambiguity and attract capital. Clear definitions improve risk assessments and make transition projects more investable. However, efforts to strengthen regulatory alignment must prioritise mutual recognition over rigid harmonisation, acknowledging national contexts and supporting flexible, transitional approaches. This is particularly important for developing countries with varying capabilities and policy trajectories. In this context, positive regulatory incentives, such as removing barriers to renewable energy investment, can also be effective. For example,

South Africa's increased license threshold on embedded electricity generation has significantly expanded its low-carbon energy pipeline[82]. Yet political risks remain significant. Corruption, elite rent-seeking political capture can distort infrastructure priorities, inflate costs, and erode public trust. To mitigate these risks, investors must have confidence that funds are transparently allocated and effectively deployed, underscoring the need for strong governance, independent oversight and anti-corruption safeguards.

Ultimately, to enhance the role of the private sector in climate and energy transition finance, governments must establish stable, predictable policy environments. This means not only adopting mechanisms like PPAs but also coordinating their implementation and ensuring long-term regulatory clarity.

Implementation approach

To unlock private capital at scale, the G20 should empower governments to establish clear, stable, predictable and enabling policy environments that lower investment risk and foster long-term investor confidence. This requires generating consistent demand for locally manufactured sustainable energy technologies and implementing stable carbon pricing frameworks. Specific actions include:

1.4.1 Ensure Market Stability for Sustainable Energy Investments

- Implement long-term PPAs and CfDs: Work with utilities, regulators, and private buyers to design bankable, long-duration PPAs and CfDs that provide stable revenue streams for sustainable energy projects. These instruments should include features such as fixed pricing (e.g., feed-in tariffs for small-scale or decentralised energy supply), inflation indexing, risk mitigation guarantees, and engagement with creditworthy off-takers to reduce investment risk and improve project bankability.
- Encourage energy procurement policies: Mandate procurement commitments from public agencies and encourage similar commitments from large corporations to purchase renewable energy and sustainable products.

1.4.2 Create an Enabling Regulatory Environment for Investment

- Establish national sustainable finance taxonomies: Develop interoperable and mutually recognised national taxonomies, aligned via the International Platform on Sustainable Finance (IPSF) to improve transparency and comparability. Importantly these taxonomies must allow for flexibility, acknowledging differing national contexts and diverse transition pathways.
- Provide fiscal and regulatory incentives for sustainable investment: Work with the World Bank, IMF, and regional development banks to design and implement fiscal incentives that promote sustainable investment in sustainable energy. Additionally, encourage governments and national energy regulators to implement positive regulatory sustainable energy investment incentive mechanisms tailored to national development priorities and market needs, thereby acknowledging differing national contexts and diverse transition pathways.

Stable policy environments reduce risk premiums and create scalable opportunities for global investors seeking predictable, long-duration returns. Regulatory alignment and interoperable taxonomies also enhance cross-border investment flows and simplify capital deployment across jurisdictions. This fosters a more transparent and investable global energy market, benefiting both public and private actors across G20 economies.

Action 1.5: Strengthen Domestic Carbon Markets

Enhance the effectiveness and credibility of carbon markets by scaling domestic carbon pricing systems, aligning credit frameworks through mutual recognition and high-integrity standards, and strengthening local capacity to manage market infrastructure.

Executive Summary

Fragmented carbon pricing systems, weak credit standards, and limited institutional capacity are constraining the role of carbon markets in financing decarbonisation. In many EMDEs, the lack of credible, high-integrity carbon credit mechanisms and alignment across jurisdictions undermines private sector participation and restricts access to climate finance.

Action 1.5 strengthens the effectiveness of carbon markets by scaling domestic carbon pricing systems, promoting mutual recognition of credit rules and standards, and supporting the development of high-integrity offsets, particularly under Article 6 of the Paris Agreement. These efforts will improve transparency, market credibility, and access to finance for energy transition projects, while also strengthening local capacity to manage core market infrastructure, such as registries and monitoring, reporting, and verification (MRV) systems.

Background and Context

Carbon pricing, through voluntary and compliance mechanisms, is emerging as a foundational tool to internalise the costs of emissions, drive decarbonisation, and mobilise public and private finance for climate action. According to the World Bank, over 70 carbon pricing initiatives are now in operation globally, covering more than 20% of global greenhouse gas emissions.[26] Well-designed carbon pricing provides economic incentives for companies to reduce emissions, supports the adoption of low-carbon alternatives, and helps overcome market failures by encouraging energy efficiency. Carbon credits and markets can also enhance governance, transparency, and international cooperation, while raising substantial capital for energy transition projects. Domestic carbon market development also holds international potential as a fair and cost-effective mechanism for reducing emissions by encouraging climate action in countries where the cost of carbon abatement is lower and delivering greater global impact per unit of investment.

A global carbon price, in theory, could play a powerful role in achieving these goals, ensuring consistent price signals across borders, addressing carbon leakage, and creating an integrated framework for emissions reduction. However, while carbon pricing is effective in driving short-term efficiency gains in lower-cost sectors, it may slow innovation in hard-to-abate sectors if implemented without complementary measures. These sectors often lack viable near-term alternatives and face additional costs under carbon pricing schemes. Therefore, well-designed carbon policies should also aim to remove barriers and support the development of innovative technologies critical for achieving long-term emissions reductions.

Additionally, introducing a single global carbon price during the energy transition may create economic and social pressures for many developing economies. This price may reflect the carbon costs acceptable to advanced economies, but these levels would impose a disproportionate burden on energy-intensive industries and fossil fuel-dependent economies in the Global South. Many of these countries lack the fiscal space, technological infrastructure, or alternative energy capacity to respond to high carbon price signals. For large state-owned energy enterprises and countries reliant on fossil fuel exports, a uniform global price would risk economic dislocation, reduced competitiveness, and social instability. It could also hinder the ability of these economies to pursue a just and gradual transition pathway. Some countries also rely more on implicit carbon pricing like energy taxes or regulations, instead of explicit carbon pricing. In these cases, even advanced countries could be negatively affected by a single price. A globally uniform carbon price could also disrupt existing carbon markets such as the EU Emissions Trading System (EU-ETS), by creating market distortions and prompting renewed scrutiny or pushback against these mechanisms.

Compliance markets can be effective instruments but may pose economic risks if not carefully designed, especially for countries with a high share of GDP in hard-to-abate sectors. In these economies, carbon pricing can raise production costs without offering viable low-carbon alternatives, potentially diverting resources from development priorities and eroding global competitiveness. This may also disadvantage countries that retain domestic industry while benefiting those that have offshored emissions. Without safeguards, such systems risk reinforcing historical inequalities and widening global imbalances.

Voluntary carbon markets offer a more flexible and complementary pathway for climate action and finance. When designed with high standards and strong governance, these markets can mobilise private finance for mitigation and adaptation efforts, particularly in countries without established regulatory frameworks. They can accelerate decarbonisation by funding projects in sectors and regions that compliance systems do not yet reach, while supporting innovation and enhancing transparency. Promoting the development of high-integrity voluntary carbon markets, aligned with principles such as those from the Integrity Council for the Voluntary Carbon Market (ICVCM), can broaden participation and enable countries to pursue climate finance strategies tailored to their national contexts.

For this reason, carbon pricing, whether implemented through voluntary or compliance-based approaches, should be viewed as one of several policy options available to countries. It should sit alongside regulation, energy taxes, or other instruments better suited to their just transition pathways. Tailored design and implementation are essential to ensuring fairness and alignment with the “polluter pays” principle, while supporting nationally determined transition pathways as countries work toward shared Paris Agreement goals.

For countries that choose to implement carbon markets, mutual recognition of carbon pricing rules and tax policies across jurisdictions, particularly among major emitters, can facilitate interoperability, reduce trade frictions, attract cross-border investment, and support a more level global playing field. An example of a cross-border carbon market is the European Union Emissions Trading System (EU ETS), which operates across multiple jurisdictions under a shared regulatory framework and includes differentiation among participating countrie[27]. At the same time, lack of alignment and divergent standards risk enabling regulatory arbitrage, fragmenting markets, and increasing compliance burdens, particularly for international companies, underscoring the importance of convergence efforts that still allow for national flexibility.

Many frameworks still lack meaningful regional participation and capacity-building, particularly in Africa. To ensure equity and long-term effectiveness, African markets should not be passive recipients of externally developed systems, but active leaders in shaping the rules, standards, and structures of carbon markets. Regional leadership can help align market design with local development priorities, protect national interests, and unlock opportunities for homegrown innovation and value creation.

At the global level, strong governance and cooperation are key to scaling high-integrity carbon markets. Mechanisms like Articles 6.2 and 6.4 of the Paris Agreement support transparent and verifiable credit trading that builds trust and advances climate goals. Well-designed domestic carbon pricing frameworks can also help mobilise finance for decarbonisation. They create the right conditions for voluntary carbon markets to grow with integrity. As both compliance and voluntary markets expand, it is important to have consistent rules, clear standards, and reliable verification. Global benchmarks such as Article 6 guidance and the Core Carbon Principles from the ICVCM offer a common reference for defining quality, improving alignment, and enabling broader participation across jurisdictions[vii]. These frameworks can make voluntary markets more credible and liquid, and help align them with national energy transition goals. This, in turn, can unlock more private sector participation in climate mitigation and adaptation.

Implementation approach

Considering the role of carbon markets in mobilising energy transition finance, the G20 should promote credible domestic pricing systems, greater regulatory coherence across jurisdictions that have chosen to implement carbon pricing schemes, and more inclusive participation from developing regions. This includes establishing clear frameworks for compliance or voluntary markets, endorsing high-integrity standards, strengthening local capacity to manage carbon market infrastructure, and enabling broader engagement from both public and private actors. Specific actions include:

1.5.1 Clarify the Future Direction of Carbon Policies

- Support domestic and robust carbon pricing systems: Advance the adoption and strengthening of national carbon pricing instruments, while providing technical and financial support to help developing countries build institutional capacity.
- Promote equitable alignment of carbon market frameworks: G20 countries should work with MDBs and international climate bodies to support the gradual convergence and mutual recognition of carbon credit standards, MRV protocols, and trading rules, while ensuring flexibility to reflect national circumstances and capabilities.

[vii] To support greater complementarity between public and voluntary carbon finance, it is encouraged that corresponding adjustments apply only when voluntary carbon credits directly impact another country's national emissions inventory (e.g., when used for compliance under Article 6). This is not a change to carbon accounting rules, but a mechanism to help unlock private sector participation in climate finance.

- Scale high-integrity, permanent offsets and credits: Support the development and trade of high-quality carbon credits and permanent offsets, including those verified under Article 6.4 and aligned with the ICVCM Core Carbon Principles. These credits must be additional, measurable, and contribute to sustainable development particularly in developing countries. Renewable Energy Certificates (RECs) and voluntary offsets should be integrated with compliance markets where appropriate. Offset schemes must be designed to complement, not substitute or delay, direct emissions reductions.
- Strengthen regional carbon market participation and sovereignty: Support African countries and other EMDEs in building and managing sovereign carbon registries and MRV systems. Provide targeted technical assistance and financing to ensure local actors can contribute to shaping carbon market rules, price-setting, and benefit-sharing arrangements, helping ensure that emerging markets participate equitably in global carbon trading frameworks.

Enhancing carbon pricing and aligning credit frameworks boosts market predictability, reduces trade frictions, and attracts investment in sustainable energy solutions. G20 economies and businesses benefit from a level playing field, new export opportunities in offsets and low-carbon technologies, and stronger demand for transition-aligned services backed by high-integrity standards.

Recommendation 2

Accelerating industrialisation across the energy value chain to promote a just energy transition through skills development, supply chain resilience and global market access

Recommendation 2:

Accelerating Industrialisation Across the Energy Value Chain to Promote a Just Energy Transition Through Skills Development, Supply Chain Resilience, and Global Market Access

Actions:

Action 2.1: Equip Workforces for the Energy Transition

Equip EMDE workforces for the evolving energy landscape by expanding access to future-ready skills training and building integrated training-to-employment ecosystems that support regional job mobility and economic participation.

Action 2.2: Build Sustainable Supply Chains and Market Access

Build resilient energy-sector supply chains and improve market integration by enhancing trade partnerships, offering targeted export incentives, establishing local manufacturing hubs, and advancing critical minerals beneficiation in EMDEs.

Action 2.3: Expand Access to Advanced Energy Technologies

Expand access to energy technologies in EMDEs by scaling open intellectual property platforms, enabling affordable licensing through a G20 patent pool, and promoting voluntary, innovation-friendly licensing frameworks.

Milestones and KPIs

Short-term Milestone: 6-18 Months	Tracking Institution	Champion Institution
Develop a G20 energy transition skilling framework through the Employment Working Group (EWG) to align skills gap assessment processes, and training, certification and employment pathways in EMDEs, in collaboration with the private sector, training institutions, and social partners **Note:** Under this framework, countries should be encouraged to establish G20-B20 partnership platforms focused on workforce development, promoting private sector involvement in skilling, reskilling, and training initiatives	ILO, OECD	**ILO**, G20 Presidency, G20 Education WG

Short-term Milestone: 6-18 Months	Tracking Institution	Champion Institution
Design an Energy Technology Transfer Platform and launch 2–3 pilots by 2027, coordinated with WIPO and UNEP-CTCN. The platform should support the development of a global mechanism for tech deployment and explore proposals for the G20 Energy Tech Patent Pool, with a G20-B20 partnership track to engage the private sector.	OECD, UNCTAD, World Bank Group	**WIPO**, G20 Presidency, G20 Development WG, UNIDO
Develop and adopt G20 principles for resilient energy supply chains — including energy corridors, off-take agreements, and local content strategies, with governments, industry, and trade bodies through the G20 Trade and Investment Working Group (TIWG)	UNCTAD, WTO, OECD	**UNIDO**, G20 Presidency, G20 Trade & Investment WG

Medium-to-long KPIs: 5-25 years	Baseline Metric	Target Metric	Sources	Tracking Institution	Champion Institution	Classification
Increase the global value unlocked through industrialisation across sustainable energy value chains[viii] by 5x **Note: Countries are encouraged to embed and track ESG performance metrics to ensure inclusive, responsible, and competitive sustainable energy industrial growth**	$2 T [2021][1]	$11 T [2040][1]	1. Boston Consulting Group (2025)	Extractive Industries Transparency Initiative	UNIDO	☆ New Indicator

[viii] This refers to growth opportunities to be unlocked in four key areas: critical minerals, green technologies, green industrial materials and green services

