Brasil's G20 presidency

Roadmap to Increase Investment in Clean Energy in Developing Countries – an initiative by the G20 Brazil Presidency

International Energy Agency

This report is an initiative of the Brazil G20 Presidency, developed with support from the International Energy Agency (IEA).

A massive scale up in clean energy investments is needed to meet the goals of the Paris Agreement. The largest increase will need to come from developing economies other than China where investments need to rise more than sixfold by 2035. The funding requirement goes beyond the capacity of public financing alone and therefore requires an unprecedented mobilisation of private capital.

Achieving the global commitments will only be possible if a collective effort is made to boost clean energy investments in developing countries over the next decade. The roadmap sets out timebound actions for scaling up private finance for the clean energy transition to leverage the investments required in different regions and sectors to build modern, clean energy systems for suppliers and users, including achieving universal access.

Table of content

Acknowledgements

The report was led by a team from the Brazilian government: Pedro Bandeira Brancante Machado (Embassy of Brazil in Paris), Mariana de Assis Especie (Mines and Energy Ministry), Leandro de Oliveira Albuquerque (Mines and Energy Ministry) and Pedro Tiê Candido Souza (Ministry of Foreign Affairs).

The primary authors consisted of Cecilia Tam and Lucila Arboleya Sarazola of the International Energy Agency (IEA), under the direction of Tim Gould. Other authors of the report were Paul Grimal and Haneul Kim, also from the IEA, and the report also benefited from input provided by numerous IEA colleagues, in particular Sylvia Beyer, Luca Lo Re, Emma Gordon, Jeanne-Marie Hays and John Rennie.

We would like to express our sincere gratitude to all the organisations and individuals who contributed their time, expertise and thoughtful feedback to this Roadmap. Your insightful comments and recommendations have been invaluable in refining the vision and direction of this document.

Special appreciation goes to Wale Shonibare (African Development Bank), Pradeep Tharakan (Asian Development Bank), Clarissa Lins (Catavento), Brianna Lazerwitz, Henri Paillere and Hal Turton (IAEA), Ricardo Gorini and Erick Ruiz Araya (IRENA), Adil Hanif and Gianpiero Nacci (EBRD), Ben Weisman (GFANZ), Amar Bhattacharya and Eleonore Soubeyran (High-Level Expert Group on Climate Finance), Sabine Cornie and Claire Nicolas (World Bank), and G20 Delegates for sharing detailed perspectives on key issues, helping to ensure that the roadmap reflects the complexity of investing in different clean energy sectors across different developing countries, while remaining grounded in actionable solutions. Your contributions have strengthened the clarity, relevance, and impact of this work. We are grateful for your commitment and collaboration, which have played a vital role in advancing this initiative.

Executive summary

The flow of capital into clean energy[1] projects and related infrastructure in developing countries today remains far below what will be required to provide affordable, secure and sustainable energy for their populations. These investments need to cover a wide range of clean energy technologies, with each country pathway having its own distinctive characteristics based on its resources, policy preferences and national circumstances. Achieving full and universal access to energy, ensuring that energy is affordable and reliable, and promoting sustainable economic development are crucial elements of national energy strategies.

The need to scale up clean energy investments is particularly acute in developing countries other than China

While global clean energy investments are set to reach USD 2 trillion this year, just 15% reaches developing countries other than People's Republic of China (hereafter, "China"). This region accounts for two-thirds of the global population and is where future energy demand will grow the quickest. China already stands out as a major player in clean energy both in terms of investments and the manufacture of clean energy technologies. Strong and sustained government support, combined with a relatively low and stable cost of capital, has enabled China's energy transition.

Meeting rising energy demand in a sustainable way while achieving access, climate and other development goals requires a massive scale-up in investments in clean energy. In developing countries other than China, these investments need to rise more than sixfold, from USD 280 billion in 2023 to USD 1.8 trillion by 2035, to align with a pathway that limits global warming to 1.5 degrees Celsius (°C). There is an urgent need for these developing countries to access larger pools of affordable finance to meet national energy and global climate goals. This includes mobilising more domestic savings into both the banking sector and local capital markets to support domestic investors, as well as engaging with international investors through foreign direct investment and through foreign portfolio investment that can tap into the more than USD 115 trillion of capital held by institutional investors.

The high cost of capital in developing countries is holding back clean energy investments

A high cost of capital pushes up financing costs and makes it much more difficult to generate attractive risk-adjusted returns, especially for relatively capital-intensive clean technologies.

[1] Clean energy includes renewable and other sources of low-emissions power generation, including nuclear and carbon capture, utilisation and storage, as well as electricity grids and grid-scale energy storage. It includes the production, transportation and storage of low-emissions fuels like liquid and gaseous biofuels and low-emissions hydrogen, and projects that deploy abatement and removal technologies including carbon capture, utilisation and storage technologies. It encompasses also efficiency improvements and electrification projects in the end-use sectors of buildings, industry and transport, the latter including the costs of batteries for electric mobility.

The IEA's Cost of Capital Observatory database, which tracks clean energy financing costs across major developing countries, shows that the cost of capital is at least twice as high in developing countries as it is in advanced economies.

Lowering the cost of capital means addressing both real and perceived risks. Long-term structural efforts to improve the rule of law and macroeconomic conditions in a country can lower country-specific risks, while strengthening energy policies, regulation and the institutions charged with the governance of energy issues can improve sector- and project-specific risks over time. While these reforms may take time to implement, a variety of short-term de-risking instruments, such as guarantees and first-loss and subordinated debt and equity, can be implemented in parallel to improve risk-adjusted returns and mobilise much-needed private capital. A 1 percentage point reduction in the cost of capital in developing countries other than China could lead to a reduction of USD 150 billion in average annual financing costs in the 1.5 °C scenario between 2024 and 2050.

Tripling in concessional funding needed to mobilise domestic and international capital

Achieving a sixfold increase in clean energy investments in developing countries is a major task. Developing countries alone will not have enough capital domestically to fund this rapid growth and meet other developmental goals. Greater international support will be needed to meet this funding gap. Total concessional funding needs for the energy sector transformation in developing countries is estimated at around USD 115 billion in 2030 and 2035. This represents more than a tripling in concessional funding by 2030 compared with current levels of support.

The record of public funding in mobilising private capital is far below what is required. According to OECD data, for every US dollar of bilateral and multilateral funding reported to the OECD, just USD 0.30 is mobilised in third-party commercial finance. While a number of individual projects have demonstrated that well-structured interventions can yield ratios of USD 3 to USD 7 of third-party commercial finance, these tend to be in cases where blended finance structures have provided de-risking in the form of first-loss equity or debt or through a guarantee instrument.

Africa requires the largest share of concessional funding, followed by India and Latin America. The share of concessional funding by technology varies substantially based on the market maturity in each region and the mix of technologies required to 2035 for the transition. In regions that are still far from meeting universal electricity and clean cooking access, such as Africa and other Asia, support is highly geared towards the power sector. Overall, the largest amounts of concessional funding across different regions are required for buildings and for grids and storage. With energy efficiency investments falling behind, targeted programmes to spur investments in more efficient buildings and appliances are needed alongside well-designed policy interventions, such as energy performance standards.

Roadmap Action Plan outlines who needs to do what and by when

The Roadmap identifies opportunities and actions to help achieve a rapid scale-up in clean energy investments by creating a virtuous circle of short-term interventions that first get projects

moving, alongside structural interventions that generate a self-sustaining flow of projects thereafter. The Roadmap Action Plan (see the next section) summarises key actions to be implemented over the next decade by governments, development partners, industry, philanthropy and international organisations. Each action identifies the lead entity best suited to direct that action, but other stakeholders will also need to be involved. In all cases, domestic governments will be critical in implementing the different solutions and making sure they are tailored to local contexts. Milestones provide a guide to prioritise near-term actions by various stakeholders and facilitate the tracking of progress. These milestones and actions should be regularly reviewed and adjusted based on progress.

Better data can drive down risk perceptions and lower financing costs

High-quality and available data are key underlying principles for any investment decision and are used by investors to evaluate projects, as well as by policy makers to ensure that they provide a fair level of compensation. The cost of capital is a critical benchmark for assessing the risk and return requirements of investors, but it is seldom available in developing countries. There is a lack of transparency around sector and project-level risk premiums. Improving the availability of cost of capital estimates has implications for the orderliness of energy transitions.

At the same time, enhancing data availability on project default rates for clean energy projects in developing countries can help overcome perceived risks. The release of the Global Emerging Markets Risk database is a good first step for better evaluating default levels in developing countries. However, as many of the projects include a high level of de-risking from multilateral development banks, this needs to be supplemented by data from privately led transactions to better reflect market conditions.

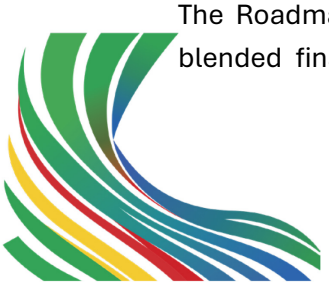
Enhance the capacity of developing countries to improve energy planning and policy

The attractiveness of investments depends on the clean energy policies, regulatory frameworks, public resources and institutional settings of different countries. Changes to all of these are required in most countries to raise projects' risk-adjusted returns and meet the requirements of private investors. The international community needs to support efforts by developing countries to create a strong enabling environment, including by strengthening the institutions that are responsible for energy sector governance and local capital markets.

Governments' commitments to clean energy transitions need to be based on effective energy strategies and planning, including credible near-term targets that are consistent with the achievement of ambitious long-term goals. Successful implementation requires the adequate capacity of governmental institutions to adopt energy transition strategies and transparent legal and policy frameworks.

Not all projects require public funding, and some markets are already privately led

The Roadmap unpacks the types of investments needed and the levels of concessional or blended finance required at the regional and sectoral levels. It underscores that different



approaches need to be applied for different types of investments and that not all projects require public funding: two fifths of today's clean energy investments in developing countries are already privately led, supported by transparent, predictable policy frameworks rather than public financial support.