Medium-to-long KPIs: 5-25 years	Baseline Metric	Target Metric	Sources	Tracking Institution	Champion Institution	Classification
Percentage of national workforce employed in local sustainable energy industries **Note: Countries are encouraged to integrate gender-disaggregated data and other social tracking mechanisms to ensure inclusive participation in sustainable energy workforces**	3-6% [2021][2]	5-10% [2040]	2. IRENA (2023)	ILO, World Bank	ILO Green Jobs Programme, UNFCCC, G20 Employment Working Group	✓ Partially aligned with India 2023 & Indonesia 2022
Number of tech transfer agreements facilitated by G20 Energy Tech Platform	n.a. [2025]	5 p.a. [2040]		UNFCCC Technology Mechanism	UNEP CTCN	☆ New Indicator

Context

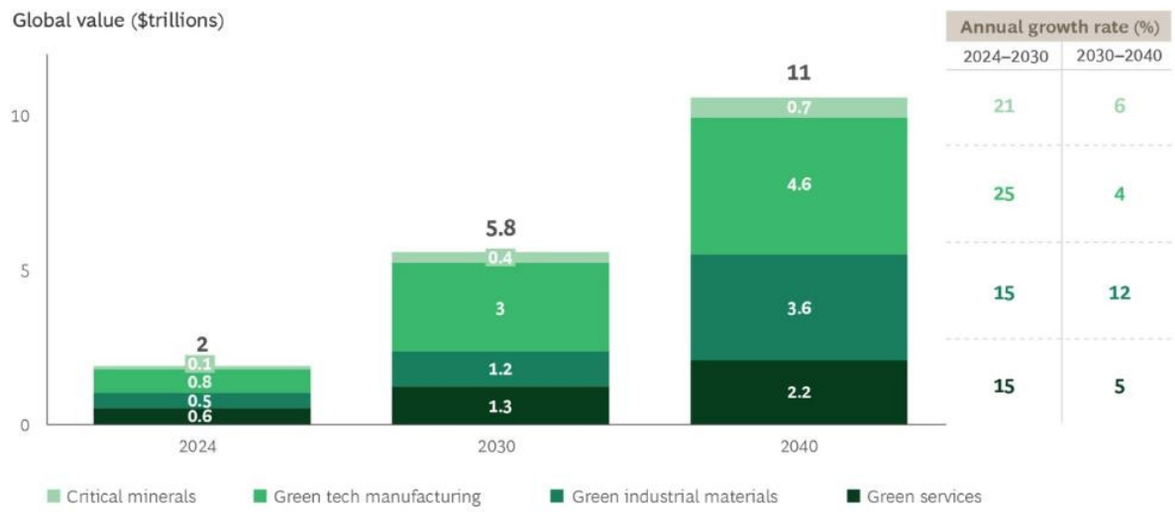
Global energy markets are entering a decisive phase, with more than 50% of the world's energy supply projected to come from renewable sources by 2050[28]. This significant shift is largely driven by rapid cost reductions in technologies such as solar PV, wind turbines, and energy storage, alongside increasingly stringent carbon abatement policies[29].

The energy transition, along with the shift to electrification and the growing need for modernised energy infrastructure, is driving the expansion of the new energy transition value chain. This, in turn, is accelerating the demand for key emerging technologies such as electric mobility, hydrogen and efficient biofuels, advanced storage (including battery) and in some extreme instances CCUS. These technologies are scaling fast, driving up the global demand for critical energy-transition minerals (such as lithium and cobalt) and low-carbon manufacturing capacity. The market for core mineral inputs linked to energy transition deployments could grow by as much as 600% to $700 billion by 2040[30]. Exhibit 15 also shows that the global energy transition value chain is expected to grow from $2 trillion in 2024 to $11 trillion by 2040[35], with particularly strong growth in sectors such as next-generation energy technology manufacturing, advanced industrial materials, and transition-aligned services.

However, not all technologies place equal pressure on critical mineral supply chains. Bioenergy, including biofuels, offer an example of an immediate and scalable solution to decarbonisation, especially for existing transport systems (including road, aviation, and maritime), without major infrastructure changes. Sustainable aviation fuel (SAF) is a key example, providing a low-emission alternative in the aviation sector using existing aircraft and fuelling infrastructure. As a complementary technology, bioenergy can support a more diversified and resilient energy mix while helping to accelerate decarbonisation, particularly in contexts where electrification remains challenging. Biofuels can, in certain cases, also generate positive economic, social, and environmental benefits. This is especially relevant for developed countries with strong agricultural sectors, such as Italy and Greece, where existing feedstock potential and infrastructure can be leveraged to scale biofuel production and deliver low-emission solutions with fewer supply chain dependencies. Brazil stands out amongst developing countries in having incorporating biofuels in its energy mix, with a combination of abundant feedstock, sustained incentives and a large domestic market.

Importantly, the energy value chain begins with extraction. Whether in fossil fuel-based systems or renewable energy production, mining plays a foundational role, particularly in securing critical minerals that are essential for energy transition technologies. However, upstream extraction faces persistent challenges, including environmental risks, social impacts, and investment constraints. These issues are especially acute in many EMDEs, where limited infrastructure, regulatory uncertainty, and high capital costs can hinder the development of bankable mining projects. While the Actions under this recommendation do not focus on extraction, it remains a crucial part of the broader supply chain that requires continued attention and investment.

Exhibit 15: Energy Transition Value Chain Growth Potential 2024-2040



Note: Because of rounding, the numbers may not add up to the totals shown. Estimates are based on IEA's Net Zero Emissions by 2050 Scenario. Values are nominal, including 2.1% annual average inflation from 2024 to 2040, which is the long-run US inflation rate implied by the average ren-year TIPS spread in August 2024 and September 2024
Source: IEA; Industry reports; BCG analysis

The growth of this new market is expected to generate up to 100 million new jobs worldwide by 2050, with approximately 38 million of these located in emerging markets and developing economies[31]. In addition, leading analysts foresee overall economic activity, including critical minerals, advanced technologies, new market services, scaling to a multi-trillion-dollar value pool by 2040[32]. These dynamics indicate a prime opening for both advanced and emerging economies to diversify, industrialise, and capture more value within local supply chains.

While many EMDEs hold substantial critical mineral reserves, most remain concentrated in the extraction stage of the value chain.[5] Global capacity for processing, refining and manufacturing of technologies such as batteries, solar panels, and wind turbines remains highly concentrated in a small number of countries.[5] This concentration creates supply chain vulnerabilities and reinforces structural imbalances, limiting the ability of resource-rich EMDEs to move beyond raw material extraction. As a result, these countries continue to miss out on the economic and industrial opportunities associated with value adding activities such as mineral processing, technology manufacturing, and integration into sustainable energy export markets.

Achieving a successful energy transition will require intensified investment, innovation, and R&D in novel technologies to ensure reliable and flexible energy systems. Large-scale deployment of variable renewable energy (VRE) sources like solar and wind must be complemented by the development of adjustment capacities, including flexible and decarbonised thermal power, geothermal and hydropower, energy storage, demand-side flexibility, and modernised transmission and distribution networks. In particular, demand-side management in industrial sectors can enable flexibilities based on their capacities, allowing industries to adapt energy consumption in response to system needs. Alongside these system-level enablers, advancing technologies such as hydrogen and its derivatives for power generation and storage will also be critical to balancing grids with high VRE penetration.

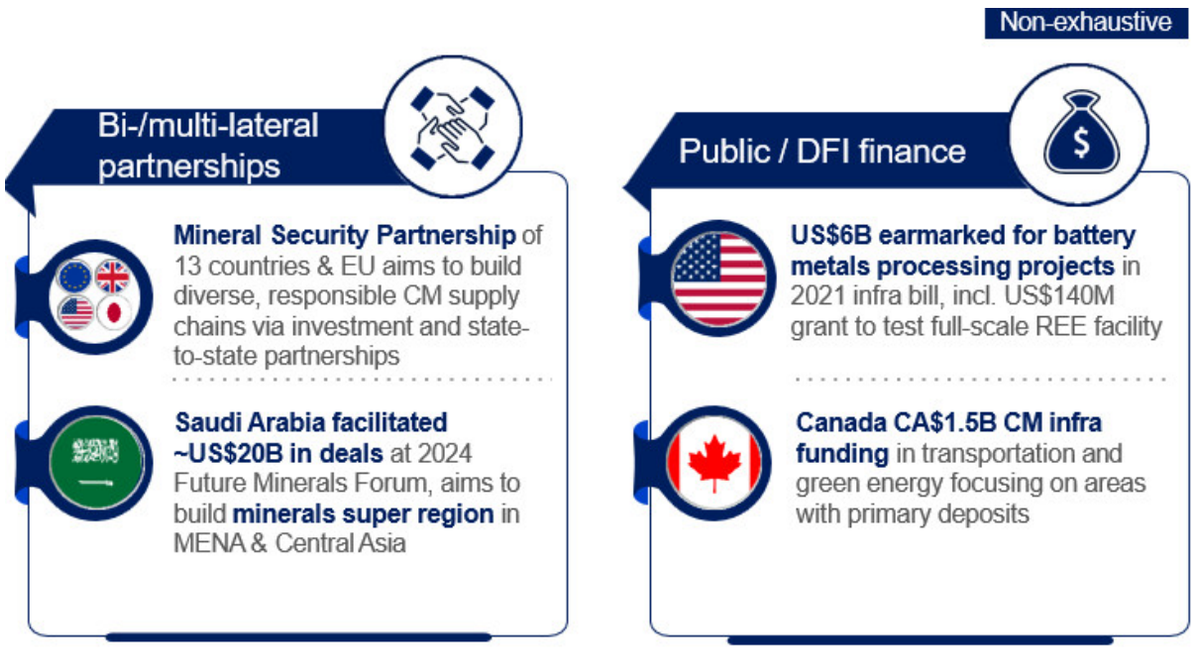
Scaling advanced energy technologies such as hydrogen, battery storage, and carbon capture will require robust R&D ecosystems, sophisticated industrial processes, and flexible energy systems. This also extends to technologies for industrial decarbonisation, including heat pump and electric boilers. However, many emerging markets still lack the technical capabilities and infrastructure to support midstream and downstream manufacturing at scale. Skill shortages, limited research capacity, and underdeveloped industrial bases remain major barriers. Even in advanced economies, high-tech industries face talent gaps in specialised areas such as electrochemistry and advanced materials, further constraining the pace of industrial expansion.

Fragmented policy frameworks, misaligned fiscal incentives, and inconsistent trade regimes dampen industrial investment. Not only do local manufacturers contend with uncertain import-export conditions, but they also face prohibitively high capital requirements for building new industrial infrastructure. Access to affordable financing is particularly challenging for nascent players in developing economies, where risk profiles and cost-of-capital considerations can stall projects.

Localising higher-value activities in energy manufacturing, mineral processing, and related supply chains can unlock sizable job creation and revenue streams. Resource-rich emerging markets can move beyond basic extraction toward more profitable midstream and downstream segments, mitigating commodity-price risks and strengthening resilience. At the same time, advanced economies can rebuild industrial bases around modern, low-carbon sectors, ensuring long-term competitiveness. The European Union's (EU) Clean Industrial Deal illustrates one approach to aligning industrial policy with energy transition and supply chain objectives[69]. The strategy combines regulatory, financial, and trade instruments to support decarbonisation, reindustrialisation, and competitiveness. It includes measures aimed at scaling advanced technologies, streamlining permitting, developing workforce skills, and supporting next-generation manufacturing capacity[69].

Ongoing geopolitical realignments highlight the vulnerabilities inherent in geographically concentrated supply chains. Major markets are now actively seeking diversified sourcing and secondary manufacturing hubs for critical minerals and renewable components. Examples are shown in Exhibit 16. By investing in local industrial ecosystems, governments and private investors can reduce supply shocks, mitigate price volatility, and ensure uninterrupted availability of key inputs (e.g., metals for batteries, chemicals for electrolysers).

Exhibit 16: Examples of global initiatives to diversify or localize supply chains



Note: CMs = Critical Minerals
Source: Ernst & Young (EY); Mining Weekly

Rapidly expanding the capacity to manufacture and deploy energy transition technologies is critical to modernising industrial systems and strengthening economic resilience. Industrial upgrading in this context can enable lower-carbon outputs across key downstream sectors, from transportation to advanced construction materials. By leveraging domestic energy resources, investing in infrastructure, and building a skilled workforce, countries can accelerate their participation in the evolving global energy economy while supporting inclusive and sustainable industrial growth Ultimately, accelerating industrial development across the energy value chain is essential for enhancing global competitiveness, economic security, and long-term resilience. With strategic policy coordination, targeted financial frameworks, and strong workforce development initiatives, both emerging and advanced economies are well positioned to capitalize on the next wave of inclusive and sustainable industrial growth driven by the global energy transition.

Action 2.1: Equip Workforces for the Energy Transition

Equip EMDE workforces for the energy transition by expanding access to energy transition–related skills training and adopting an ecosystem-based approach to workforce development. This includes building robust training-to-employment pipelines and supporting regional job mobility to meet the demands of evolving energy and industrial markets.

Executive Summary

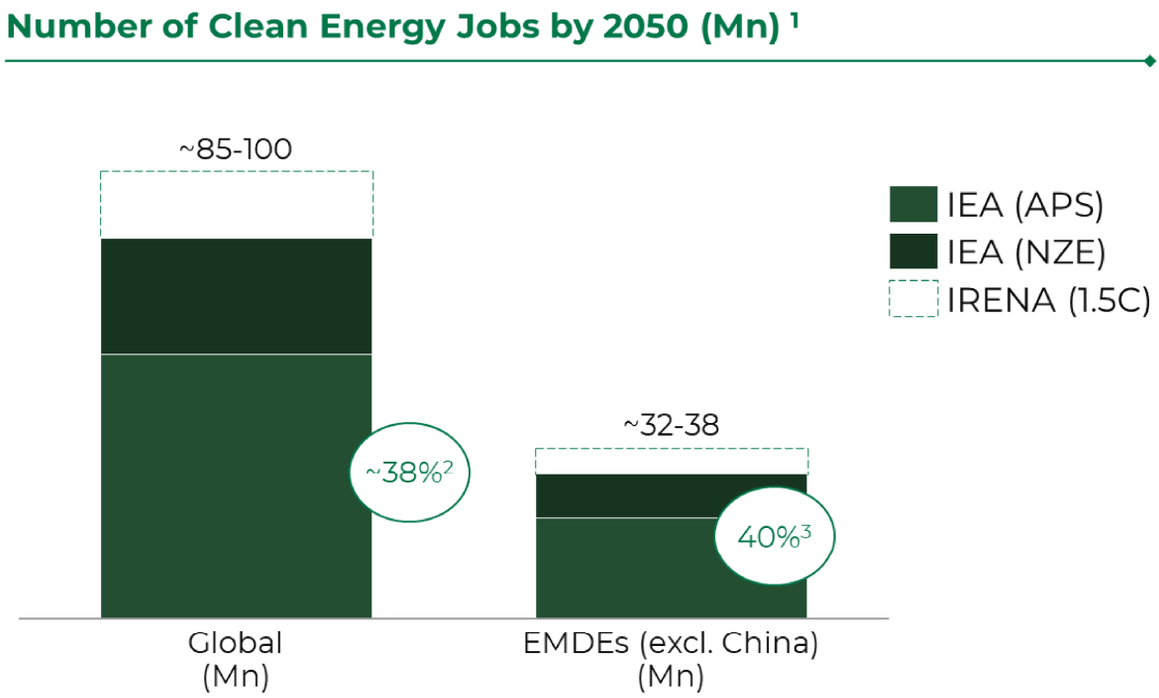
A global shortage of skilled talent, particularly in EMDEs, is constraining the growth of energy transition industries. Many countries lack the workforce capabilities needed to support critical mineral processing, energy infrastructure deployment, and advanced manufacturing in low-emissions sectors.