For mature technologies in established markets, there are many examples of how good policies and a willingness to work with the private sector can unlock large flows of both domestic and international private capital. Here standardisation is key; there is a need to shift away from bespoke transactions towards a larger flow of off-the-shelf deals.

Facilitated interventions need to use public instruments strategically to bring in larger amounts of private capital

There is a second significant category of projects where public and private finance need to work together. Alongside good policies, larger volumes of concessional funds from the international community should be used strategically to help establish new clean energy markets and bring in much larger volumes of private capital. These facilitated interventions cover mature technologies, such as solar and wind, in least developed countries, as well as emerging technologies, such as green hydrogen and energy storage, in middle-income developing countries.

The third and final group of projects that need more concessional funding includes projects mainly in the LDCs or post-conflict situations where country risk is high and the private sector is unlikely to get involved, or where costs are prohibitively high. This group of publicly driven investments also includes nascent technologies, for example for energy-intensive industries, where technology risks and costs remain too high.

Platforms can enable partnerships and the development of project pipelines at scale

Across all three investment areas, there is an important role for platforms to enable partnerships that can bring together all sources of finance – public, private, domestic and international. These platforms can enable the sharing of data, including from the private sector, to lower project risks and improve risk-adjusted return requirements to help build project pipelines. They can also enable a shift towards project standardisation and replication, as well as the development of suitable financing instruments at the scale needed to attract institutional capital.

Roadmap Action Plan

Achieving a clean, sustainable, just, affordable and inclusive energy transition to a net zero emissions energy system while meeting other sustainable development goals will require a substantial acceleration in clean energy investments in all parts of the world, but particularly in developing countries. Currently, the flow of capital into clean energy projects and related infrastructure in these economies remains far below what will be required to provide affordable, secure and sustainable energy for their populations.

These investments need to cover a wide range of clean energy technologies, with each country pathway having its own distinctive characteristics based on its resources, policy preferences and national circumstances. Achieving full and universal access to energy, ensuring that energy is affordable and reliable, and promoting sustainable economic development are crucial elements of these national strategies. Substantially enhanced international support is key to ensuring that developing countries have the tools and resources necessary to mobilise capital at scale. This includes putting in place policy frameworks that can achieve the suitable risk-adjusted returns necessary to attract domestic, international, public and private sources of capital.

This Roadmap identifies opportunities and actions to help achieve a rapid scale-up in clean energy investments in developing countries by addressing the real and perceived risks affecting different kinds of energy projects. Projects are grouped into three broad categories according to technology and country risk to reflect the different types of interventions that may need to be prioritised in each case:

- **Privately led** investments are those in clean energy technologies that are relatively low risk and mature, such as solar and onshore wind, in countries with relatively good credit ratings. An example is utility-scale solar PV in Brazil or India. Both countries have been mobilising capital for these projects, especially from the private sector, for various years already and now generally require only limited interventions.
- **Facilitated interventions** are investments of two broad types:
  - in technologies that have reached commercial maturity in other jurisdictions (in both advanced economies as well as some developing countries) that have yet to be introduced at scale in nascent markets and need additional de-risking to gain market confidence (like utility-scale solar PV in Indonesia)
  - in emerging technologies in relatively low country-risk jurisdictions within developing countries that require additional support for the first commercial-scale projects, such as hydrogen projects in Chile.
- **Publicly driven** investments are clean energy investments in the LDCs with low credit ratings, where commercial capital is either absent or too costly to access, or those in nascent technologies that require substantial public support to lower costs – for instance carbon capture, utilisation and storage (CCUS) in the power sector.

Around 40% of clean energy investments in developing countries in the 1.5 °C scenario in 2035 fall under privately led investments, slightly over half are categorised as facilitated interventions and the remainder are publicly driven investments. These categories are not static: projects that require a measure of public support today can become privately led as underlying country or technology risks diminish. Facilitated interventions need to be designed in ways that not only help individual projects to move ahead but also clear the path for more projects to follow without the same level of support.

The Action Plan presented in the next section provides a summary of **key actions** to be implemented over the next decade covering three priority areas:

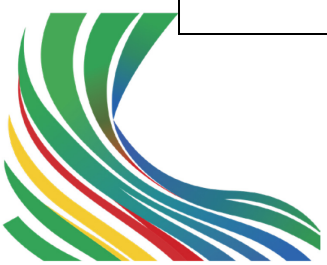
- policy planning and capacity development
- interventions that can enable clean energy projects to reach financial close; this set of actions includes – in *italics* – the risks or barriers that each action is trying to address
- data reliability and availability.

The Action Plan also specifies the following:

- The **leading entities** identified as best suited to direct each action. However, other stakeholders also need to be involved, and in all cases, domestic governments will be critical in implementing the different solutions and making sure they are tailored to the local context.
- The **milestones** provide a guide to facilitate the tracking of progress and to help prioritise near-term actions by various stakeholders. These milestones and actions should be regularly reviewed and adjusted based on progress and market developments.

Action Plan: What, who and when?

Priority	Milestones	Key actions	Leading entities
Priority Focus #1: National policy planning and capacity development			
National and regional strategies	2025/2026	Expand the development of national strategies that align with multiple development goals, including climate, energy access, just energy transition, industrialisation and urbanisation. These should include an investment plan (pipeline of projects) and procurement plan to tender investments competitively.	Domestic governments with support from international organisations and DFIs
	2027-2030	Design and implement regional programmes to support the development of just energy transition strategies for all major regions	DFIs and international organisations
	2025-2030	Implement training programmes targeted at local financial institutions to build expertise in financing clean energy projects	DFIs and international organisations



Priority	Milestones	Key actions	Leading entities
Enabling policies and tracking frameworks	2025/2026 Biannually from 2026	Complete a review of clean energy investment policies for major developing regions and develop recommendations for priority areas to advance towards a common framework for investment policy for various clean energy sectors Report progress on key energy policy and planning developments in major developing countries	International organisations and philanthropies International organisations
Capacity building	2025-2030 2025-2030	Undertake capacity building needs assessments in at least 10 countries and allocate a substantial amount of technical assistance budgets to capacity and training programmes, depending on the country's needs. Complete regional trainings on energy planning and institutional capacity and support the establishment of national programmes.	DFIs and international organisations DFIs, international organisations and philanthropies
Priority Focus #2: Interventions to enable financial close			
Cross-cutting	2025-2030	*High transaction costs, information asymmetry and small scale of individual projects*. Create regional and national platforms among financial institutions and DFIs to facilitate data sharing on project default rates and risk-adjusted returns for clean energy. The platform would act as a clearing house for financing projects by matching financial institutions to transactions and would also facilitate the aggregation and securitisation of smaller projects to sizes suitable for institutional investors.	Industry associations and DFIs
Privately led	2030	*Need to bring in new sources of finance*. Design and implement instruments or structures to attract sources of finance beyond commercial debt, such as first-loss equity facilities to mobilise institutional investors or fiscal incentives for green securities to attract domestic retail investors.	National government, DFIs (technical assistance) and commercial financial institutions (structuring)

Priority	Milestones	Key actions	Leading entities
Facilitated interventions Access	2025-2030	*Very high perceived risks by private investors*. Allocate USD 5 billion per year in concessional funding for clean cooking programmes targeting sub-Saharan Africa and other Asia, in particular.	DFIs and philanthropies
	2025-2030	*Little growth or start-up equity available*. Expand and establish dedicated facilities, particularly including equity capital, to finance off-grid projects in sub-Saharan Africa, other Asia and Pacific Island States.	DFIs
Grids	2030	*Little experience with private sector participation*. Pilot business models for private sector participation in transmission in at least two additional countries.	DFIs
	2035	*Slow rate of investment*. At least quadruple concessional finance for grid investments in developing countries, accompanied by efforts to simplify and streamline permitting processes where these are unduly complex.	National governments, DFIs and National Development Banks (NDBs)
Low-emissions power generation	2030	*Technology-specific risks*. Introduce risk-sharing funds and facilities to address early-stage risks (e.g. exploration risks for geothermal) in at least one country per major region, following models used successfully in countries like Brazil.	National govts, DFIs and NDBs
	2035	*Low market confidence*. Accelerate concessional finance to kick-start relatively mature technologies (e.g. utility-scale solar or wind) that need additional de-risking for the first projects or where a country's credit worthiness is low and a binding constraint.	DFIs
	2035	*Off-taker risk*. Increase the portfolios of international institutions that provide payment guarantees to low-emissions power generation projects in developing countries.	DFIs
Energy efficiency in buildings	2025-2030	*Difficulty accessing financing*. Expand dedicated on-lending facilities to finance building solutions in all major regions. Such facilities could be administered and managed by regional MDBs (e.g. EBRD, AfDB, ADB or IADB) through national development banks.	MDBs and NDBs
	Annually from 2025	*Little experience among finance providers*. Extend training on best practices of financing mechanisms to domestic banks in at least two countries per major region.	DFIs and International Organisations
Decarbonising transport	2025-2027	*Ecosystem risk*. Set up pilot programmes to finance EV charging networks in at least two countries per major region.	DFIs