Action 2.1 aims to promote inclusive workforce development by expanding EMDE access to international training and certification programmes, advancing multi-stakeholder, ecosystem-based education-to-employment models, and facilitating regional job mobility. It places particular emphasis on reaching underrepresented groups, including youth, women, and vulnerable communities, to ensure fair participation in emerging energy and industrial job markets.

Background & Context

A global talent shortage poses a significant risk to realizing the full potential of energy transition–driven industrial growth. By 2050, the energy transition could generate 85–100 million new jobs, with emerging markets and developing economies (EMDEs) capturing up to 38 million of them, as seen in Exhibit 17[31]. Yet many regions lack the advanced engineering, chemistry, and high-tech vocational skills needed to support critical mineral beneficiation and next-generation technology manufacturing. Competitiveness in renewables, battery storage, and low-carbon industrial processes hinges on specialized expertise, spanning lithium refining, fuel cell technologies, and systems engineering [33]. When such skills are scarce, projects stall, critical resources go underutilised, and private investment flows to more capable markets. This challenge is especially acute for emerging economies endowed with cobalt, lithium, and rare-earth elements. In these economies, constrained human capital hampers midstream and downstream industrialisation, limiting opportunities beyond raw commodity export.

Exhibit 17: Number of Low-carbon Energy Jobs Globally by 2050 (Mn)



Source: IEA; International Renewable Energy Agency (IRENA); BCG analysis

Despite these hurdles, there is clear scope for high-impact collaboration. Public institutions like the International Labour Organization (ILO), WorldSkills have laid vital groundwork for energy transition linked-skilling programmes in advanced manufacturing, critical material handling, and renewable energy operations[34]. These efforts have gained particular momentum in Africa. The Pan African Training Center for Renewable Energy and Energy Transition, for example, focusses on building essential managerial and professional skills needed in the energy transition sector. Meanwhile, private actors such as Renewable Energy Solutions for Africa (RES4Africa) Foundation, with the support of the Enel Foundation as a knowledge partner, have played a growing role in sector-specific training and investment-readiness. Through its training initiatives, RES4Africa focuses on developing local technical skills essential for the deployment and maintenance of renewable energy systems. Similarly, the International Renewable Energy Agency (IRENA) and Eni have launched a training programme titled 'Capacity Building on Biofuels' to equip ministerial officials from various African countries with knowledge on biofuels, supporting informed policymaking and technical readiness. Such initiatives are critical for fostering the skilled workforce needed to drive a successful and inclusive energy transition.

Cross-border mobility agreements, particularly for engineering professionals, can alleviate near-term skill shortages while facilitating technology transfer and best-practice sharing. Public–private partnerships (PPPs) can further strengthen workforce development when governments co-fund initiatives and incentivize local job placement. These collaborative models highlight the economic potential of investing in robust transition linked skilling and underscore the need for an ecosystem-based approach. This is a coordinated skilling model that brings together government, industry, education and training institutions, and financial actors to align skilling efforts with national transition goals. However, to avoid unintended talent drain from EMDEs, mobility frameworks must be designed with

safeguards, such as regional job-matching schemes, reintegration pathways, or incentives for returning talent, to retain skilled workers within domestic and regional labour markets, preserve the benefits of public training investments and prevent long-term skill outflows.

To ensure inclusion and fair opportunity, this ecosystem approach must also prioritise the participation of vulnerable groups like the youth. Many young people face structural barriers to accessing technical training and employment, even though they represent a vital source of innovation, entrepreneurship, and long-term workforce sustainability in Africa and other EMDEs. Equally important is supporting workers and communities affected by fossil fuel phaseout. A truly just transition must integrate Just Exit Strategies into workforce planning, providing targeted reskilling, income support, and economic diversification for those impacted by the decline of coal, oil, and gas sectors. Within the ecosystem-based model, demand-led skilling, anchored in close collaboration with industry and guided by current and future labour market trends and requirements, is essential to ensure training is responsive and investment-ready. South Africa's Just Energy Transition Skilling for Employment Programme (JET SEP) exemplifies this model, coordinating private sector efforts to deliver an inclusive, demand-led skills platform that prepares the workforce for the country's transition to a low-carbon economy[36].

To fully harness the benefits of skilling and employment initiatives, it is essential that countries begin with comprehensive baseline skills studies and targeted skills gap assessments. These assessments help identify existing capabilities, highlight priority areas for capacity-building, and align training programmes with real labour market needs. Equipped with the right skills, individuals can become both competent producers and informed consumers in the new economy, driving local innovation, supporting advanced energy deployment, and contributing to a just and inclusive transition[73].

In parallel with worker-focused skilling, it is equally important to build the entrepreneurial and managerial capabilities needed to generate demand for those skills. Job creation in the energy transition depends not only on a trained workforce but also on business leaders and innovators who can develop viable business models for the energy transition and scale up sustainable energy enterprises. Supporting entrepreneurship, particularly among youth and local MSMEs, can unlock new employment pathways and stimulate energy access solutions tailored to community needs. This requires targeted capacity building for enterprise development, access to finance, and coordinated support from national employers' organisations, such as Business Unity South Africa (BUSA), that understand local market dynamics and can bridge training with job creation. Fostering a supportive business environment is thus an integral component of the ecosystem-based approach, ensuring that skills development translates into real economic opportunities in the low-carbon economy.

Seizing this opportunity requires a unified commitment from governments, international financial institutions, and major employers to build a strong pipeline of specialized talent for the energy sector. Targeted skilling programmes may bridge the global supply–demand gap, prevent localized "brain drain," and lay the foundations for new industrial ecosystems that foster inclusive growth.

Implementation approach

To support inclusive workforce development in the context of the global energy transition, access to energy transition–related skills must be enhanced in EMDEs Additionally, employment pathways must support a smooth and fair transition for affected workers. Key actions include:

2.1.1 Enhance EMDE Access to Skills Training and Knowledge Programmes:

- Expand access to energy transition skills training in EMDEs: Partner with and scale up established training initiatives such as the ILO ITC's "Skills for a Greener Future," the Pan African Training Center for Renewable Energy and Energy Transition, and the Res4Africa Academy. Ensure meaningful inclusion of business and employer perspectives, including through stronger private sector participation in forums such as the OECD. These efforts should build on and complement existing international programmes, particularly ongoing work by the ILO on skilling and just transitions, to avoid duplication and ensure alignment with evolving labour market needs.
- Facilitate knowledge sharing for energy transition skills: Strengthen support for initiatives like the UN International Green Learning and Skills Accelerator, where global energy transition leaders share technical expertise and best practices with industries in EMDEs to advance workforce development aligned with evolving energy systems.

2.1.2 Develop Sophisticated Training-to-employment Pipelines

- Leverage ecosystem approaches to skilling: Promote inclusive education-to-employment models, like South Africa's JET SEP, that align training with industry needs, support worker transitions, and ensure access for marginalised groups including youth, women, informal workers and vulnerable communities.
- Negotiate regional job placement agreements: Establish regional mobility partnerships to enable certified job trainees to access employment across borders during the transition. Modelled on South Africa's JET SEP, a coordinated African framework could support standardised training, certification, and cross-border job placement, ensuring fair access to emerging employment opportunities. These agreements should also include mechanisms such as placement targets within the region, public-private reintegration schemes and opportunities for underrepresented groups, including women, and informal and transitioning workers.
- Strengthen entrepreneurship and enterprise development for job creation: Support training programmes that build the capacity of entrepreneurs and local MSMEs to develop scalable, sustainable energy businesses. Work with national employers' organisations (like BUSA in South Africa) to align these efforts with local market dynamics and foster an enterprise ecosystem that translates skills development into meaningful employment opportunities in the low-carbon economy.

Expanding energy transition skills in EMDEs grows the global talent pool, helping G20 industries address labour shortages and reduce deployment delays. Standardised training and mobility frameworks also improve workforce alignment across borders, supporting supply chains and creating new partnership opportunities for G20 firms in emerging markets.

Action 2.2: Build Sustainable Supply Chains and Market Access

Build resilient new market manufacturing supply chains and boost market access by expanding trade partnerships, introducing export incentives, developing local manufacturing hubs, and advancing critical minerals beneficiation in EMDEs.

Executive Summary

New energy market supply chains remain heavily concentrated in a few countries, limiting value addition and market access for EMDEs, even as many are rich in critical minerals essential to the energy transition.

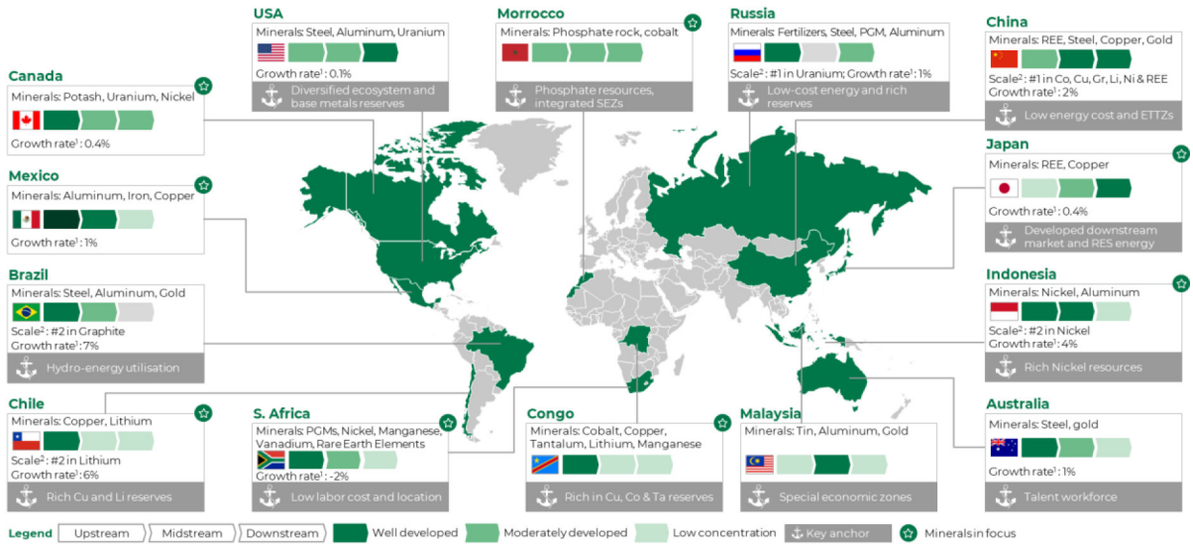
Action 2.2 supports trade-driven industrial development by enabling EMDEs to move up the value chain through expanded trade agreements, export incentives, and strategic alliances for advanced technology manufacturing and mineral processing. It also promotes local production through industrial clusters, public procurement, and a G20-aligned due diligence framework to ensure fair and sustainable participation in global supply chains for critical energy transition minerals and technologies.

Background & Context

Sustainable energy value chains remain dominated by a handful of major players. These players are at the forefront of manufacturing and exports for solar PV components, batteries, and wind turbines[5]. This concentration allows market leaders to capture the most downstream value. Meanwhile, EMDEs are largely constrained to raw material extraction or basic processing. However, they are well positioned to capture greater value from energy supply chains, due to factors such as rich critical mineral reserves, low costs, and established markets, as seen in Exhibit 18. Africa, for example, holds 70% of global cobalt reserves, making it a key player in the energy transition[71]. Yet many African countries remain locked into extraction, missing the opportunity to move up the value chain[71]. A significant share of the continent's resources also remains geologically underexplored, as Africa has been consistently overlooked in global mineral exploration investment[72]. A coordinated stock take of both proven and potential reserves could support regional specialisation and trade by identifying complementary assets across countries, improve feedstock access, and unlock regional synergies for shared industrial development. For Africa and other mineral-rich EMDEs, this imbalance offers a strategic opportunity to retain more value by expanding into refining, manufacturing, and component assembly. With the right policies, these regions can reduce dependence on commodity exports and become active players in the low-carbon energy supply chain becoming a critical part of the materials transition ecosystem.

Trade barriers, such as tariffs, strict import quotas, and fragmented regulations, further entrench this imbalance by preventing EMDE producers from achieving the scale needed to enter advanced markets. Although policymakers in the EU and the United States have pledged to diversify their supply chains, many EMDEs lack the necessary investment frameworks and capacity to capitalise on changing geopolitical dynamics. Adding to these obstacles is the absence of stable offtake agreements; without reliable buyer commitments, local firms hesitate to expand production of batteries, solar components, or related infrastructure, thus missing out on potentially lucrative value-added export opportunities.

Exhibit 18: Map of upstream, midstream and downstream development



Source: S&P Capital IQ

Global demand for critical minerals has surged amid rapid growth in electric vehicles, battery storage, and low-carbon industrial processes. By 2040, the market for these "sustainable tech manufacturing" applications may exceed USD 4.6 trillion, yet most refining capabilities and downstream manufacturing remain concentrated in a few established hubs[35]. Evolving climate policies, ranging from carbon border adjustments to corporate ESG mandates and inflation reduction acts, are reshaping procurement strategies, prompting major buyers to diversify suppliers in pursuit of price stability and secure sourcing. This shift presents a prime opening for EMDE manufacturers equipped to deliver large-scale, consistent production and meet growing demand for low-carbon energy components.

Government incentives, such as tax credits, export subsidies, and pricing support programmes, have proven instrumental in helping local manufacturers to not only expand their market access and compete globally, but also strengthen domestic supply chains. For example, energy tax credits in the US provide incentives for domestic manufacturing of low-carbon energy technologies, aiming to create a strong domestic supply chain and reduce reliance on imports.

Well-targeted fiscal measures can lower production costs, improve price competitiveness, and attract the large-scale investments needed to scale EMDE participation in advanced technology value chains.

However, successful market entry increasingly depends on meeting rigorous sustainability standards, positioning low-carbon certification as a strategic differentiator. Rising interest in verified "low-carbon" components, from refined metals to fully assembled solar modules, provides EMDE producers with a strong opportunity, if they can demonstrate credible environmental compliance and uphold robust social and human rights standards. By securing credible certifications and adhering to stringent ESG requirements and local content requirements, local suppliers can establish a competitive position in a growing sustainable energy value chain, one that prioritises environmental integrity, social responsibility, and inclusive economic participation. Aligning expectations on environmental, human rights, and social safeguards can help level the playing field, enhance trust in sustainable supply chains, and support more equitable global participation. Emerging international standards, such as the UN Guiding Principles on Business and Human Rights (UNGPs), illustrate how due diligence expectations are evolving globally. These widely recognised principles, provide a flexible framework for identifying, preventing, and addressing environmental and human rights risks in global supply chains. Their growing relevance reflects a shift toward greater accountability for companies operating across borders, while allowing countries to implement due diligence measures in ways that reflect their own legal systems, institutional capacity, and development priorities.

Implementation approach

To enhance global market competitiveness of EMDEs, G20 should prioritise increasing fair market access through trade and investment agreements, streamlined logistics, creating steady demand for local processors and manufacturers, and building supply chain resilience. Specific actions include:

2.2.1 Enable Fair Access and Integration into Global Sustainable Energy Value Chains

- Expand trade access and supply chain integration: Establish preferential trade agreements, low-carbon corridor pacts, and strategic alliances with global buyers to reduce non-tariff barriers, streamline export processes, and promote joint ventures that support technology transfer and value chain integration.
- **Promote alignment on due diligence standards:** Support the development of a G20-aligned approach to due diligence that allows for both voluntary and mandatory frameworks, based on national contexts. The approach should integrate environmental, biodiversity, and human rights considerations, drawing on established international standards such as the **UNGPs**. This would help reduce regulatory inconsistencies across jurisdictions, support fair competition, and ensure that firms in EMDEs can participate equitably in low-carbon energy supply chains.

2.2.2 Encourage Incentives to Enhance Local Industry Competitiveness

- Implement export financing and incentives: Work with WTO to introduce targeted incentives, such as tax credits and export subsidies, to enhance the price competitiveness and strengthen supply chains of domestic critical minerals processing industries and locally manufactured energy components[ix].

[ix] Incentive measures like tax credits, export subsidies and local content requirements must align with WTO rules like the Agreement on Subsidies and Countervailing Measures (ASCM). These prevent the introduction of discriminatory policies that could distort fair competition.

- Promote the use of mature and low-cost energy sources in industry: Support the adoption of validated, affordable, and transition-ready energy technologies such as bioenergy and biofuels to reduce production costs and improve energy reliability for local manufacturers. This should be pursued through targeted public policies, fiscal incentives, and streamlined trade and export procedures, helping domestic industries compete more effectively in global markets while lowering their emissions footprint.

2.2.3 Facilitating Domestic & Regional Market Formation

- Nurture domestic production: Introduce phased local content requirements to nurture domestic production of key components (e.g., inverters, battery cells), while capping thresholds to avoid excessive cost increases.
- Introduce industrial zones/clusters: Support formation of domestic industrial clusters and strengthen regional supply chains.
- Convene regional coordination platforms for minerals and energy trade: Establish ministerial-level regional forums. These forums would bring together Ministers of Trade, Minerals, and Energy to develop coordinated strategies on critical minerals and alternative energy development. These forums, in collaboration with regional private sector actors, can support the creation of harmonised protocols and investment frameworks. For example, a Forum of SADC Ministers could help consolidate a unified regional strategy on critical minerals and sustainable energy, enabling more effective engagement with G20 partners and global buyers.

Expanding manufacturing and supply chain capacity in EMDEs helps G20 economies diversify sourcing, reduce exposure to supply disruptions, and lower the cost of sustainable energy technologies. Trade partnerships and joint ventures open new markets for G20 businesses while enabling secure, ESG-compliant access to critical minerals and components. This action strengthens global value chains, supports industrial resilience, and creates growth opportunities across both emerging and advanced markets.

Action 2.3: Expand Access to Advanced Energy Technologies

Expand access to energy technologies in EMDEs by scaling open intellectual property platforms, enabling affordable licensing through a G20 patent pool, and promoting voluntary, innovation-friendly licensing frameworks.

Executive summary

High licensing costs, opaque Intellectual Property (IP) regimes, and fragmented patent ownership continue to limit new technology access for EMDEs, stifling domestic industrialisation and slowing the global diffusion of new advanced energy solutions.

Action 2.3 supports expanded technology access by strengthening open-source platforms, creating a G20-backed Energy Patent Pool, promoting multilateral technology transfer agreements, and developing interoperable intellectual property frameworks to reduce licensing friction and foster inclusive innovation in EMDE supply chains.

Background & context

EMDE producers face limited access to affordable intellectual property (IP), constrained by high upfront licensing costs, restrictive royalty structures, and fragmented or opaque patent ownership. These barriers, compounded by weaker negotiating positions and underdeveloped legal infrastructure, undermine local industrialisation, deter investment, and slow the global dissemination of critical energy transition technologies. Overreliance on a select group of advanced economies for next-generation energy technologies increases supply chain vulnerabilities and delays progress in resource-rich regions that could otherwise contribute more actively to the global energy transition. In this context, the wider use of accessible transition fuels such as biofuels can help ease the challenges of technological dependence by offering a viable low-carbon alternative, particularly in regions where access to advanced, proprietary energy technologies remains limited.

Models from other industries, such as the Medicines Patent Pool, highlight how multilateral open-licensing consortia can drive accessibility in lower-income regions, reduce overheads, and nurture local R&D capacity[37]. By streamlining legal processes and sharing best practices, such mechanisms pave the way for broader market participation. Moreover, the projected growth in the global manufacturing related to energy transition technologies can generate vast opportunities for emerging players able to surmount the prevailing technology barriers. Rapid diffusion of key innovations depends on effective partnerships that link capital, expertise, and supportive policy frameworks.

In this context, platforms like Mission Innovation and WIPO GREEN demonstrate how greater collaboration can standardise best practices and alleviate licensing friction. Expanding these initiatives to incorporate a wider range of industrial and energy-related patents would further reduce barriers for new market entrants, fostering diverse, competitive ecosystems worldwide.

Many EMDEs already possess critical minerals or maintain industrial bases primed for rapid scaling to meet surging global demand yet they frequently lack the technical know-how to unlock the full potential of these resources. Targeted knowledge transfer and skill-building efforts can enable them to become major contributors to the global energy supply chains.

By promoting fair and transparent licensing practices, G20 economies can uphold IP as a driver of innovation while addressing access barriers that may limit emerging market participation in new technologies. Encouraging IP frameworks based on FRAND (fair, reasonable, and non-discriminatory) terms can help expand the global pool of capable producers, support supply chain diversification, and strengthen resilience against systemic and geopolitical risks.

Still, technological adoption is deeply interlinked with workforce development. As countries advance the energy transition and deploy new technologies, it is essential to train workers with the skills needed to operate, maintain, and innovate around those technologies. This approach complements the principle of technological neutrality, ensuring that a wide range of technologies can be adapted and scaled based on local capabilities and innovation ecosystems. Transferring technology without simultaneously investing in local skills, research, and innovation risks reinforcing dependency. A balanced approach that integrates capacity-building with co-innovation can strengthen indigenous R&D ecosystems and foster a sustainable, inclusive path to industrial growth, benefiting both EMDEs and the global community.

Implementation approach

To support skills development and strengthen beneficiation and manufacturing capacity, the G20 should facilitate and expand the transfer of energy transition technologies to EMDEs. This can be achieved by lowering technology access barriers, leveraging existing international platforms, promoting technology transfer agreements, and developing inclusive regulatory frameworks for technology sharing. Specific actions include:

2.3.1 Leverage Open-source Tech – sharing Platforms in Skilling

- Strengthen partnerships with World Intellectual Property Organization (WIPO): Collaborate with WIPO GREEN to grant all G20 countries open access to databases of energy transition technologies, patents, and expert knowledge, supporting advanced skills development and industrial innovation.
- Encourage open-source innovation through Mission Innovation (MI): Expand G20 participation in Mission Innovation (MI) to drive collaborative R&D in next-generation energy systems, while accelerating knowledge transfer and technical capacity-building in EMDEs.

2.3.2 Enhance Technology Transfer to Strengthen Supply Chains

- Promote bilateral and multilateral tech transfer agreements: Set up a G20 Energy Technology Transfer Platform in collaboration with WIPO and UNEP-CTCN. Use the platform to support matchmaking, legal assistance, and technology deployment in G20 EMDEs. It will also help operationalise a G20 Energy Tech Patent Pool, based on a model similar to the Medicines Patent Pool, to enhance access and remove IP licensing barriers for critical energy technologies.

2.3.3 Enable Collaborative and Innovation-Friendly Tech Transfer Frameworks

- Promote voluntary IP-sharing mechanisms and co-development incentives: In partnership with WIPO GREEN and WTO, support the creation of G20-aligned frameworks that facilitate cross-border technology deployment through voluntary patent pools, co-development partnerships, and incentives for joint innovation. These efforts should be harmonised with existing IP treaties and standards, preserving the role of IP in encouraging innovation while enabling broader, equitable access to sustainable energy technologies.

Improving access to sustainable energy technology IP in EMDEs supports supply chain diversification and reduces overreliance on a few advanced manufacturing hubs, benefiting G20 economies seeking greater resilience and security. Open licensing and technology-sharing frameworks also create new markets for G20 innovators, while accelerating co-development and commercial opportunities.

Recommendation 3

Accelerating the expansion and modernisation of energy infrastructure to increase energy efficiency, access, and reliable power supply

Recommendation 3:

Accelerating the expansion and modernisation of energy infrastructure to increase energy efficiency, access, and reliable power supply.

Actions:

Action 3.1: Enhance Climate-Resilient Energy Infrastructure

Enhance energy infrastructure resilience to climate shocks by establishing a G20 knowledge hub, supporting global markets through mutually recognised standards for resilient sustainable technologies, and integrating climate risk into infrastructure planning.

Action 3.2: Develop Flexible, Integrated Energy Systems

Build flexible, shock-responsive, and interconnected energy systems by aligning national and regional infrastructure plans, embedding digital and modular design, and expanding regional power markets and cross-border data systems.

Action 3.3: Accelerate Local Energy Infrastructure Delivery

Accelerate infrastructure delivery in local governments by streamlining permitting through centralised digital platforms, fast-track approvals, and targeted technical support to local communities.

Milestones and KPIs

Short-term Milestone: 6-18 Months	Tracking Institution	Champion Institution
Establish national energy infrastructure champion institutions in G20 countries to help unlock cross-border energy infrastructure pipelines by aligning regional masterplans and coordinating technical support with implementation bodies such as the AU, ASEAN, GIF, and AUDA-NEPAD, under the coordination of a G20 Infrastructure Action Council led by the Infrastructure Working Group	World Bank	**GIF**, G20 Presidency, G20 Infrastructure WG
Develop a G20 energy infrastructure development framework for modern, digitised, and resilient energy systems — including shared standards for climate risk disclosure, digital integration such as smart infrastructure, AI-enabled monitoring, and data science applications, and	World Bank, OECD	**ISSB**, G20 Presidency, G20 Infrastructure WG

Short-term Milestone: 6-18 Months	Tracking Institution	Champion Institution
resilient design, by 2027, in collaboration with national regulators, ISSB, and GSEF, coordinated by the G20 Infrastructure Working Group. **Note:** This should include an African sub-framework that sets regionally relevant milestones, with potential piloting in countries like South Africa, in alignment with AUDA-NEPAD infrastructure priorities.		
Develop a G20 strategic plan to scale infrastructure delivery in local municipalities by identifying capacity gaps and models for technical assistance, planning, and financing, through collaboration with GIF, UNOPS, and local programmes such as South Africa's Cities Programme, led by the G20 Infrastructure Working Group. The plan should include a G20-B20 partnership track to leverage private sector expertise, investment, and delivery capacity. **Note:** The plan should incorporate regional sub-frameworks, particularly for Africa, with tailored milestones and pilot initiatives to test delivery models in diverse local government contexts.	GIF, UNOPS	**GIF**, ICLEI, G20 Presidency, G20 Infrastructure WG

Medium-to-long KPIs: 5-25 years	Baseline Metric	Target Metric	Sources	Tracking Institution	Champion Institution	Classification
Double the annual global investment in grid infrastructure	$ 390 B [2024]1	$750 B [2040][2]	1. IEA (2025) 2. IEA (2024)	IEA	**GIF**	✓ Fully aligned with Brazil 2024
Achieve 50% adoption rate of G20-endorsed infrastructure development framework	n.a. [2025]	50% [2040]		World Bank, GIF	**UNOPS**, G20 Infrastructure WG	☆ New Indicator
Grid infrastructure modernised (length)	n.a. [2025]	+ 80 M km [2040][3]	3. IEA (2023)	IEA	**GIF**	✓ Partially aligned with Brazil 2024

Context

The global energy system is steadily evolving as countries seek to diversify energy sources and cut emissions. This transition is propelled by the rapid rise of renewables, increased use of transition fuels, and the emergence of decentralised solutions like battery storage and mini-grids. At the centre of this transformation lies strategic energy infrastructure, the physical and digital systems that enable energy production, transport, storage, and consumption across sectors such as power, industry, transport, and buildings. Key infrastructure components include transmission and distribution (T&D), renewable power generation, storage systems, sustainable fuels (like hydrogen and biofuels), transition fuels (e.g., natural gas), and carbon management technologies such as CCUS in extreme circumstances.

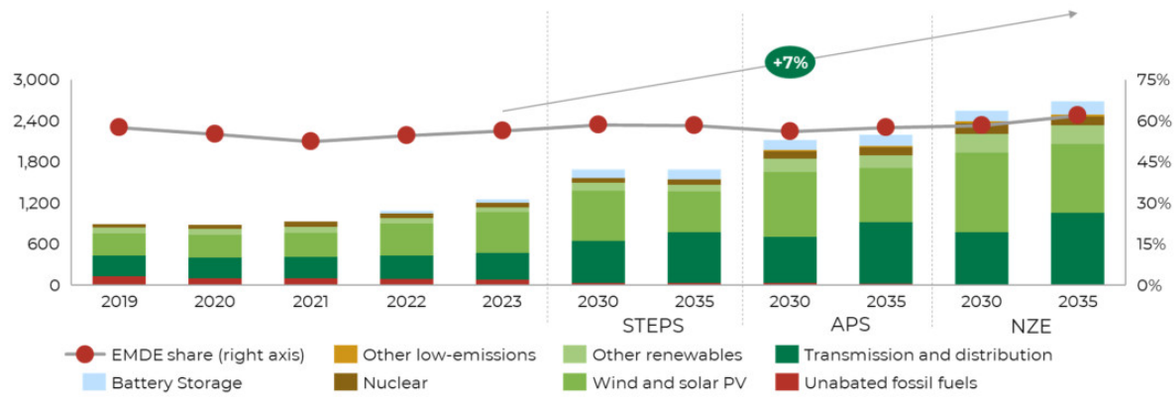
An effective energy transition requires a diverse infrastructure mix. While electricity grids remain foundational, they must be complemented by systems for transporting and storing alternative energy carriers, especially in sectors that are difficult to electrify. This includes hydrogen, biomethane, and liquid biofuels, supported by pipelines, storage systems, and conversion facilities.