Priority	Milestones	Key actions	Leading entities
	2026-2027	*Difficulty accessing financing*. Set up pilot programmes in at least two countries per major region to provide low-cost auto loans and leasing models for EV deployment.	DFIs
	2025-2030	*Need for market creation*. Expand national programmes to support the financing of electric two- and three-wheelers and e-buses to reach 25% coverage in developing countries.	DFIs
Emerging technologies	2025-2026	*Very high perceived risks by private investors*. Create a global facility to increase patient capital for emerging technologies (e.g. low-emissions fuels or CCUS) with long lead times in countries with relatively good credit scores.	Philanthropies and DFIs
	2027-2030	*Need for long-term signals*. Establish at least two regional and at least five national facilities to accelerate the rollout of emerging technologies in developing countries.	DFIs
Publicly-driven	By 2030	*Very little equity capital in developing countries*. Adapt one of the existing facilities, such as Infraco Africa or Infraco Asia, to provide global first-loss equity/refundable grants or similar capital for first-of-a-kind clean energy projects in high-risk developing countries.	DFIs and philanthropies
	2025-2026	*Low availability and high financing costs*. Adapt existing credit enhancement facilities to lower the cost of debt financing for the first clean energy projects in countries perceived as high-risk in Africa, other Asia and Pacific Island States.	DFIs
	2027-2030	*Need to ensure recurrent funding*. Regular replenishments of facilities upon achievement of set milestones.	Country and philanthropic donors
	2025-2030	*Low project returns*. Disburse at least USD 20 billion per year in concessional funding towards off-grid electricity access projects in markets with low returns and high risks.	DFIs and Philanthropy
	Annual	*Lack of innovation capacity*. Under the Research and Innovation Working Group, maintain an annual report on the tracking of clean energy innovation policies and targets for the co-development, transfer, dissemination and diffusion of knowledge.	Research and Innovation Working Group, IEA, Mission Innovation and the IEA Committee on Energy Research and Technology

Priority	Milestones	Key actions	Leading entities
Macro-related risks	2025-2026	*Uncertainty about domestic financial regulations*. Set up and implement a joint task with the Sustainable Finance Working Group to identify barriers to clean energy finance and investment created by prudential regulation and propose recommendations to overcome these challenges.	Sustainable Finance Working Group
	2027-2030	*Currency risk*. Improve the availability and affordability of hedging instruments by expanding the Currency Exchange Fund's currency risk hedging capacity, especially aimed at supporting clean investment in higher-risk developing countries.	Currency Exchange Fund and national governments
	2027-2030	*Payment risk*. Increase the exposure of institutions providing guarantees and extend political-risk insurance solutions as well as credit enhancement to higher-risk countries and technologies.	DFIs and national governments
	2025-2035	*Low depth and participation of local financial markets*. Expand programmes targeting financial inclusion and the development of local capital markets.	National governments supported by DFIs
Priority Focus #3: Data reliability and availability			
Improve data	2025/2026	Create and maintain a free public database of facilities supporting clean energy project de-risking in developing countries.	DFIs and GFANZ
	2025-2030	Continue to expand the Cost of Capital Observatory database to additional clean energy sectors and developing countries.	IEA
	2025/2026	Build on the publication of the Global Emerging Markets Risk database by expanding access to clean energy project default rates targeting also private transactions without high levels of DFI support, information on private capital mobilisation rates and project returns for clean energy projects in developing countries.	DFIs together with international organisations and the private sector
	2025-2030	Expand Global Emerging Markets Risk data to the market and country levels.	DFIs

Notes: "Major region" refers to the following country groupings: sub-Saharan Africa, Southeast Asia, Latin America, India, other Asia and Pacific Island States, Eurasia, Middle East and North Africa. "Emerging technologies" indicates technologies that are not yet mature or those in sectors where there are no viable business models, either in advanced or developing countries; these technologies include hydrogen, hydrogen-based fuels, advanced biofuels and CCUS.

Introduction

The prospects for clean, sustainable, just, affordable and inclusive energy transitions hinge on the availability of investment and finance. Investment in a range of clean energy technologies and related infrastructure has increased substantially over the last 5 years and is set to reach USD 2 trillion in 2024. However, these capital flows are not evenly distributed around the world, and there is a clear and worrying shortfall of clean energy projects in many developing economies, which account for just 15% of global clean energy investments.

Addressing this imbalance and pushing for more inclusive approaches is a clear objective of Brazil's G20 Presidency. This builds on the outcomes of Indonesia's G20 Bali Compact and Bali Energy Transition Roadmap and India's G20 focus on accelerating access to low-cost capital.

The Brazilian Presidency has undertaken a wide stakeholder consultation in the development of this Roadmap, including discussions with the Energy Transitions Working Group and the Task Force for the Global Mobilization against Climate Change and a workshop held with financial institutions in the margins of London Climate Action Week. The IEA, with inputs from other international organisations (International Atomic Energy Agency (IAEA) and International Renewable Energy Agency (IRENA)) and development finance institutions (African Development Bank, European Bank for Reconstruction and Development and World Bank), has provided support to the Brazilian Presidency to develop the accompanying analysis and Action Plan.

This Roadmap recognises that each country will chart its own national pathway towards its energy and climate goals. It is not prescriptive on technology choices and takes a broad view of what constitutes clean energy investment. The coverage of clean energy investment encompasses renewables and other sources of low-emissions power generation, including nuclear power where countries choose to pursue it, as well as electricity grids and grid-scale energy storage. It includes the production, transportation and storage of low-emissions fuels like liquid and gaseous biofuels and low-emissions hydrogen, and projects that deploy abatement and removal technologies, including CCUS technologies. It also covers efficiency improvements and electrification projects in the end-use sectors of buildings, industry and transport, with the latter including the cost of batteries for electric mobility.

The Roadmap is informed by scenario modelling that maps out future investment requirements to reach national and global climate goals (see Box 1). The scenarios are intended to give a sense of the scale and direction of the investment flows that are consistent with these goals; they are not the only pathways to achieve them. In common with other comparable analytical and modelling efforts, these scenarios highlight the need for a rapid acceleration in the deployment of a wide range of clean energy technologies, and have a central role for the early and widespread transition to electrification using low-emissions sources of electricity and a determined push to introduce more efficient end-use technologies.

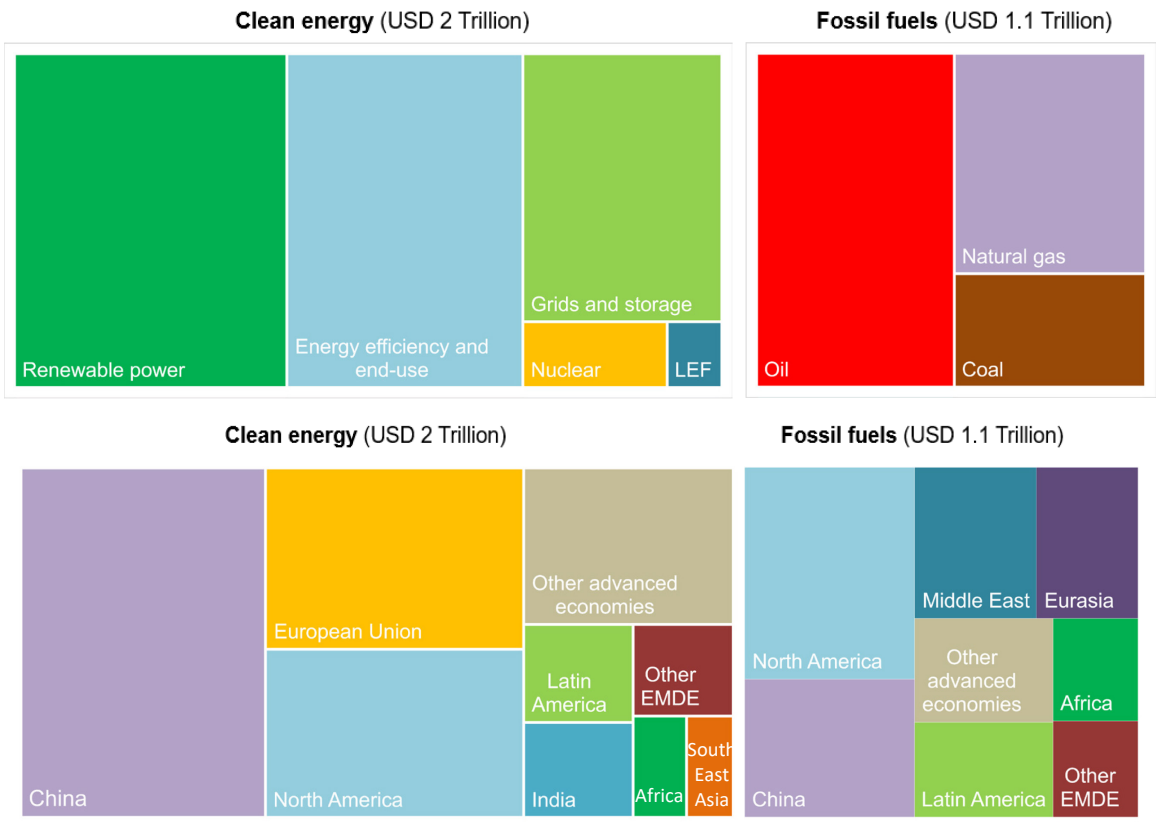
The world is not on course for either of these scenarios and so remains vulnerable to much more severe consequences from climate change. Aligning with a 1.5 °C or net zero scenario requires substantial changes in direction (policy, new financing instruments, de-risking strategies globally agreed taxonomies for low-carbon technologies), and this Roadmap is precisely geared towards putting these changes into motion by defining the actions and opportunities for enhanced collaboration, both between countries and between the public and private sectors.

Mapping clean energy investment and finance flows

Global clean energy investment trends

Global energy sector investments were around USD 2.8 trillion in 2023 and are set to exceed USD 3 trillion for the first time in 2024, with almost USD 2 invested in a range of clean energy technologies and infrastructure for every USD 1 spent on fossil fuel supply. Prior to the global pandemic, this ratio was closer to 1:1. Global investments in clean energy have grown strongly in recent years, driven not only by emissions reduction goals but also by strong underlying economics, considerations of energy security during a period of extreme volatility in fossil fuel prices, and competition among leading economies for positions in the new clean energy economy that will be an important source of growth and employment in the coming years.