Natural gas infrastructure plays a crucial transitional role. In emerging markets and hard-to-electrify sectors, it offers an affordable option that can eventually be repurposed to carry hydrogen and biomethane. Hydrogen infrastructure, particularly for large-scale storage, also facilitates sector coupling, the strategic integration of electricity, heating, transport, and industry. Technologies like power-to-gas-to-power enable the storage of surplus renewable electricity as hydrogen, which can later be reconverted to electricity or used in other sectors. Meanwhile, sustainable biofuels (such as sustainable aviation fuel and renewable marine fuel) are essential for decarbonising sectors where direct electrification is infeasible. Together, these components form a resilient, integrated infrastructure landscape that can support a more flexible and inclusive energy system.

Battery Energy Storage Systems (BESS) are pivotal in integrating variable renewable energy (VRE) sources such as wind and solar. By storing surplus electricity and supplying it when demand spikes, BESS stabilise grids, reduce curtailment, and increase system reliability. In the IEA's Net Zero Emissions (NZE) Scenario, global energy storage must grow to 1,500 GW by 2030, with 90% of this growth expected from batteries, reaching 1,200 GW, a 14-fold increase[104]. To stay on track, BESS deployment must grow by an average of 25% annually through 2030[104]. Beyond grid integration, BESS enables electric mobility, second-life EV battery use, and supports off-grid electrification, particularly in remote communities. These systems also enhance industrial efficiency, reduce electricity costs, and support electrified technologies like heat pumps and thermal storage, especially in energy-intensive sectors.

Power, specifically electricity, and transmission and distribution (T&D) systems, have been widely acknowledged to play a central in the energy transition. Electricity is projected to account for more than 50% of global final energy consumption by 2050 under the IEA's Net Zero Emissions scenario, up from around 20% today[70]. Meeting this target will require not only a rapid expansion of electrification across sectors, but also sustained and ambitious investment in renewable energy sources. The IEA (2023) states that tripling global renewable capacity by 2030 is the single largest driver of emissions reductions in the Net Zero Emissions by 2050[103], placing increased pressure on power systems to absorb and deliver large volumes of sustainable electricity reliably and affordably. Additionally, Exhibit 19 shows that global power sector investment is expected to rise substantially across all decarbonisation scenarios, with the largest increases in renewable power sources like wind and solar PV, as well as transmission and distribution. As electrification expands across sectors such as transport, industry, and buildings, ensuring that electricity is reliably and affordably delivered through resilient T&D infrastructure will be essential to sustaining low-carbon energy progress. This also makes modern infrastructure planning critical to achieving universal energy access goals, particularly in underserved regions where extending reliable power is key to unlocking development.

Exhibit 19: Power sector investment by technology and scenario, and share in EMDEs 2019-2035 Billion USD (2023, MER) under STEPs, APS and NZE Scenarios



Note: MER = market exchange rate: EMDE = emerging market and developing economies. STEPS = Stated Policies Scenario. APS = Announced Pledges Scenario. NZE = Net Zero Emissions by 2050 Scenario. Other renewables include waste, bioenergy, geothermal, hydropower, concentrating solar power, marine (tide and wave) energy for electricity and heat generation. Other low emissions include fossil fuels with CCUS, hydrogen and ammonia.
Source: IEA (2024)

While low-carbon energy deployment is gaining momentum, global renewable capacity additions rose by nearly 50% in 2023, the fastest growth rate in two decades, transmission and distribution infrastructure development has not kept pace[38]. T&D systems, critical for

delivering reliable, affordable power, are under growing strain. This infrastructure needs to be developed not only for power generation expansion but also for demand side decarbonisation as electrified solutions expand in industry, transport, buildings.

In advanced economies, more than 30% of transmission infrastructure is over 40 years old, raising concerns around efficiency and resilience.[39] In emerging markets, the need to expand access and support new demand adds further complexity. According to the International Energy Agency (IEA) (2023), the world must add or modernise infrastructure by 2040[40], an amount roughly equivalent to the entire existing global infrastructure. Without significant investment and planning, delays in energy infrastructure expansion could slow the energy transition and increase overall system costs.

Despite surging investment in renewables, power infrastructure development continues to lag. Permitting delays, supply chain disruptions, and workforce shortages are common across jurisdictions, leading to grid connection backlogs and undermining both energy security and investor confidence. As detailed in Exhibit 20, lead times for critical T&D components like transformers, HVDC cables, and electrical installations have increased by over 100–200%, with corresponding cost increases of 30–80%. These bottlenecks significantly delay project implementation. The IEA (2023) highlights that while renewable energy projects can often be deployed within one to five years, T&D infrastructure takes significantly longer, often five to fifteen years, to plan and complete[41]. Compounding this mismatch is the rapid growth in electricity demand from the decarbonisation of end-use sectors such as industry, transport, and buildings, which increasingly rely on power-based solutions like electrified heating, EV charging, and industrial electrification. This demand is growing even more rapidly with the rise of AI and digital technologies, which are becoming major contributors to global electricity consumption. This places additional pressure on T&D infrastructure. Without action, this growing gap between electricity supply, infrastructure capacity, and end-use electrification needs threatens to delay national energy deployment targets.

Exhibit 20: Table of project grid project delays and connection bottlenecks

Asset class	Spending category	Severity[1]	Lead time increases over the past few years	Price increases over the past few years
Materials – Overhead lines	Steel structures	Low	Limited, but regions differ (US: 50-100%)	Limited, but regions differ (US: 30-50%)
Materials – Overhead lines	Conductors	Medium	>100% (to>12 months for some suppliers)	30-80%
Materials – Substations	Power transformers/reactors	High	>100% (to 24-48 months on average)	30-60%
Materials – Substations	Switchgear	Medium	>200% (from 14-16weeks to 40-60 weeks)	>50%
Materials – Underground cables	HVAC cables	Medium	>100% (to>12 months for some suppliers)	30-80%
Materials – Underground cables	HVDC cables	High	>100% (to 4-6 years, suppl. dependent)	30-80%
Materials – HVDC offshore connections	Converters	High	50-100% (to 5-7 years)	30-50%
Materials – HVDC offshore connections	Offshore platforms	Low	Limited (currently 5-7 years)	Emerging price increases
Engineering and installation services	Electrical installation	High	>200% for some regions and services	>50%
Engineering and installation services	Civil works	Medium	Limited, except for specialist areas	Up to 20%, possibly higher for specialist areas
Engineering and installation services	Engineering services	Medium	Limited, except for specialist areas	>30%, particularly for specialist areas

Severity: Low Medium High

1. Severity scoring covers price increases and supply chain constraints
Note: Data covers lead time increases and price increases over the past three to four years. HVAC = high-voltage alternating current; HVDC = high-voltage direct current.
Source: BCG project experience

As climate risks intensify, many energy systems remain vulnerable to extreme weather and chronic stress. This infrastructure fragility increases costs and threatens reliability. As such, network resilience, the ability to withstand, adapt to, and recover from disruptions, has become essential to energy planning. Achieving this requires both physical and digital upgrades. Grid hardening strategies, such as undergrounding power lines, elevating substations in flood-prone areas, and deploying fire-resistant or self-healing materials, can significantly reduce outages during floods, wildfires, and storms.

Countries are starting to reflect these priorities in policy. In Italy, the Regulatory Authority for Energy, Networks and Environment (ARERA) has embedded resilience and sustainability targets in its 2022–2025 strategic plan, encouraging investments that strengthen infrastructure against climate impacts[42]. This involves an incentive mechanism to encourage distribution system operators to perform investments that enhance the distribution infrastructure's resilience against climate-related risks such as heat waves, ice accumulation on overhead lines, flooding, and windstorms. This is supported by the national Plan for Adaptation to Climate Change (PNACC), approved in 2023, which promotes coordinated climate risk mitigation across sectors, including energy[43].

In parallel, digitalisation is transforming infrastructure operations. Smart meters, sensors, and AI-enabled analytics help operators to optimise complex systems, while detecting and responding to issues in real time, improving reliability and reducing downtime. Digital platforms also enable the integration of distributed energy resources (DERs) like rooftop solar, batteries, and EVs, enhancing local resilience and flexibility. According to IEA data, digital tools can cut outage durations by up to 30–50% when paired with advanced T&D management systems.

This is a pivotal moment to reimagine energy systems. Future-ready infrastructure must deliver low-carbon power while enabling resilient, adaptive energy flows. Digitalisation, modular design, and cross-sector coordination (spanning energy, transport, digital technologies etc.) can lower system costs, strengthen energy infrastructure reliability, and unlock economic value. Decentralised solutions like mini-grids and rooftop solar can also offer countries flexibility to tailor implementation to local needs and improve electricity access, especially in underserved areas. While all countries must modernise their energy systems, the pace and pathway will depend on national contexts and development goals.

To meet this moment, policy action must focus on three priorities:

- **Resilient Infrastructure Systems**: Develop modernized, climate-resilient infrastructure by creating enabling regulatory frameworks, promoting the sharing of best practices, accelerating trade in resilient infrastructure products and services, and encouraging climate assessments in infrastructure planning.
- **Integrated and Adaptive Planning**: Guide infrastructure build-out through coordinated, cross-sectoral planning that aligns power, transport, industry, and digital development. Embedding physical and digital flexibility from the outset will be critical to ensuring resilience and enabling cross-border energy flows.
- **Regulatory and Delivery Acceleration**: Streamline permitting and approval processes, anticipate planning needs while aligning incentives around speed, cost-effectiveness, and social value. Governments and regulators must shift from reactive oversight to proactive enablement, removing unnecessary barriers and fast-tracking strategic infrastructure.

As the IEA underscores, achieving a secure and sustainable energy future will depend not only on how much low-carbon energy is generated, but on how reliably and efficiently it is delivered. Whether it's modernising aging transmission lines, connecting remote renewable resources, or fostering regional power trade, infrastructure will define the pace and inclusivity of the global energy transition.

Action 3.1: Enhance Climate Resilient Energy Infrastructure

Enhance energy infrastructure resilience to climate shocks by establishing a G20 knowledge hub, supporting global markets through mutually recognised standards for resilient sustainable technologies, and integrating climate risk into infrastructure planning.

Executive Summary

Climate-related shocks and extreme weather events are exposing critical weaknesses in energy infrastructure, particularly aging and underprepared T&D systems, threatening the reliability and security of energy supply in both advanced and emerging markets.

Action 3.1 strengthens infrastructure resilience to climate shocks by establishing a G20 knowledge hub for sharing best practices, supporting global markets for climate-resilient technologies, and embedding climate risk assessments and disclosure into infrastructure planning and investment processes.

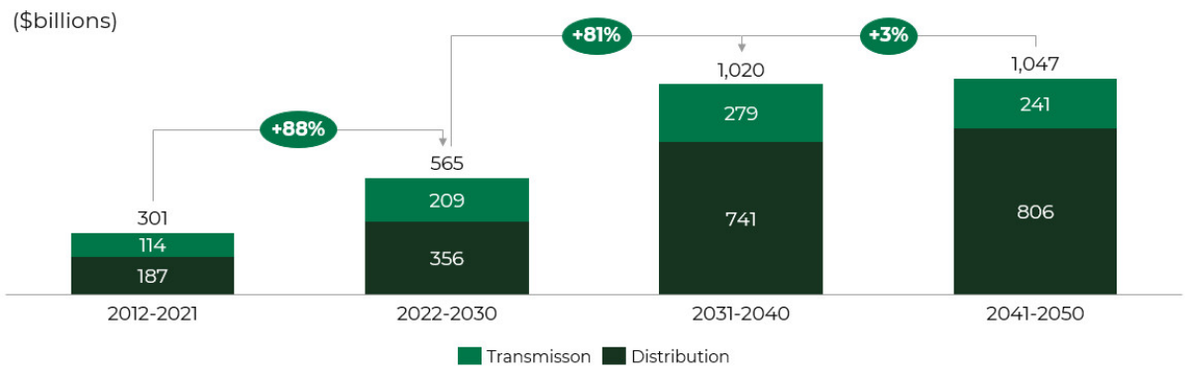
Background and context

A reliable, flexible, and climate-resilient energy infrastructure is foundational to accelerating the energy transition, improving energy access, and ensuring long-term energy security. However, existing T&D systems are increasingly strained by rising demand, aging assets, and the growing integration of variable renewable energy sources.

Significant T&D upgrades are needed across both advanced economies and EMDEs. These upgrades will help reduce network congestion, integrate a wider mix of renewable energy, and meet growing electricity demand in a decarbonising world. As shown in Exhibit 21, recent projections highlight that global investment in T&D infrastructure must increase by over 80% in the next two decades to meet Net Zero Emissions (NZE) goals. Yet despite this necessary ramp-up in investment, project implementation is often delayed by supply chain disruptions, permitting bottlenecks, and skilled labour shortages.

At the same time, much of the world's existing energy infrastructure is aging and ill-equipped to handle emerging energy challenges. In many developed countries, key grid assets are more than 40 years old, increasing the risk of system failures and vulnerability to climate shocks[39]. In emerging markets, the challenge is twofold: building new infrastructure at scale while avoiding the inefficiencies and rigidities of legacy systems. This includes addressing persistent energy efficiency gaps, which remain a critical but underleveraged solution in many EMDEs. Energy efficiency projects can significantly reduce energy consumption, costs, and emissions, while also enhancing access, affordability, and system reliability, making them a vital pillar of both climate resilience and development.

Exhibit 21: Average annual investment in global transmission and distribution networks by decade under the NZE scenario



Source: IEA (2022); IMF; BCG analysis

The energy infrastructure of the future must go beyond basic expansion. It must be resilient to climate impacts and adaptive to emerging energy technologies, including solar photovoltaic (PV), wind power, green hydrogen, BESS, and in extreme instances, CCUS. This will require coordinated investment in digitised and cross-sectoral infrastructure, such as smart grids, advanced sensors, and real-time analytics. These tools enhance grid management and enable operators to respond to outages or anomalies quickly.

To this end, international platforms like the Global Smart Energy Federation (GSEF), an alliance of smart grid associations, utilities, and think tanks, play a critical role in sharing innovation, best practices, and policy guidance to advance secure, low-emission, and flexible power systems. Similarly, the European Commission's BRIDGE initiative connects smart energy projects under Horizon 2020 and Horizon Europe, enabling peer learning and recommendations to overcome implementation challenges and support system-level energy transitions.

Moreover, developing resilient infrastructure will demand the creation of a robust market for adaptation products and services. This includes developing more resilient infrastructure products and materials, improving access to insurance and financial products tailored to climate resilience, and integrating climate risk analysis and disclosure into investment decisions. This calls for stable and transparent regulatory environments that support the fair, inclusive and efficient trade of such products and services.

Implementation approach

To advance the development of resilient infrastructure, the G20 should drive global coordination by establishing a knowledge hub for best practice sharing, supporting trade in climate-resilient technologies, and integrating climate risk assessments into infrastructure planning.

3.1.1 Promote Knowledge Transfer for Resilient T&D Infrastructure Design and Digital Integration

- Establish a G20 Knowledge Hub: Employ the Global Smart Energy Federation (GSEF) and leverage the EU's BRIDGE initiative to develop and facilitate technical collaboration and knowledge exchange on resilient infrastructure planning, with a focus on smart grid integration, digital tools, and extreme weather adaptation.

3.1.2 Promote Mutual Recognition in the Resilient Infrastructure Market

- Create a G20 agreement to support trade in climate resilient technologies and services: Leverage the work done by the WTO's Technical Barriers to Trade agreement to create a mutually recognised regulatory environment and standards that enable the development, certification, and cross-border trade of climate resilience products and services, such as resilient infrastructure materials and climate risk analytics.

3.1.3 Promote Climate Risk Disclosure and Resilience Assessment in Infrastructure Planning

- Incorporate climate risk and resilience mandates in infrastructure planning: Include climate resilience as a standard part of infrastructure policy and project development through improved assessment, transparency, and monitoring. This includes encouraging national energy regulators and planning bodies to include climate impact assessments in new infrastructure projects and working with the International Sustainability Standards Board (ISSB) to establish climate risk disclosure frameworks across infrastructure sectors.

Enhancing energy infrastructure resilience reduces climate risks and improves energy security across G20 and global markets. Mutually recognised standards and climate risk integration support investor confidence, while opening new opportunities for G20 firms in smart grids, resilient materials, and digital infrastructure.

Action 3.2: Develop Flexible, Integrated Energy systems

Build flexible, shock-responsive, and interconnected energy systems by aligning national and regional infrastructure plans, embedding digital and modular design, and expanding regional power markets and cross-border data systems.

Executive summary

Fragmented infrastructure planning, high electricity costs, and limited regional integration continue to hinder the development of resilient, responsive energy systems in EMDEs, exposing them to complex demand shocks.

Action 3.2 promotes integrated infrastructure development by aligning national and regional masterplans and embedding flexible and digitised planning tools. It also supports expanding regional energy markets (such as power pools) and data-sharing platforms. These actions will help to reduce costs, strengthen reliability, and improve long-term system resilience.

Background and context

Many countries still rely on fragmented infrastructure planning frameworks that fail to account for systemic risks, long-term transitions, or the benefits of regional integration. At the same time, high electricity costs continue to hinder industrial competitiveness, particularly in regions where outdated or inefficient systems dominate. These elevated costs not only limit the viability of energy-intensive manufacturing but also act as a barrier to the adoption of potentially lower-carbon power sources, which often require upfront infrastructure coordination and policy support. An often-overlooked but critical aspect is the high level of distribution utility losses, particularly in Sub-Saharan Africa, which erode system efficiency, increase costs, and undermine the reliability of electricity supply. Reducing these losses must be a core objective of the energy transition, as it directly enhances operational efficiency and supports the stable integration of renewable energy.

To address these gaps, Integrated and Adaptive Planning has emerged as a global best practice. It involves consolidating national and regional masterplans, adopting scenario planning and stress-testing methodologies, and deploying real-time technologies for rapid response. This approach enables infrastructure systems to better absorb shocks, respond to evolving demands, and support broader economic, social, and environmental objectives. As part of this, regional integration offers a strategic opportunity to reduce costs, enhance reliability, and accelerate decarbonisation by pooling energy resources across borders. Cross-border energy integration can also help balance supply-demand mismatches and build systemic resilience, particularly in regions like Africa, South Asia, and Latin America, which hold untapped potential for power pool expansion and shared infrastructure. Initiatives like power pools and interconnectors allow countries to share renewable capacity, manage demand fluctuations, and reduce reliance on fossil fuels.

The African Union's PIDA programme plays a central role in championing this shift across the continent. It is aimed at fostering socio-economic development and integration across the continent through the advancement of critical infrastructure. The initiative is operationalized through sequential Priority Action Plans (PAPs), each outlining specific infrastructure projects for designated periods[48]. Through its PAPs (PAP I and II), PIDA facilitates regional integration across transport, energy, ICT, and water, helping countries prioritize and coordinate investment-ready projects that meet future demand [48]. In alignment with this effort, the African Union Development Agency (AUDA-NEPAD) Continental Master Plan (CMP) promotes harmonised planning and infrastructure integration across multiple African regions. The CMP is designed to provide a strategic roadmap for connecting Africa's five power pools, supporting the vision of a fully integrated and efficient continental power system[65].

Likewise, countries like India, the UK and China are embedding long-term and adaptive strategies into their national infrastructure systems, proving that coordinated, flexible, and technology-enabled planning enhances resilience and project bankability. For example, in the UK, the National Infrastructure Commission employs adaptive pathways planning to build resilience against a range of uncertainties (including climate change impacts, changing energy demand and technological disruption) to better prepare for multiple future scenarios[63]. Meanwhile, India's National Smart Grid Mission (NSGM) is modernizing the country's electricity infrastructure by deploying digital sensors, smart meters, and Internet of Things (IoT) technologies to improve T&D efficiency and reliability[64]. Furthermore, China is advancing a strategy to build a "new-type power system" that supports both its energy transition and energy security goals. The system marks a shift from traditional fossil fuel-dependent grids toward a more flexible, renewable-centric framework[92]. While renewable energy forms the backbone, the strategy also prioritises advanced energy storage, smart-grid integration and demand-side management to ensure a stable, efficient and affordable supply of sustainable power[92]. As countries incorporate long-term energy strategies, it is essential that any investment in transition fuels, such as natural gas, is accompanied by clear decarbonisation pathways and sunset provisions to prevent long-term dependency and stranded asset risks. Structured exit plans can help ensure that revenues from such investments are used to accelerate the shift toward renewable and resilient energy systems.

Implementation approach

To enhance resilience in infrastructure systems, regional co-ordination, and implementation of fast response mechanisms, G20 should align infrastructure masterplans with climate goals, promote adaptive design plans and leverage smart technologies in planning and design. Specific actions include:

3.2.1 Building Integrated and Future-Ready Infrastructure Systems

- Consolidate and implement priority infrastructure masterplans: Work with institutions like the AU's PIDA and the Global Infrastructure Facility (GIF) to consolidate existing national and regional infrastructure masterplans. Focus on identifying and prioritising high-impact, investment-ready projects that align with transition and development goals, and accelerate their implementation through coordinated funding, policy, and technical support.
- Embed flexibility and resilience in infrastructure planning frameworks: Embed scenario-planning, stress testing and flexible modular designs into infrastructure design plans to make them adaptive to uncertainty e.g., climate risks, demand fluctuations, and technology shifts.

3.2.2 Strengthen Local Integration through Engagement Tools

- Develop localised planning tools: Employ institutions like UN-Habitat and Local Governments for Sustainability (ICLEI) to create analysis and positioning tools that support structured dialogue with local authorities to ensure infrastructure plans reflect ground-level realities, community needs, and climate vulnerabilities.

3.2.3 Promote Mutual Recognition of Reporting Standards for Adaptive Infrastructure Planning

- Facilitate cross-regional reporting alignment: Leverage the ISSB to support the development of reporting frameworks that are interoperable and mutually recognised across countries and regions. This approach enables comparable disclosure, supports progress tracking, and encourages the exchange of best practices, while allowing countries to tailor reporting to their national contexts.

3.2.4 Enhance Cross-border Co-ordination and Integration

- Strengthen regional power pools and integrated infrastructure systems: Expand existing regional power pools (e.g., SAPP, WAPP, EAPP) to support subsidised industrial zones with competitively priced, lower-carbon power. Complement this with integrated cross-border data platforms, building on initiatives like AUDA-NEPAD's Continental Master Plan, to enable coordinated planning, real-time infrastructure management, and faster disaster response.
- Assess risks of negative electricity prices: As a short-term measure, integrate risk assessments of negative electricity prices, typically driven by inflexible generation and supply-demand imbalances. These can undermine interconnection incentives and market stability in highly integrated systems. The risk is likely to ease as market flexibility and regional coordination improve over time.

Aligning national and regional energy systems enhances global energy stability and reduces supply volatility, benefiting G20 economies reliant on secure, affordable energy flows. Expanding regional power pools and integrated data platforms opens new markets for G20 firms in grid technologies, digital tools, and infrastructure services. Improved coordination and planning also support faster project delivery and lower operational costs across interconnected energy systems.

Action 3.3: Accelerate Local Energy Infrastructure Delivery

Accelerate energy infrastructure delivery in local governments by streamlining permitting processes through centralised digital platforms and fast-track approvals, and targeted technical support.

Executive summary

Slow regulatory processes and bottlenecks, limited local capacity, and inadequate community engagement continue to delay infrastructure delivery in EMDEs, undermining investment, deepening service gaps, and slowing the energy transition.

Action 3.3 supports streamlined regulatory and permitting processes through centralised digital platforms and fast-track approvals for priority projects. It also strengthens municipal delivery capacity and embeds inclusive community engagement to ensure efficient, accessible, and trusted infrastructure development.

Background and context

Efficient and timely infrastructure development is pivotal for economic growth and societal well-being. The process of infrastructure expansion and delivery involves more than just technical and economic execution, it also entails significant social, political, and environmental shifts. Thus, a just transition requires infrastructure planning that prioritises accessibility, community impact and trust building.

Many EMDEs encounter significant obstacles that impede the swift execution of infrastructure projects. These challenges predominantly stem from regulatory bottlenecks and constrained local delivery capacities. Accelerating permitting processes is essential to overcoming these barriers. For example, many decarbonisation projects, particularly in renewables or demand-side sectors, are delayed not only due to fragmented approvals but also because grid expansion plans are misaligned with industry investment timelines. Slow regulatory processes and limited foresight in infrastructure development deter private investment and delay project implementation.

Complex and fragmented regulatory frameworks often lead to protracted approval processes, causing substantial project delays and cost overruns. For instance, in India, land acquisition disputes account for nearly 25% of project delays, while regulatory challenges, such as delays in obtaining environmental clearances, contribute significantly to project timelines and budgets[51]. Importantly, disruptions to livelihoods, inadequate community consultation, and poor business compliance, can further delay projects, even when formal regulatory procedures are in place.

Globally, inefficiencies in infrastructure investment are pronounced. Up to 38% of global infrastructure investment is not spent effectively due to bottlenecks, lack of innovation, and market failures[52]. Implementing fact-based project selection and streamlined delivery processes can potentially reduce spending by more than $1 trillion annually while delivering the same amount of infrastructure[52].

However, delays are not always technical, often, they stem from a lack of meaningful community consultation and insufficient consideration of the social consequences of resource reallocation, which can deepen existing inequalities and undermine efforts toward a just transition. As seen in Germany's Energiewende, transparent dialogue and early community engagement can reduce opposition and build long-term trust[62]. In countries like Mexico, legally mandated mechanisms like Free, Prior, and Informed Consent (FPIC) help safeguard the rights of communities by ensuring consent is obtained before projects affecting ancestral land proceed, offering a valuable model for integrating social protections into infrastructure planning[84].

In emerging markets, infrastructure deficits remain acute. Investors in these regions experience an average of 4.3 power outages per month, resulting in losses amounting to 3.4% of annual sales.[53] Such infrastructural deficiencies not only deter investment but also escalate development costs, underscoring the necessity for robust regulatory frameworks and efficient project delivery mechanisms.

Local governments are often at the forefront of infrastructure implementation. However, many grapple with limited technical expertise, financial resources, and institutional capacities, which hinder effective project execution. In South Africa, for example, an estimated R518.35 billion worth of infrastructure assets require maintenance and protection[54]. Yet, challenges such as financial distress and inadequate service delivery capabilities persist across numerous municipalities.

A diagnostic review by South Africa's National Treasury highlighted a significant 'capability gap' in local government, emphasizing that service delivery infrastructure is in decline, with some not fit for purpose[55]. This gap is widening as service delivery demands increase, pointing to the need for capacity-building initiatives[55].Similarly, in Indonesia, studies have shown that poor local government capacity impedes the effective implementation of administrative, fiscal, and political decentralisation, affecting public service delivery and infrastructure development[56].

Addressing these challenges necessitates a dual approach:

- Regulatory Streamlining: Simplifying and aligning approval processes to reduce delays and enhance transparency.
- Capacity Building with Community Engagement: Empowering local governments with the necessary skills (such as planning, procurement, and engineering expertise), resources, and institutional frameworks to effectively manage and deliver infrastructure projects., while embedding meaningful consultation processes with affected communities.

As mentioned in the context section of Recommendation 3, Italy's ARERA provides a best-case example of how regulatory regimes should be adapted to enable the energy transition, promote greater participation of grid operators, incentivize investment, and improve the infrastructure's resilience to adverse events due to climate change.

By implementing these reforms, countries can create an enabling environment that attracts investment, accelerates project delivery, and ensures that infrastructure developments meet the needs of their populations efficiently and sustainably.

Implementation approach

To achieve efficient project delivery and attract investment, G20 should enable faster, high-quality infrastructure development by streamlining permitting and other regulatory processes and enhancing regional product delivery capacity through technical assistance. Specific actions include:

3.3.1 Streamline Permitting Processes

- Develop centralised permitting platforms and interoperable templates: Establish single-window digital platforms to consolidate approvals across government agencies, improving coordination and transparency. Use tools like the World Bank's PPIAF to develop mutually recognised permitting templates and guidelines across regions and sectors, reducing compliance complexity and administrative burdens.

3.3.2 Strengthen Community Engagement in Project Delivery Frameworks

- Develop inclusive community engagement and due diligence frameworks: Encourage early-stage community consultation within permitting processes, underpinned by both environmental and human rights impact assessments. These frameworks should include clear guidelines for transparent dialogue and local benefit-sharing schemes, drawing on legal mechanisms like FPIC to safeguard community rights and participation.

3.3.3 Strengthening Local Delivery Capacity Through Targeted Support

- Promote capacity building for local infrastructure delivery: Partner with initiatives like UNOPS and GIF to support municipal infrastructure through scaled national programmes (e.g., South Africa's Cities Support Programme, Brazil's Urban Growth Acceleration Programme). Provide tailored planning, technical expertise, project management assistance and governance support to close capacity gaps and accelerate rollout.

Faster, more predictable infrastructure permitting in EMDEs reduces project delays and investment risk for global developers and financiers. Strengthening local delivery capacity and embedding community engagement creates more stable, investable environments for G20 firms in energy, engineering, and infrastructure services. This action also supports supply chain reliability and helps meet growing demand for just, inclusive, and resilient infrastructure globally.