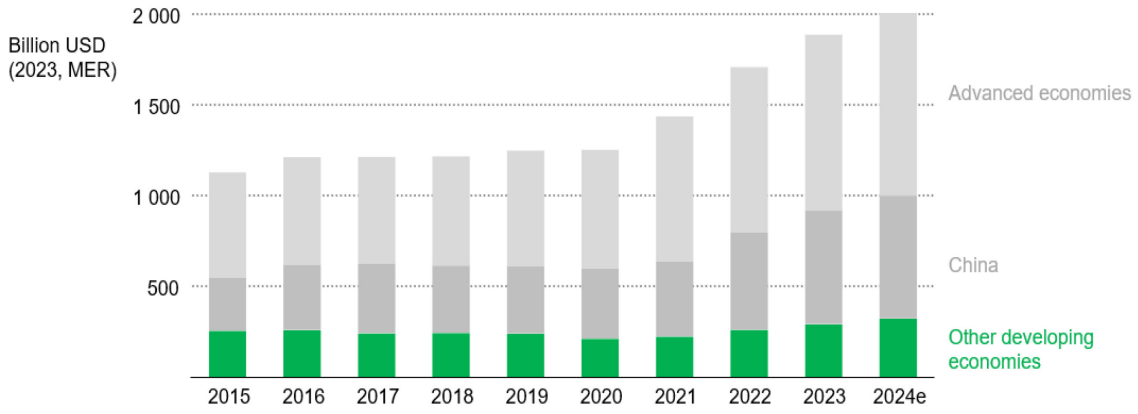
Figure 1: Global energy investments by composition and region, 2024e



Note: EMDE = emerging market and developing economies; LEF = low-emissions fuels; SEA = Southeast Asia.

There are, however, regional imbalances in these capital flows that put at risk the prospects of meeting the Paris Agreement and other sustainable development goals in an equitable and orderly way. Advanced economies and China, together, account for 85% of all clean energy investments today, and the share of other developing countries has fallen back to around 15% of the total, even though these economies account for two-thirds of the global population and one-third of global GDP. This misalignment is a major concern, given that demand for energy services in developing economies will inevitably grow in the coming years to support rising standards of living, including universal access to energy and the buildout of modern national infrastructure.

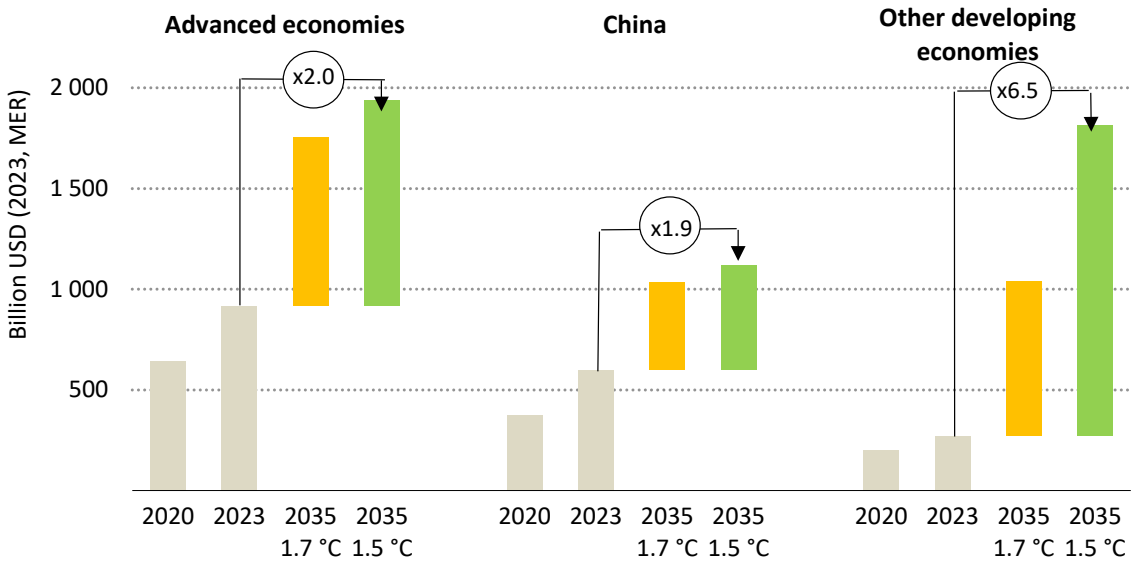
Figure 2: Global clean energy investment by region



Two-thirds of the world's population live in developing economies other than China, but these countries account for only around 15% of global clean energy investment

Investment in clean energy projects needs to grow in all parts of the world to meet climate and other sustainable development goals. However, the required increase is particularly steep in developing economies other than China. For example, to get on track with the scenario that limits the increase in global average temperatures to 1.5 °C, the IEA estimates that spending on clean energy needs to double in advanced economies and China by 2035. However, in other developing economies, the required increase is more than six times the amount invested in 2023. The current policy environment in many developing countries remains a major barrier to accelerating the shift to clean energy, alongside the high cost of capital and lack of affordable long-term financing for clean energy projects. As things stand, many developing regions (notably fossil fuel exporters) invest considerably more in fossil fuels than in clean energy.

Figure 3: Clean energy investments in 2020 and 2023 and the projected requirements to meet national and global climate goals in 2035



The required increase in clean energy investment over the next ten years to align with national and global climate goals is particularly steep in developing economies other than China

Box 1: Scenarios used in this report

This Roadmap uses two IEA scenarios to illustrate the changes in investment flows that would be consistent with national and global climate goals.

- The **1.5 °C scenario** outlines an increasingly narrow but still achievable pathway for the global energy sector to achieve net zero CO_2 emissions by 2050. In doing so, it limits the long-term rise in global average temperatures to 1.5 °C (following the Paris Agreement) with limited overshoot. This does not mean that all economies have to reach net zero emissions at mid-century; the scenario clearly recognises that countries have varying starting points, capacities and resource endowments. Advanced economies take the lead and reach net zero emissions by around 2045 as a group. China achieves net zero emissions around 2050 in this scenario, and other developing countries reach it well after 2050. The global net zero CO_2 emissions target is achieved thanks to net negative emissions in advanced economies. This scenario also aligns with the broader Sustainable Development Goals, including the achievement of universal energy access by 2030 and significant improvements in air quality.

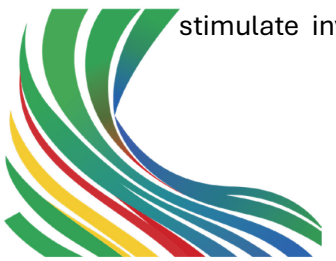
- The **1.7 °C scenario** is derived not from a global goal but from the full and timely achievement of all national and regionally defined energy and climate targets, including net zero goals. This, in turn, affects the investment choices made in countries without long-term energy or emissions goals because of the steeper cost reductions that it produces for a range of clean energy technologies. The scenario does not work back from a defined global temperature goal (as the 1.5 °C scenario does), nor can it necessarily be considered an optimal way to limit global warming to 1.7 °C in 2100 (with a 50% probability). However, it provides governments and other stakeholders with a detailed read of the implications of current long-term targets, if achieved in full and on time.

Clean energy investment trends in developing countries

Total investments in the energy sector in developing economies amounted to around USD 1.5 trillion in 2023. Investments in clean energy accounted for some 60% of the total, around USD 900 billion. China accounted for by far the largest share (over 70%) of clean energy spending, at around USD 650 billion, compared with USD 250 billion (less than 30%) invested in all other developing economies. In practice, China is the global investment leader in most clean energy technologies, including solar, wind, nuclear, hydropower and electric vehicles (EVs). Investors in China benefit from a relatively low and stable cost of capital, and domestic sources of capital account for more than 90% of all clean energy financing.

Today, around 80% of clean energy spending in developing economies is in the power sector. Spending on low-emissions sources of generation grew to USD 460 billion in 2023, predominantly for new generation projects for wind and solar PV. Investments in renewable sources of generation have grown in recent years, facilitated by supportive policy frameworks and rapid reductions in capital costs, particularly for solar, where costs have declined by around 80% over the last decade. Other low-emissions generation technologies have made contributions to the overall trend, including hydropower and geothermal. Many of these economies, including China, India, the Russian Federation (hereafter, “Russia”) and elsewhere, are investing in new nuclear plants.

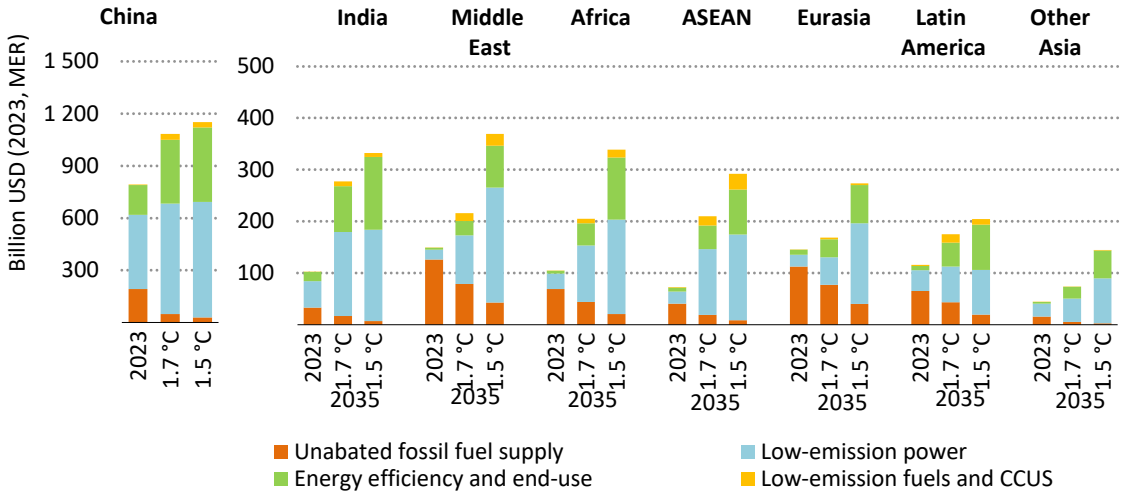
Spending on transmission and distribution grids in developing economies was over USD 160 billion in 2023. Over 95% of all grid transactions were done using corporate finance (on-balance sheet), while the remainder was done through project finance transactions (off-balance sheet). The recent increase in spending has been driven in large part by Latin America, with countries including Brazil, Chile, Colombia, and Panama making efforts to stimulate investment. Brazil more than doubled its grid investments in 2023, helped by



auctions for more than 10 000 km of new projects. Overall, China accounts for more than half of total grid investments, Latin America comprises over 10% and the remaining 35% comes from other emerging markets and developing economies.