Appendix

Rationale for selected medium-to-long term KPIs:

	KPI	Baseline	Target	Rationale
Recommendation 1	Increase international financing for just energy transition (JET-Ps) by 7x	$45 B [2023]	$330 B [2040]	JET-Ps are effective in mobilising climate finance for EMDEs, but slow funding flows have hindered tangible just transition outcomes. The baseline and target metrics represent the cumulative pledges and investment targets for existing JET-Ps (South Africa, Indonesia, Vietnam and Senegal).
	Increase the percentage of energy transition investment needs met in EMDEs* (*excl. China)	15%-20% [2022]	70%-80% [2040]	Closing the energy transition investment gap in EMDEs is critical, as current flows fall well short of what is needed. These countries require between USD 1.4 to 1.9 trillion annually by 2030 through 2050 to meet Paris Agreement goals[86], yet they currently receive only USD 225 to 260 billion. On average EMDEs have received 15% to 20% of their region-specific investment needs[86]. Tracking this percentage is key to narrowing the investment gap.
	Achieve 50% adoption rate for G20-endorsed CP framework	n.a. [2025]	50% [2040]	Country Platforms (CPs) help countries align finance with national priorities; a G20 CP framework can position them as central tools for coordinated investment, policy certainty, and delivery of just transition outcomes
Recommendation 2	Increase the global value unlocked through industrialisation across sustainable energy value chains by 5x	$2 T [2021]	$11 T [2040]	The global energy transition value chain is expected to grow from USD 2 trillion to USD 11 trillion by 2040, driven by four key areas critical minerals, low-carbon technologies, industrial materials and services in sustainable energy[35]
	Increase the percentage of national workforce employed in local sustainable energy industries	3-6% [2021][88]	5-10% [2040]	A global talent shortage risks stalling sustainable industrialisation; tracking sustainable energy employment as a share of the national workforce is essential to ensure countries are equipped to capture their share of the 40 million jobs expected to be created by the global energy transition by 2050.[87]
	Number of tech transfer agreements facilitated by G20 Energy Tech Platform	n.a. [2025]	5 p.a. [2040]	Facilitating and tracking sustainable energy tech transfer agreements expands access to critical technologies, helping EMDEs overcome licencing

	KPI	Baseline	Target	Rationale
				barriers, and accelerate sustainable industrial development and sustainable energy deployment
Recommendation 3	Double the annual global investment in grid infrastructure	$390 B [2024]	$750 B [2040]	Expanding and modernising grid infrastructure is critical to meet rising demand and avoid costly delays. Tracking the investment in grid infrastructure will help ensure collective progress toward the global target on grid expansion for enhanced energy access and security. The baseline represents the current global grid investment (2024)[90], while the target is the annual investment required (by 2030) to meet net zero goals[91].
	Achieve 50% adoption rate of G20-endorsed infrastructure development framework	n.a. [2025]	50% [2040]	A G20-endorsed energy infrastructure framework can accelerate the deployment of resilient, future-ready grids by aligning planning, regulation, and investment—critical to closing infrastructure gaps, reducing delays, and enabling the low-carbon electrification needed for a net-zero transition
	Grid infrastructure modernised (length)	n.a. [2025]	+ 80 M km [2040]	In advanced economies alone, more than 30% of existing infrastructure is over 40 years old[39]. According to the IEA (2023), over 80 million km of grid lines must be added or upgraded by 2040 under the Announced Pledges Scenario (APS)[40].

Abbreviations

A&R	Adaptation and Resilience
AAAP	Africa Adaptation Acceleration Program
AfDB	African Development Bank
AMR	Americas
ARERA	Italian Regulatory Authority for Energy, Networks and Environment
ASEAN	Association of Southeast Asian Nations
AU	African Union
AUDA-NEPAD	African Union Development Agency - New Partnership for Africa's Development
BESS	Battery Energy Storage Systems
BNDES	Brazilian Development Bank
CBAM	Carbon Border Adjustment Mechanism
CCUS	Carbon Capture, Utilisation and Storage
CfDs	Contracts for Difference
CO2	Carbon Dioxide
CPI	Climate Policy Initiative
CPs	Country Platforms
DFI	Development Finance Institution
EC	European Commission
ECA	Export Credit Agency
EIB	European Investment Bank
EMDEs	Emerging Markets and Developing Economies
ESG	Environmental, Social and Governance
EU	European Union
EVs	Electric Vehicles
FATF	Financial Action Task Force
FPIC	Free, Prior, and Informed Consent
GCA	Global Center on Adaptation
GCF	Green Climate Fund
GEF	Global Environment Facility
GDP	Gross Domestic Product
GFF	Global Financing Facility
GIF	Global Infrastructure Facility
GSEF	Global Smart Energy Federation
GW	Gigawatt
HVO	Hydrotreated Vegetable Oil
IEA	International Energy Agency
IFC	International Finance Corporation
ILO	International Labour Organization

IMF	International Monetary Fund
IPCC	Intergovernmental Panel on Climate Change
IPG	International Partners Group
IPSF	International Platform on Sustainable Finance
ISSB	International Sustainability Standards Board
ITC	International Trade Centre
IRENA	International Renewable Energy Agency
JET-PMU	Just Energy Transition Project Management Unit
JET-Ps	Just Energy Transition Partnerships
JET-SEP	Just Energy Transition Skilling for Employment Programme
LCS	Low-carbon Solutions
LFI	Local Financial Institution
MDBs	Multilateral Development Banks
MRV	Monitoring, Reporting and Verification
MW	Megawatt
MWe	Megawatt electrical
NAPs	National Adaptation Plans
NDB	New Development Bank
NDCs	Nationally Determined Contributions
NSGM	National Smart Grid Mission
NZE	Net Zero Emissions
OECD	Organisation for Economic Co-operation and Development
OPEC	Organization of the Petroleum Exporting Countries
PAP	Priority Action Plan
PIDA	Programme for Infrastructure Development in Africa
PGMs	Platinum Group Metals
PPA	Power Purchase Agreement
PPIAF	Public-Private Infrastructure Advisory Facility
PV	Photovoltaic
R&D	Research and Development
REIPPPP	Renewable Energy Independent Power Producer Procurement Programme
RES4Africa	Renewable Energy Solutions for Africa
RST	Resilience and Sustainability Trust
SAPP	Southern African Power Pool
SAF	Sustainable Aviation Fuel
SDRs	Special Drawing Rights
SFWG	Sustainable Finance Working Group
SIDS	Small Island Developing States
MSME	Micro, Small and Medium Enterprises

T&D	Transmission and Distribution
UN	United Nations
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNEP-CTCN	UNEP Climate Technology Centre & Network
UNFCCC	United Nations Framework Convention on Climate Change
UNIDO	United Nations Industrial Development Organization
UNOPS	United Nations Office for Project Services
USA	United States of America
USD	United States Dollar
VRE	Variable Renewable Energy
WEF	World Economic Forum
WIPO	World Intellectual Property Organization
WTO	World Trade Organization

Glossary

Contracts for Difference (CfDs)	Agreements that stabilise revenue by covering the gap between a fixed “strike price” and market price, protecting investors from price volatility in energy markets
Energy	The full range of sources, carriers, and systems that power economies and societies—including electricity (from both renewable and non-renewable sources), fossil fuels such as coal and hydrocarbons (oil and natural gas), critical minerals essential for energy technologies (such as lithium and cobalt), as well as energy crops, biomass, and emerging fuels like green hydrogen. It also includes the infrastructure and technologies that enable the production, transformation, and use of these energy sources
General corporate purpose facilities	Flexible loans or credit lines that companies can use across their operations, not tied to a specific project but often linked to broader sustainability goals
Optimal Energy Mix	The combination of energy sources—across renewables, transition fuels, and low-carbon dispatchable technologies—that best meets the energy needs of a country or region in terms of affordability, reliability, sustainability, and security. It is shaped by local resource availability, infrastructure capacity, policy goals, and socio-economic priorities
Platform-based Facilities	Finance provided through coordinated investment platforms (e.g., country platforms) that support multiple projects or sectors under a unified framework
Power Purchase Agreements (PPAs)	Long-term contracts between energy producers and buyers that set fixed terms for electricity pricing and supply, providing revenue certainty for energy projects
Transition Fuels	Lower-carbon energy sources (e.g., natural gas, low-carbon hydrogen, biofuels) used as interim solutions to support reliable and affordable energy during the shift from high-emission fuels—particularly in fossil fuel-dependent economies facing infrastructure or affordability constraints.
Tipping Points	Critical thresholds where small changes trigger self-reinforcing dynamics that lead to a fundamental and irreversible shift in financial markets e.g., climate policy certainty is a positive tipping point that reinforces investment climate action (Source: Driving sustainability transitions through financial tipping points (Nadia Ameli et al.))
Value unlocked through industrialisation across the sustainable energy value chain	This refers to growth opportunities to be unlocked in four key areas: critical minerals, low-carbon technologies, industrial materials, and services in sustainable energy

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Member Composition

Chair, Deputy Chair & Co-chairs

Chairperson

Name	Organisation	Position	Organisation Country
Daniel Mminele	Nedbank Group Ltd.	Chairperson	South Africa

Deputy Chairperson

Name	Organisation	Position	Organisation Country
Shamini Harrington	Minerals Council South Africa	Senior Executive: Climate Change	South Africa

Co-Chairs

Name	Organisation	Position	Organisation Country
Catherine Koffman	Green Climate Fund	Director	African Region
Dan Marokane	Eskom	CEO	South Africa
Daniel Godinho	WEG	Director of Sustainability & Institutional Relations	Brazil
Dipak Patel	Presidential Climate Commission	Head of Climate Finance & Innovation	South Africa
Eng. Peter Njenga	KenGen	CEO	Kenya
Leslie Maasdorp	British International Investment	CEO	UK
Mandy Rambharos	Verra	CEO	USA
Paolo Scaroni	Enel	Chairman	Italy
Roger Martella	GE Vernova	Executive VP & CCO	USA
Simon Baloyi	Sasol	President & CEO	South Africa
Zhang Zhigang	State Grid Corporation of China	Executive Chairman	China

Task Force & PMO

Task Force PMO

Name	Organisation	Country
Anthony Costa (Head)	Business Unity South Africa	South Africa
Cas Coovadia (B20 Sherpa)	Business Unity South Africa	South Africa

Task Force Meeting Schedule

Date	Format
24 March 2025	Virtual
14 April 2025	Virtual
15 May 2025	Virtual
25 June 2025	Virtual

Distribution of Task Force Membership by Gender

Gender	Count
Female	80
Male	111
Total	**191**

Distribution of Task Force Membership by Organisation Based Country

Country		Count
	Argentina	2
	Australia	2
	Austria	1
	Brazil	16
	China	8
	Costa Rica	1
	Cote D'Ivoire	1

Country		Count
	Denmark	1
	Egypt	1
	France	3
	Germany	1
	Ghana	1
	India	6
	Italy	12
	Japan	1
	Kenya	6
	Republic of Korea	1
	Lesotho	1
	Netherlands	1
	Nigeria	1
	Norway	2
	Russian Federation	12
	Saudi Arabia	3
	Singapore	1
	South Africa	86
	Spain	3
	Switzerland	2
	United Kingdom	5
	United States	9
	Zimbabwe	2

Task Force Members

Member Name	Organization Name	Job Title	Organisation Country
Abel Sakhau	Sanlam	Chief Sustainability Officer	South Africa
Abraham Nelson	Consumer Goods Council of South Africa (CGCSA)	Executive, Consumer Goods Risk Initiative	South Africa
Adeyemi Sowande	Tripplelink Global Solutions Ltd	Managing Partner	Nigeria
Agnes Vinblad	United States Council for International Business (USCIB)	Policy Director, Environment, Climate & Sustainability	United States
Ahmed Mohamed	World Benchmarking Alliance	Global Finance Engagement Lead	Netherlands
Aidan Wildschut	Scatec	Communications and Public Affairs Advisor	South Africa
Aisha Izzet	Takamol	Senior Executive Advisor	Saudi Arabia
Alex McNamara	National Business Initiative (NBI)	Head: Environment	South Africa
Alex Philip Vogel	Sasol R&T	Senior Manager Integration and Early Engineering	South Africa
Alexander Thiel	Sappi Limited	Senior Project Executive	South Africa
Ambrose Vusumuzi Richard Mabena	Mining Industry Association of Southern Africa	Executive Secretary	South Africa
Andrea Bos	Hydrogen Park	President	Italy
Andrei Komendant	Earthood Rus	Just Transition, Validation and Verification Body, Climate Change	Russian Federation
Andrei Licitsyn	JSC “Russian Railways”	Head of the Environment and Technosphere Safety Department	Russian Federation
Andrey Melnichenko	Russian Union of Industrialists and Entrepreneurs (RSPP)	Chairman of the RSPP Committee on Climate Policy and Carbon Regulation	Russian Federation
Andrey Sapozhnikov	En+ Group	Associate Director for International Cooperation	Russian Federation
Anna Tunkel	Sustainable Impact LLC	Founder and CEO	United States

Member Name	Organization Name	Job Title	Organisation Country
Anushka Bogdanov	Risk insights	Chair	South Africa
Asif Hyder Parvez	A&B Global Mining	Head - Business Development	South Africa
Aurelien Patrick Maudonnet	Helexia Brasil	CEO	Brazil
Aureo Ricardo Salles de Barros	ASM Renova	President	Brazil
Avhapfani Tshifularo	Fuels Industry Association of South Africa	Chief Executive	South Africa
Bernard Mukwaira	World Kinect Corporation	Director, Regulatory & Trade Compliance	United Kingdom
Bong Man Kim	Federation of Korean Industries	Vice President	Korea, Republic of
Carin Tredoux	Sasol	Vice President: Office of the CEO	South Africa
Carina Wessels	Alexforbes	Executive: Governance, Legal, Compliance and Sustainability	South Africa
Carleen Wenner	Albright Stonebridge Group	Director, Sustainability	United States
Carlos Retaino	Cámara Argentina de Comercio y Servicios	Director	Argentina
Celia Roldán	IBERDROLA	Public Affairs Manager	Spain
Charles Molapisi	MTN South Africa	CEO	South Africa
Chastukhin Ilya	Public Joint Stock Company (Inter RAO UES)	Chief Investment Expert	Russian Federation
Claudio Luiz de Viveiros	Wilson Sons	Institutional Rel. Manager	Brazil
Clifford Rikhotso	South African Wind Energy Association	Energy Policy Advisor	South Africa
Collen Dlamini	South African Chamber of Commerce and Industry	CEO	South Africa
Danielle Silva Bernardes	National Transport Confederation	Executive Manager	Brazil