Investments in energy efficiency and end-use electrification in developing economies remain relatively low, at USD 235 billion in 2023, with the notable exception of China, which accounts for three-quarters of this amount, where efficiency policies are widespread and electric mobility is growing fast. However, outside of China, energy efficiency investment is set to rise by around 30% in 2024 with improved energy efficiency policy and regulation and innovative financing models like Colombia's energy savings insurance and India's Perform, Achieve and Trade scheme for industry, offering important opportunities to increase investment.

Figure 4: Energy investments in developing economies in 2023 and projected requirements to meet national and global climate goals in 2035



Note: ASEAN = Association of Southeast Asian Nations.

Rapid growth in clean energy investments is needed across all developing economies to meet national and global climate goals, driven by power investments, electrification and energy efficiency

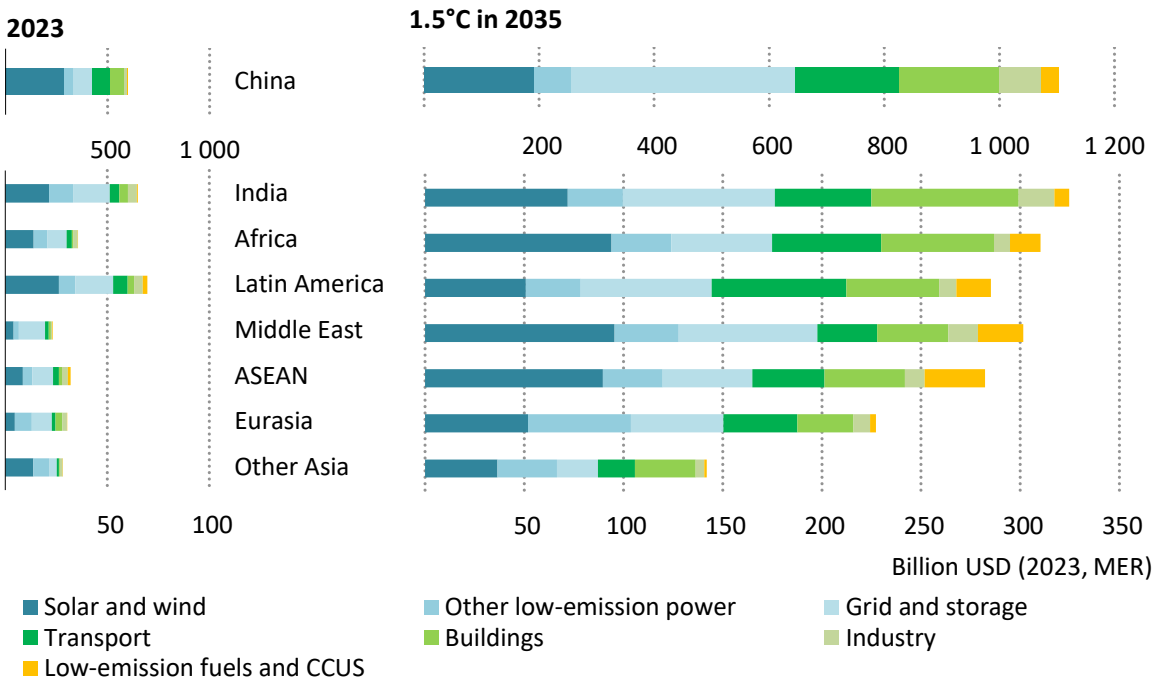
Investments in low-emissions fuels and CCUS projects were around USD 10 billion in 2023, a small fraction of overall clean energy spending. Most of the investments in developing economies in this category are in liquid and gaseous biofuels, led by Brazil, Indonesia and other countries in Southeast Asia and India. However, there are growing signs of interest in other low-emissions fuels, including the world's largest low-emissions hydrogen plant in Saudi Arabia. CCUS activity is picking up, with the oil and gas industry in the lead. The United Arab Emirates recently approved two CCUS projects to capture emissions from gas processing plants, and Saudi Arabia is advancing plans for a 9 Mt CO_2 hub at Jubail. Efforts to mobilise capital to finance green steel, cement, chemicals and ports in EMDE will also be needed to enable the decarbonisation of heavy industry.

Clean energy investment in developing economies needs to increase from USD 900 billion in 2023, to USD 2 trillion by 2035 under the 1.7 °C scenario, in which all economies meet their national climate goals, and to almost USD 3 trillion to align with the global 1.5 °C scenario. Increases in clean energy investment are especially steep for most developing economies other than China.

For the moment, countries are not on track to reach these goals. There is no single pathway to do so, and the approach taken by each country will differ. IEA modelling provides indicative guidance on what the mix of clean technologies might look like based on costs, resource availability and today's mix of policies and projects. Our analysis also underscores the strong need for international financial and technical support and collaboration to bridge the investment gaps.

Investments in low-emissions generation and in grids and storage increase to more than USD 1 trillion in the 1.5 °C scenario by 2035, and the power sector remains the single largest category of clean energy investments. However, their share in total clean energy investment drops back as investments in other parts of the clean energy economy pick up, notably in energy efficiency and electrification. Meeting climate and sustainable development goals will require investments in a broad set of low-emissions technologies and infrastructure.

Figure 5: Clean energy investments in developing economies by region and sector in 2023 and in the 1.5 °C scenario in 2035



Increased clean energy investment is needed across the board, but the largest increases are required to boost efficiency and electrification in the end-use sectors, notably in buildings and transport

The largest growth in clean energy investments is projected to be in the buildings sector to improve the energy performance of the housing stock and the efficiency of the appliances purchased by households as incomes grow. Supportive policies are also vital to open sustainable choices for mobility, including public transportation and electric mobility, initially often via electric two- and three-wheelers and buses as well as electric passenger cars. By 2035, USD 180 billion annually is also being invested in developing economies in a range of low-emissions fuels and CCUS.

As more energy service needs are met through clean energy technologies, so the need for investment in unabated fossil fuel supply declines. Sequencing is important: continued investment is required to keep markets in balance while energy transitions are in progress and to avoid damaging price volatility, but the extent of this requirement depends on the speed at which clean energy investment scales up and become economically viable. A slow pace risks locking in old technologies that can lead to carbon lock-in and future stranded assets. Actions that minimise emissions from fossil fuel supply, notably by cutting methane leaks to the atmosphere and eliminating routine flaring of natural gas, are essential in any future scenario and also contribute to energy security by capturing resources that would otherwise be wasted.

Are clean energy technologies affordable for developing countries?

The falling cost of many clean energy technologies in recent years has opened up a huge opportunity to chart a new course for the energy sector in developing economies. Cost reductions have mainly been driven by a virtuous circle of innovation, accelerated deployment, economies of scale and policy support. In the power sector in 2023, more than 95% of new utility-scale solar PV installations and new onshore wind capacity had lower generation costs than new coal and natural gas plants. Liquid biofuels in some countries offer lower-emitting, commercial and cost-competitive alternatives to fossil fuels requiring no, or minimal, upfront capital costs for consumers. In Brazil for instance, nearly 90% of light-duty vehicles can operate on gasoline or ethanol (flex-fuel vehicles), allowing drivers to choose ethanol when less expensive than gasoline. Liquid biofuels can also help offset fossil fuel imports and support local economic development but must be developed within sustainability bounds.

Not all the technologies required for clean energy transitions are yet cost-competitive with the incumbents, particularly when it comes to the production of energy-intensive industrial goods and long-distance transportation, but examples of cost reductions for clean technologies extend well beyond renewable power.

For many consumer-facing technologies, it is becoming increasingly the case that the clean, efficient choices are the most affordable ones, especially when the lifetime costs are considered. For example, while electric cars and two- and three-wheelers may sometimes have higher upfront costs, although this is not always the case, they typically result in substantial savings because of lower operating expenses. Efficient appliances, such as air-conditioning units, usually recoup any upfront premium through lower operating costs. Heat pumps can be more expensive than gas-fired boilers for heating alone, depending on the relative prices of electricity versus gas, but are typically competitive when considering both cooling and heating. The low prices of solar PV modules create openings for residential consumers to install home solar systems, with their value enhanced by cheaper batteries. Meanwhile, the bulk procurement of efficient LED lighting, an approach pioneered in India, can generate major cost savings for consumers.

The need for continued clean energy innovation and cost reductions is far from over. There is still plenty of scope to improve the performance, cost and interoperability of many existing clean technologies. This is particularly important in sectors such as heavy industry and long-distance transport, where low-emissions technologies and processes are not yet readily available or economically viable. It will likewise be essential to make clean technologies more accessible in developing economies and to support the emergence of local, self-sustaining innovation ecosystems in these markets. Governments and development finance institutions (DFIs) can play a larger role in providing grants or early capital to support local startups and research institutions.

Making clean energy technologies more accessible in developing economies means addressing two inter-related issues that are central to this Roadmap. Many clean energy technologies require higher upfront investment, offset over time by lower operating expenditures. These upfront costs are an important barrier; in the absence of policy interventions at the national and international levels, there is a clear risk that poorer households, firms, communities and countries could be shut out from the clean energy economy. This risk is exacerbated by inadequate access to financing and the high cost of capital in many developing economies. As discussed in detail in subsequent sections, the cost of capital for clean energy projects in many developing economies can be at least two or three times higher than in advanced economies (or in China, where the cost of capital is relatively low) and in some cases much higher still.

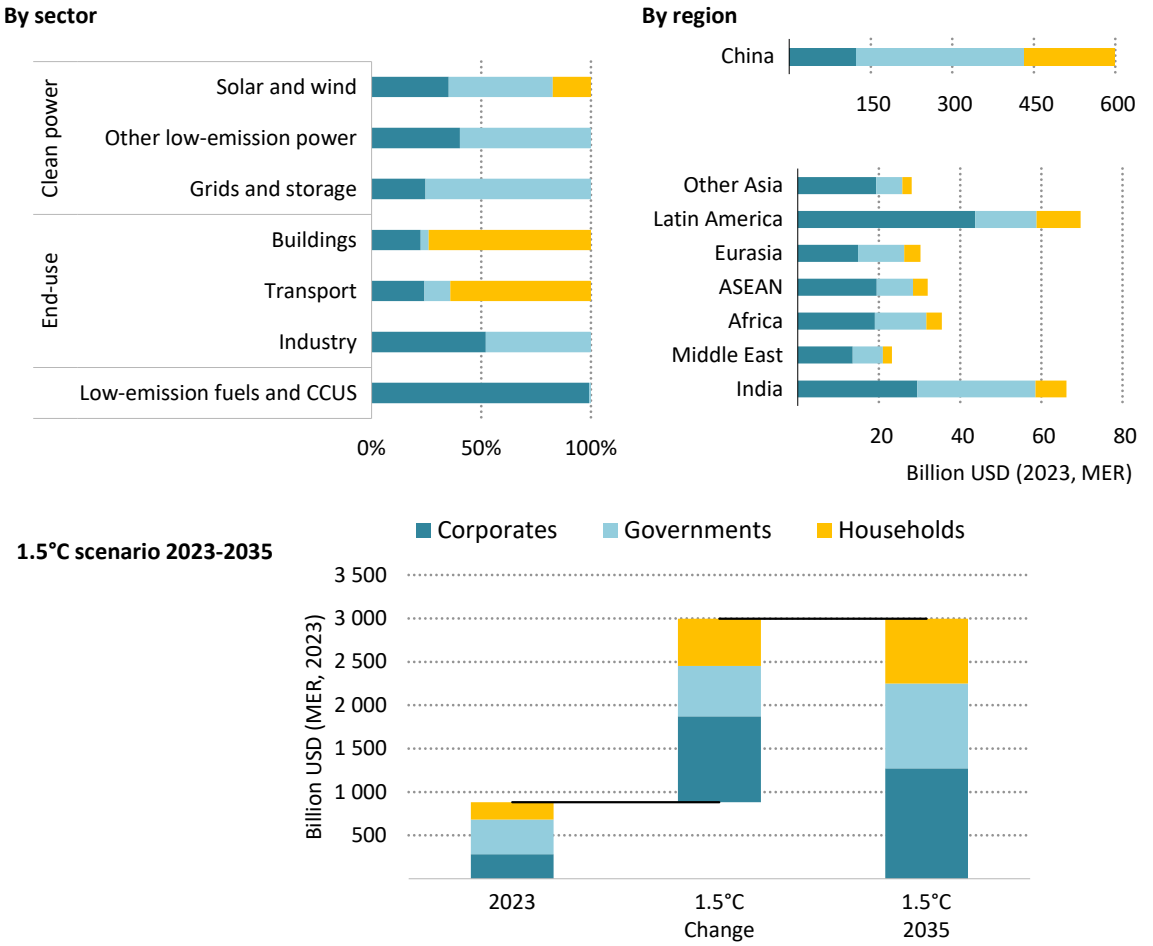
Who is investing in clean energy projects in developing countries?

Of the USD 900 billion in clean energy investments in developing economies in 2023, the IEA estimates that around 47% was made by governments and state-owned enterprises (SOEs) and 31% by private companies, with households accounting for the remainder.

Understanding who is making energy investment decisions in different countries and regions can provide useful insights into the sorts of strategies and policy interventions needed to unlock more capital for clean energy projects.

Governments and SOEs in developing economies tend to play more important roles as investors in the energy sector than they do in advanced economies. This influence extends in many cases to aspects of clean energy, especially in China where roughly half of all clean energy investments are made by governments or SOEs. In most other developing economies, private companies are taking a more prominent role.

Figure 6: Sources of investment for clean energy projects in developing economies in 2023 and in the 1.5 °C scenario in 2035



Scaling up clean energy investment in developing economies will require creating many more opportunities for the private sector, including households, to engage in the energy sector

In the power sector, among generation projects, the share of private companies tends to be higher in utility-scale wind and solar projects and lower in sectors such as hydropower and nuclear, where state-owned players tend to dominate given the strategic nature and security-related issues of these assets. SOEs are important for grid investments, especially for transmission, although some developing economies – notably in Latin America – are looking to encourage private investment in networks. Currently, private companies are the primary investors in low-emission fuels and CCUS..

Households are becoming a much more significant part of the broader clean energy investment picture. Upgrading the energy performance of buildings and appliances, electrifying end-uses where possible and investing in rooftop solar, electric mobility and technologies such as heat pumps will not be possible without broad public involvement. Energy efficiency investments are distinct among other clean energy technologies given the high participation of households, with 70% of spending in buildings and 55% in transport. Currently, the share of households in clean energy investments in most developing economies remains low; China is the notable exception, driven in large part by the rising popularity of EVs, with most models competitive on an upfront basis with internal combustion engine vehicles. This analysis of the sources of investment has important implications for the prospects for rapid clean energy transitions in developing economies. It highlights that the financial sustainability and investment strategies of SOEs, and the extent to which they focus on clean energy, are crucial variables for the future of energy investments. Some SOEs are already taking on additional roles in clean energy, particularly in technologies adjacent to existing areas of expertise. In the case of national oil companies, for example, this includes areas such as offshore wind, geothermal energy, CCUS, and low-emissions fuels.

However, given the scale of the investments required and constraints and limited resources of governments and SOEs of governments and SOEs, environments must enable for the private sector (including households) to take on a larger role in the energy sector in many developing economies. Financing options tend to vary between SOEs and private companies, with the latter relying more on project finance, if available, and the former having more access to concessional funding. Finally, the requirement for upfront spending by households on clean energy technologies raises issues of affordability, as many developing economy households, particularly those in the LDCs, may not be able to cover the upfront costs of clean technologies, even if a lifetime cost calculation brings benefits. This underscores the importance of government regulation (e.g. on minimum energy performance standards) and innovative financing measures, such as India's bulk procurement of LEDs.

Who is financing clean energy projects in developing countries?

Around 75% of the finance currently going to support clean energy investments in developing economies other than China comes from commercial sources. This includes equity investments made by private enterprises and households alongside debt from commercial

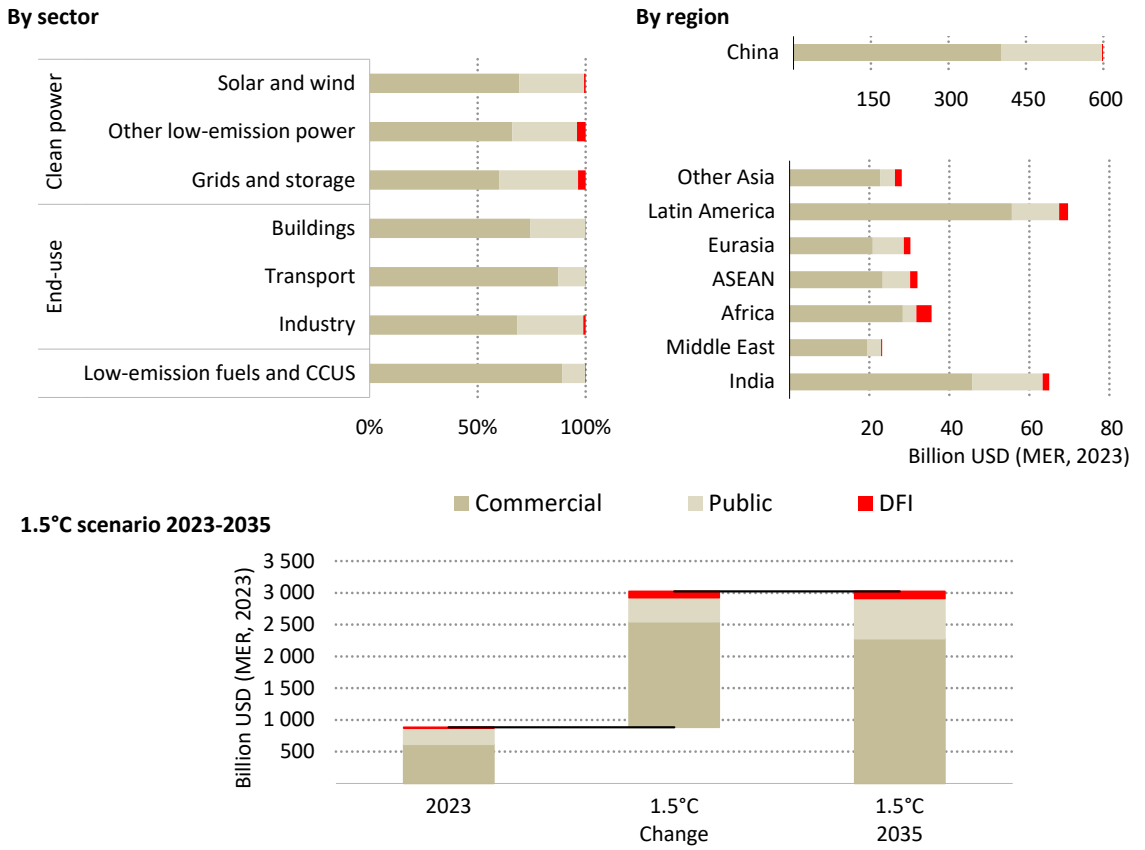
banks and financial institutions. It also includes some finance from public financial institutions, such as national development banks, sovereign wealth funds and pension funds, that operate primarily on a commercial basis, although some of this funding may in practice be state directed, especially in developing economies with strong industrial policies.