Member Name	Organization Name	Job Title	Organisation Country
Dany Qian	Jinko Solar Co., Ltd	Global Vice President	China
Daobiao Chen	CPFL Energia	Chairman of Board	Brazil
David Madon	IFAC (International Federation of Accountants)	Director - Sustainability, Policy & Regulatory Affairs	United States
Deeana Ahmed	Our Next Energy	Chief Strategy Officer	United States
Deshan Naidoo	Afrivolt & Cannon Asset Managers	Chairman & Managing Director	South Africa
Devaksha Maharaj	Ikigai Engineering	Managing Director	South Africa
Dion Mhlaba	Energy Venture Capital	CEO	South Africa
Dr Achieng Ojwang	UN Global Compact Network South Africa	Executive Director	South Africa
Dr Oupa Nkagisang	South32	Senior Manager Stakeholder Relations	South Africa
Dzingira Matenga	Ntiyiso Consulting	Managing Director	South Africa
Emiliano Serracchiani	Snam Spa	Senior Manager International Relations and Legislative Affairs	Italy
Emmanuel Adu Essah	University of Reading	Head of School/Associate Professor in Sustainable Technologies	United Kingdom
Ernest Mulibana	Anglo American	External Communication Manager	South Africa
Evgenia Boykova	CJSC “Plant of Electrotechnical Equipment”	Commercial Director	Russian Federation
Fabio Brasiliano da SIlva	ABIHPEC	Director, Sustainable Development	Brazil
Faisal Alfadl	Saudi Green Building Forum	Secretary General	Saudi Arabia
Francisco Javier Canalejo Ariza	REPSOL	Head of International Relations	Spain
Frank David Ochieng	KenGen Kenya PLC	Marketing and Corporate Communication Manager	Kenya
George Drammeh Akelola	Kenya Electricity Generating	Assistant Legal Manager - Projects & Dispute Resolution	Kenya

Member Name	Organization Name	Job Title	Organisation Country
	Company PLC (KenGen)		
Gianfranco Caccamo	Icaro Ecology S.p.A.	General Director	Italy
Gideon Raath	Grupo Cobra	Head of Development - Africa	South Africa
Giovanni Murano	UNEM – Unione Energie per la Mobilità	President	Italy
Giuseppe Dalessandro	EEMAXX ENGINEERING	Business Development Manager	Italy
Happy Khambule	BUSA	Director	South Africa
Hong Zha	CPFL Energia	Board Secretary	Brazil
Ingrid Reumert	Ørsted	SVP - Global Stakeholder Relations	Denmark
Ipeleng Odette Selele	RRS Trade and Investment	Group CEO	South Africa
Isabel Cane	Cane Advisory	Director	France
Ivan Zhidkikh	Russian Union of Industrialists and Entrepreneurs (RSPP)	Executive Secretary of the RSPP Committee on Climate Policy and Carbon Regulation	Russian Federation
James Stuart Mackay	Energy Council of South Africa	Chief Executive Officer	South Africa
Janet Muthoni Macharia	Kenya Revenue Authority	Compliance officer	Kenya
Jarredine Morris	Carbon Trust Africa	Associate Director: Co-Head, Africa	South Africa
Jas Govender	Sasol	Head Shared Value	South Africa
Jean Baptiste Baroni	Medef	Head of Climate Policy	France
Jo Dean	Enerj Carbon Management (Pty) Ltd Chair of SAESA and SAIIE ESC	CEO	South Africa
Joaquín Pablo Valverde Vila	Spanish Chamber of Commerce in South Africa	General Manager	South Africa
Jose Arroyo	United States Council for International Business (USCIB)	Manager	United States

Member Name	Organization Name	Job Title	Organisation Country
José Fabiano Lima de Barros	Vesuvius	HSE & Sustainability Manager Steel South America	Brazil
Joubert Roux	Zero Carbon Charge (Pty) Ltd	Chairman & Founder	South Africa
Juliana Pinto	McKinsey & Company	Associate Partner	Brazil
Júlio César Tôrres Ribeiro	CELULOSE NIPO-BRASILEIRA S/A	Vice President	Brazil
Julio Espirito Santo	Self-Employed - Global Consultant	Global Innovation and R&D Consultant on Bioeconomy and Biotechnology	Brazil
Julius Opio	International Chamber of Commerce - Kenya	Chairman	Kenya
Justin DAgostino	Herbert Smith Freehills	Global CEO	China
Justine Bolton	FirstRand Group	Carbon and biodiversity specialist	South Africa
Kai Simon Eikli Yuen	Norwegian Shipowners' Association	Advisor	Norway
Katherine Gao	Trina Solar Co., LTD	Co-Chair	China
Katrin Harvey	Foundations Platform F20	Secretary General	Austria
Kaustubh Raju Wadekar	HPAIR ICT-Indian Oil Campus	Executive Director	India
Kedi Wang	CPFL Energia	CFO	Brazil
Kenneth Wamwangi	Kenya Electricity Generating Company PLC	Ag. Asst. Legal Manager, Regulatory Affairs	Kenya
Kgomotso Marjorie Selokane	Heron Marine	Chief Executive Officer	South Africa
Kirill Antonov	PJSC Gazprom Neft	Business Development Programme Manager	Russian Federation
Kiyomi Kasai	KEIDANREN (Japan Business Federation)	Deputy Director, Environment & Energy Policy Bureau	Japan
KRM Prakash Kumar	SSRES	CEO	India

Member Name	Organization Name	Job Title	Organisation Country
Lidia Guryeva	State Development Corporation VEB.RF	Executive Director	Russian Federation
Ligia Paula Pires Pinto Sica	Sigma Lithium	VP of Institutional/Government Relations and Communication	Brazil
Loshni Naidoo	JSE	Chief Sustainability Officer	South Africa
Louise Maizieres	DIHK (German Chamber of Commerce and Industrie)	Director for Hydrogen and International Energy Partnerships	Germany
Luca Giovanni Donelli	Euros S.r.l. - Holding of Donelli Corrosion Protection Services Since 1911	Market Development Manager	Italy
Luca Matrone	Intesa Sanpaolo	Global Head of Energy	Italy
Luca Pezzi	ENI	Head of Relations with International Organisations	Italy
Luis Martí Álvarez	ACCIONA	Director for Public Policy and Regulation	Spain
Luiza Demoro	BloombergNEF	Global Head of Energy Transitions	United Kingdom
Luthando Brukwe	Mineworkers Development Agency	Head: Strategy	South Africa
Mansoor Parker	ENS	Tax Executive	South Africa
MAO YUANKAI	XIZANG ZHUFENG RESOURCES CO., LTD	CEO	China
Marcela Chacón	BAYER AG	Director for United Nations Relations and Global Affairs	Costa Rica
Marco Piredda	Eni	Head of International Public Affairs	Italy
Marianela Suarez	Unión Industrial Argentina	Head of Environment and Sustainable Development Department	Argentina

Member Name	Organization Name	Job Title	Organisation Country
Mario Guiseppe Pennisi	Biostate Pty Ltd	Managing Director	Australia
Maseabi Marageni	The Association of Black Securities and Investment Professionals	Head of Business Development	South Africa
Mathieu Gardies	Hype	Founder, President and CEO	France
Melania Chiponda	Shine Collab	Executive Director	Zimbabwe
Melvin Keith Jones	Proconics	Group CEO	South Africa
Michelle Norah Andrews	Soventix	Business Development Manager	South Africa
Mike Levington	Navitas Holdings (Pty) Ltd	Managing Director	South Africa
Min Yu	JA Solar Technology Co., Ltd	Vice President of Global Corporate Affairs	China
Mmusi Thema	Mashimong Ventures	Corporate Finance Analyst	South Africa
Moeketsi Mpotu	Middelburg Chamber of Commerce and Industry	President	South Africa
Mohamed Tarek Mohamed Safwat ElGamal	Redcon Construction	Chairman	Egypt
Molebogeng Leshabane	iX Engineers	CEO	South Africa
Monicah Karanja	Kenya Electricity Generating Company PLC	Transformation Management Office	Kenya
Morwesi Ramonyai	World Bank	Senior Advisor	South Africa
Motshegwa More	Tshikululu Social Investments	Social Investment Specialist	South Africa
Mugove Chikarakara	Renyuwa Energy	Team Head Renewable Energy	Zimbabwe
Musaab Al Mulla	Saudi Aramco	Vice President, Energy and Economic Insights	Saudi Arabia
Mzila Isaac Mthenjane	Minerals Council South Africa	CEO	South Africa
Nancy Raine Adams	Allan Gray	Investment analyst	South Africa

Member Name	Organization Name	Job Title	Organisation Country
Natalia Soledad Ambrosio	Bayer	Senior Manager in International Stakeholder Relations	United States
Nehemia Mampodi Thekiso	Thekvest Group (Pty) Ltd	Co-Founder and Director	South Africa
Nicole Bigby	Fieldfisher LLP	Sustainability and ESG Director	United Kingdom
Nicole Monge	APCO	Director, Climate and COP Lead	United States
Nicoletta Pollio	Enel S.p.A.	Chief of Staff - Chairman Office	Italy
Nigel Beck	FirstRand Bank - RMB	Executive Head: Sustainable & Transition Finance & ESG	South Africa
Nkosana Mahlangu	Scatec	Government Affairs	South Africa
Noel Pillay	South32	Chief Operating Officer	South Africa
Nombulelo Mketi	Siyakhanyisa Consortium	Project Director	South Africa
Nompumelelo Nzimande	Dumas group	Chief Financial Officer	South Africa
Nomsa Sibanda	All Weather Capital (Pty) Ltd	ESG Analyst	South Africa
Ntlai Mosiah	Autonomi Capital	Director	South Africa
Obakeng Mabel Abigail Makapane	Global Shapers Johannesburg - World Economic Forum	Curator and Economist	South Africa
Ontlametse Khwene	PowerChina HDEC	Construction Project Manager (Renewable Energy)	South Africa
Patience Mpofu	Insight Mining Experts	CEO	Australia
PeggySue Khumalo	Investec	Head of Public Sector Engagement	South Africa
Per Anker Nilssen	Confederation of Norwegian Enterprise (NHO)	Senior Advisor	Norway
Phemelo Mitchell	Pele Energy Group	Senior Business Developer	South Africa

Member Name	Organization Name	Job Title	Organisation Country
Phindile Nkosi	Public and Environmental Economics Research Center, School of Economics, University of Johannesburg	Director	South Africa
Pragasen Naidoo	Tsiko Africa	Chief Executive Officer	South Africa
Pratham Golcha	Asha Hospital	Digital Marketing and Communications Manager	India
Preola Adam	The Coca-Cola Company	Senior Sustainability Director	South Africa
Prisca Soko	African Women In Business	Chairperson	South Africa
Pule Charles Mothibi	Puremo Real Estate Company	Director	Lesotho
Qhakazile Mathebula	City Power	General Manager, Network Asset Creation	South Africa
Rachel Asante Owusu	IUCN (International Union for Conservation of Nature)	Senior Programme Coordinator - Climate Change Team and Energy Transition	Switzerland
Ralph Nathan Holt Jr	Ultimate Performance	Founder and CEO - Global Organizational & Business Performance Transformation Leader	United States
Randi Kristiansen	GFANZ	Executive Director, JETP	United Kingdom
Raphael de Paiva Barbosa	Grupo Florestas	Chief Executive Officer - CEO	Brazil
Renato De Filippo	Confindustria Energia	Head of Energy Sustainability and International Affairs - Confindustria Energia (Italian Energy Sector Business Association)	Italy
Rethabile Mbokodi	UN Global Compact Network South Africa	Programme Manager	South Africa
Rishel Dharmapall	Southern African German Chamber of Commerce and Industry	Circular Economy Sector Expert-SADC	South Africa

Member Name	Organization Name	Job Title	Organisation Country
Rita Chen	Agripower South Africa	Managing Director	South Africa
Ritesh Reddy Seri	Hindustan Petroleum Corporation Limited	Engineer	India
Roland Baah Teye	Deloitte & Touche Ghana	Director	Ghana
Roshaton Aldiné Morgan	GM Boiler and Steam Consulting Engineering	Production Manager	South Africa
Ruggero Arico	Bergs & More	Of Counsel	Italy
Sabatha Mthwecu	Solar Rais	Founder	South Africa
Sam Maphumulo	South African Sugar Association	Sustainability Manager	South Africa
Sediba Portia Mzozoyana	Kunwaba Seroronin	Managing Director	South Africa
Sergei Kozlov	PJSC “El5-Energo”	Environmental Engineer	Russian Federation
Sergey Machekhin	PJSC RusHydro	Deputy Director General. Project Engineering, Sustainable Development and International Cooperation	Russian Federation
Sergey Tverdokhleb	EuroChem	Advisor to CEO	Russian Federation
Shahzeb Khan	StarX91 Technologies Pvt. Ltd.	Director & CEO	India
Shingirai Caroline Kanzara Obinwa	Fragomen	Director Sub-Saharan Africa	South Africa
Shirley Webber	Absa Group Limited	Managing Principal, Coverage Head - Resources & Energy	South Africa
Shiva Prashanth	NTPC Limited	Senior Manager	India
Sibusiso Nkomo	Cambridge Institute for Sustainability Leadership	Programme Manager	South Africa
Sicebile Ndlovu	ST2 Group	Director	South Africa
Stephane Ouedraogo	Stallion Capital Africa	Managing Partner	Cote D’Ivoire

Member Name	Organization Name	Job Title	Organisation Country
Stephanie Winet	International Organisation of Employers	Head of Stakeholder Engagement	Switzerland
Sunil Gandhi	TotalEnergies Marketing South Africa	General Manager Strategy	South Africa
Tendai Matika	UN PRI	Head of Africa	South Africa
Thabo Molekoa	Siemens Energy	CEO	South Africa
Thinga Nethanani	Kulani Energy	Chief Earth Protector	South Africa
Thokozile Zambane	Bayakha Infrastructure Partners	COO	South Africa
Thusang Mahlangu	Allianz Commercial	CEO of Allianz Global Corporate & Specialty (AGCS) South Africa	South Africa
Tlalane Lesoli	Continental Africa Power Supplies	Strategic Projects & Business Development	South Africa
Tori Liu	TrinaSolar Co., Ltd.	Public Affairs Director	China
Ugeshree Thakurpersad	DevRani Consult PTY LTD	CEO	South Africa
Vivek Gianpersad	Baker Hughes	Managing Director	South Africa
Ana Bonilha	Raizen	Sustainability Advocacy Specialist	Brazil
Wilson Lee	Clean Kinetics	Chief Engineering Officer/Co-founder	Singapore
Wilson Nascimento	Brasilprev Seguros e Previdência S/A	Administration Manager	Brazil
Yoganathan Sigamoney Pillay	Anglo American	Regional Carbon & Innovation Lead	South Africa
Zanele Ngayi	Empowomen	Director	South Africa
Zhang Yang	China Council for the Promotion of International Trade	Section Chief	China
Zhe Kong	China Council for the Promotion of International Trade	Deputy Director	China

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