Most of the remainder comes from public sources, which include public equity stakes in SOEs, public subsidies and tax incentives for energy consumers, and finance from some state-owned financial institutions, such as export credit agencies as well as central banks. In contrast, public sources of finance play a larger role in China.

Around 4.5% of the finance comes from development finance institutions (DFIs) that have an explicit development mandate. DFIs in this context covers international finance from bilateral DFIs (such as France's Agence Française de Développement, Germany's KfW and the Japan International Cooperation Agency) and multilateral DFIs (such as the World Bank Group, the European Bank for Reconstruction and Development, the Asian Development Bank and the African Development Bank). National development banks (such as Brazil's National Bank for Economic and Social Development (BNDES) and Indonesia's PT Sarana Multi Infrastruktur) can also provide significant amounts of finance to the energy sector and are currently represented under public sources of finance. DFI participation in a project either as an equity or debt holder, whether through grants or the provision of guarantees, typically strengthens project viability and helps to unlock higher amounts of private financing. This can pave the way for the next wave of projects without the need for DFI support.

All sources of finance will need to grow if the rising energy needs of developing economies are to be met in a sustainable way. As examined later in this Roadmap, with appropriate policies in place, investments in mature clean technologies in middle-income economies should be able to rely on private, commercial finance. However, there is a large category of investments that need to be facilitated by some form of risk mitigation and collaboration between the public and private sectors, and another part that will need to be publicly driven as either the technology risks or country risks are too high to engage private finance in a cost-effective way. As markets and countries mature, regular evaluation is necessary to determine the extent of risk mitigation required, if any.

Figure 7: Sources of finance for clean energy projects in developing economies in 2023 and in a 1.5 °C scenario in 2035



Commercial sources of finance provide the main support for clean energy projects, catalysed in some cases by development finance institutions

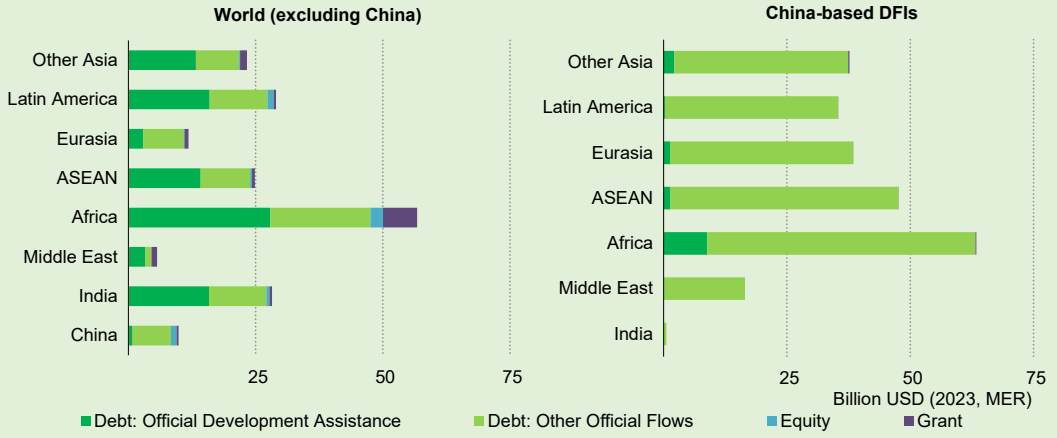
DFIs are uniquely positioned to catalyse investment flows towards sustainable and resilient energy infrastructure in developing economies. Alongside direct financing, they can provide policy support, capacity building and concessional capital focused on de-risking projects to mobilise international as well as domestic private capital. Not all projects require DFI participation, and participation should be limited to projects where risk-adjusted returns are inadequate to mobilise private capital. In the 1.5 °C scenario, DFI funding for energy projects would need to grow by around seven times between today and 2035, compared with a nearly fourfold increase in commercial sources of finance and a doubling of public finance. In absolute terms, the largest growth in capital will need to come from commercial sources of finance, and the limited DFI funds must more effectively leverage much higher multiples of private capital.

Box 2: Development finance institutions and the energy sector

From 2013 to 2021 (the last year for which comprehensive data are available), cumulative DFI financing to the energy sector was around USD 470 billion, with slightly more than half provided by China-based DFIs. Energy financing from China's DFIs has fallen from its peak in 2016 and averaged USD 27 billion in annual disbursements over the period examined, while support from other DFIs has been more constant, averaging USD 21 billion annually.

Around 65% of DFI financing over the period was directed towards clean energy, with investments in energy efficiency in transport and transmission and distribution grids accounting for more than 40%. Financing for fossil fuels continues, albeit from a smaller group of providers. This includes Chinese DFIs which, in line with their pledge in 2021, have stopped financing new coal projects abroad but still provide funding to oil and gas projects. Many of the major DFIs have committed to increase their support for clean energy and climate-related projects.

Figure 8: Development finance for energy projects from China-based and other international DFIs by recipient region and financial instruments, cumulative 2013-2021.



Most of the support available from DFIs is debt financing, and around a quarter is highly concessional

Historically, financing was primarily in the form of debt, accompanied by much smaller amounts of grant and equity financing. Less than half of the total debt financing was provided on highly concessional terms or in the form of Official Development Assistance (ODA), where 10-45% of the loans were grant equivalent. Nearly 80% of global DFI financing was reported to be provided in US dollars and euros, with only very limited amounts of local currency lending.

A crucial metric for the impact of DFIs is their success in mobilising additional capital from the private sector. The record on this front has been mixed. Over the last decade, an average of USD 12 billion was mobilised each year by DFIs for climate-related projects from the private sector, of which nearly USD 8 billion went to energy, industry, construction and transport. This represents a leverage ratio of about USD 0.3 for each USD 1 in multilateral and bilateral funding for clean energy technologies. Designing and implementing solutions that can better utilise DFI capital to de-risk private investments in lower-income countries will be essential to meet investment goals.

What is the capital structure of clean energy projects in developing countries?

The capital structure of different clean energy projects varies substantially across parts of the energy sector. Debt financing tends to play a bigger role in investment in clean generation and grids. Many low-emissions power generation projects are backed by long-term power purchase agreements (PPAs). In the case of grids by regulated tariffs, these provide for more predictable revenues, making debt financing easier to access and more affordable.

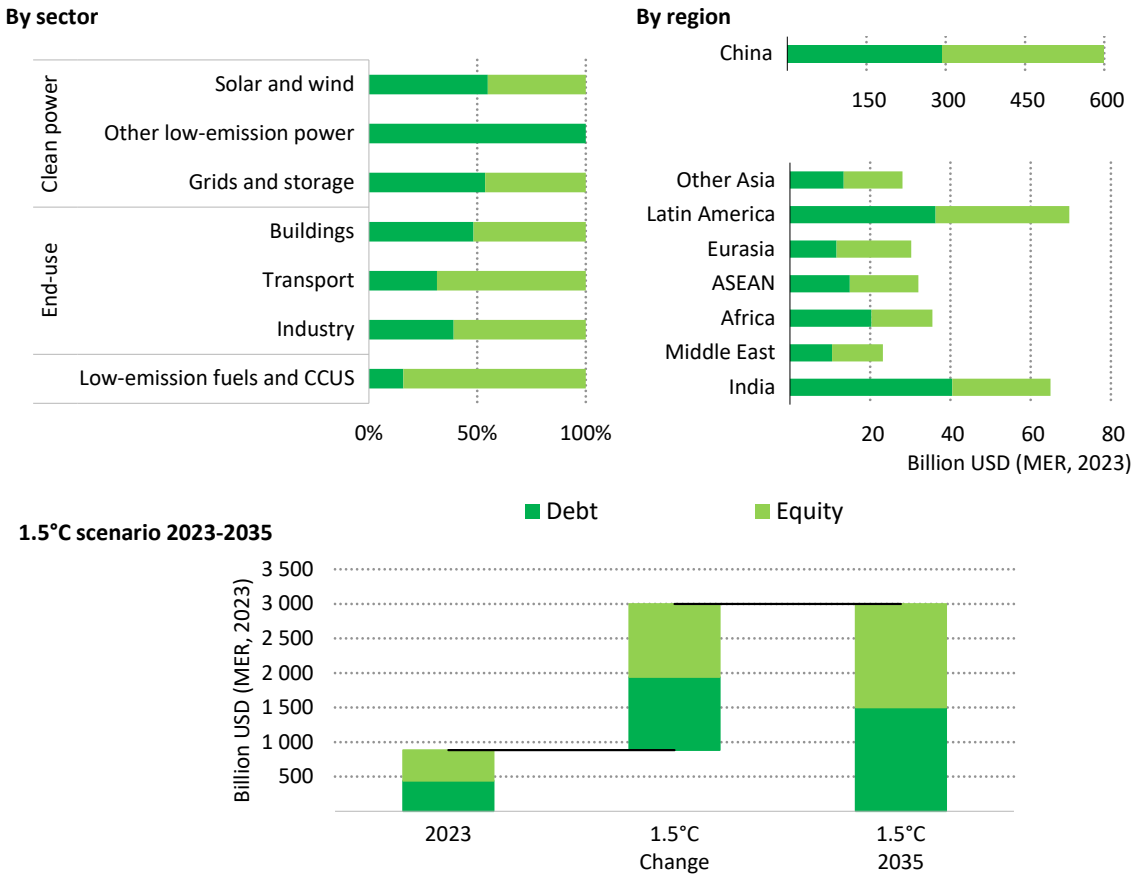
The current level of investment in clean fuels is relatively low, but the riskier nature of projects in early-stage and emerging technologies means that equity financing is often the only way that such projects can move forward as most lenders will not yet consider these projects bankable. In the end-use sectors, most investments in more efficient appliances and other efficiency upgrades are financed via equity, mostly from household savings, as the cost of consumer loans can be very high in developing economies and many consumers may already be indebted. The current capital structure for transport investments shows a greater reliance on equity financing, related to government-backed investments for public transport. Investments in industry are characterised by higher shares of equity financing, as corporations tend to fund energy efficiency investments through internally generated cash flow rather than debt. Developing countries tend to have higher shares of small and medium-sized enterprises (SMEs), which have more restrictive access to affordable financing, limiting their spending on clean energy technologies.

As clean energy transitions progress, demand for both debt and equity capital is needed to finance clean energy projects, with the share varying depending on technology maturity, the availability of predictable cash flows for debt financing and the investor type. On-balance sheet corporate finance is the norm for debt financing in most developing countries and creates limits to the amount of debt financing that can be raised. Where possible, non-recourse-based project finance, which is widely used for large-scale infrastructure projects in advanced economies and to a more limited degree in developing economies, needs to be expanded.

The ramp-up in spending on low-emissions generation and networks, opportunities to refinance operating projects once initial permitting and construction risks have diminished, and opportunities to tap into deeper local capital markets (and local currency financing) in developing economies provide opportunities to accelerate debt financing. This can also represent an opportunity for DFIs to promote the participation of commercial banks by reducing their own stakes after the riskiest stage of development has been passed.

Debt generally has a lower cost than equity, and efforts to shift towards more debt financing will be positive for prospects of financing transitions. However, much depends on the broader context of debt levels and their sustainability, especially given that many developing economies are already facing problems with indebtedness and the scaling up of concessional debt financing from DFIs.

Figure 9: Capital structure of clean energy projects in developing economies in 2023 and in the 1.5 °C scenario in 2035



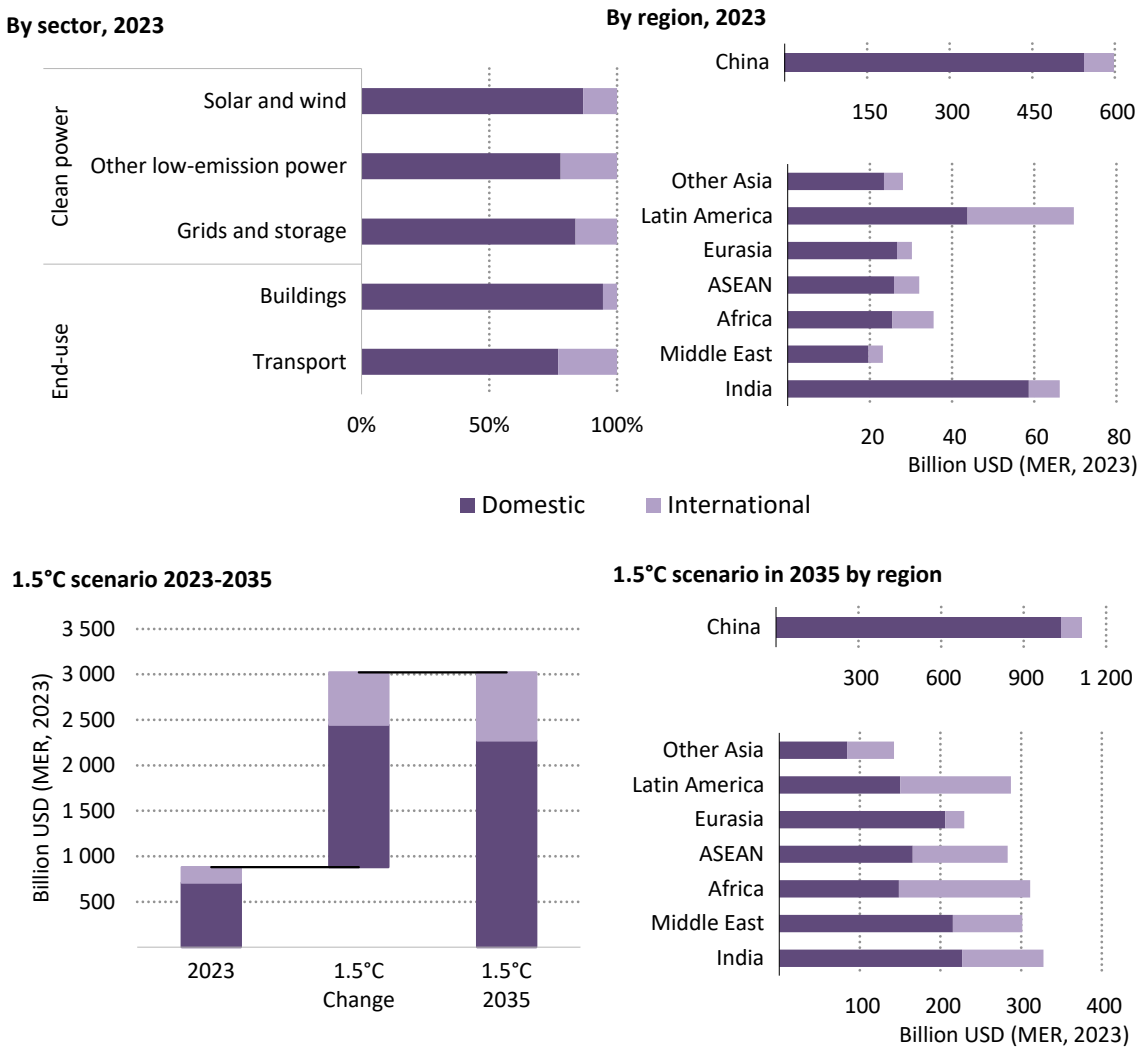
Scaling up of both debt and equity financing is needed in the 1.5 °C scenario, though varying levels are seen across sectors, where power requires more debt and end-use more equity

Increasing access to both domestic and international sources of equity will be key, particularly for investments in new markets and for emerging technologies where developers lack a track record and often struggle to meet the capital requirements of commercial banks. Where debt financing costs are too high for households and SMEs, equity financing, often through savings and cash flow, will likely remain the dominate source in the medium term, with a need to shift longer term towards debt financing and, where possible, non-recourse project financing. Supported green loans can help to lower financing costs for households in developing countries and can be aggregated and financed from the green bond market.

What is the split between domestic and international sources of capital?

For the moment, domestic sources of capital account for most of the financing for clean energy investment projects across all sectors and regions in developing economies. This finding is heavily conditioned by the weight of China in the overall numbers, as more than 90% of clean energy projects in China are domestically funded. However, domestic funding has been crucial in other developing economies that have successfully scaled up clean energy investment, including India and South Africa. Latin America provides a more balanced picture, with a mixture of domestic and international capital behind clean energy expansion in Brazil, Chile and Mexico. The region has successfully attracted high levels of foreign direct investment into clean energy projects through strong policy and regulatory frameworks.

Figure 10: Origin of finance for clean energy projects in developing economies in 2023 and in a 1.5 °C scenario in 2035



The scale-up of clean energy investment required in developing economies implies greater reliance on international sources of capital, with the exception of China

There is scope in many developing economies to deepen local capital markets in ways that increase the availability of domestic capital for projects in clean energy, as well as in other sectors of the economy. Developing secondary markets from operating assets with stable revenue streams can help recycle capital from local banks into new projects by bringing in capital from international and domestic institutional investors. However, the sheer volume of capital required for successful clean energy investments makes it likely that much greater inflows of international capital will be required. IEA analysis suggests that all developing economies other than China would require a sharp increase in the share of international sources of finance in order to get on track for the 1.5°C scenario.

This shift towards greater international capital will require targeted interventions from policy makers to create investment opportunities that can attract both foreign direct investment and foreign portfolio investment. The latter is needed to mobilise capital, particularly from institutional investors that typically do not make direct investments in projects. Attracting international investors will require strengthening macroeconomic conditions, enhancing sovereign risk ratings and implementing solutions to lower the cost of currency hedging that can make projects unattractive. Financing instruments, such as green, social, sustainable and sustainability-linked bonds, have the potential to mobilise private capital at scale by attracting institutional investors that do not typically invest in individual projects.

The potential for Green, Social and Sustainability Linked Bonds (GSSB) is enormous. Since 2019, GSSB represent 20% of all issuances by electrical utilities. There is also a need for project aggregation platforms and securitisation vehicles that can overcome the asymmetry between the relatively small size of most energy transition projects (especially for energy efficiency projects) in developing economies and the relatively large minimum investment size that major institutional investors require. Financial intermediaries that can use larger institutions' funds (on-lending) to support small-scale projects can also help to overcome scale barriers. Attention will also be needed on regulatory provisions (for example, risk-weighted capital rules under Basel III) in advanced economies that disincentivise investments and/or portfolio exposure to developing economies.

The task ahead

Reaching energy transition and other sustainable development goals in developing economies will require investments from multiple types of investors and support from multiple sources of finance. All types of funding will need to be scaled up: public and private funding, domestic and international, concessional and non-concessional - but two elements stand out. There is a need for greater involvement of the private sector and for well-coordinated, enhanced international financial and technical support.

There are plenty of positive examples in developing economies where clear regulation, vision and intent to move ahead with clean energy transitions, and a readiness to work with the private sector have yielded impressive results. In essence, this means providing the conditions to meet investor expectations on suitable risk-adjusted returns. Different types of investors and capital providers will be willing and able to take on different types of risks with higher returns required for higher levels of risk. Riskier projects will have higher shares of equity capital seeking higher returns than debt capital providers who seek predictable cash flows. Domestic investors and capital providers are better placed to absorb country-related risks, while international investors and capital providers that have strong experience with clean energy projects are often willing to take more technology risk.

The overall quality and predictability of the domestic business environment is a critical variable, especially as the balance of capital spending on energy in developing economies

shifts away from dollarised, globally traded commodities, such as oil, towards clean energy projects that rely on domestically generated revenues. Broad country-related risks and macroeconomic factors typically account for a large share of country-by-country variations in the cost of capital for clean energy projects in developing economies. These include the rule of law and sanctity of contracts, as well as concerns on currency fluctuations and convertibility. The regulatory landscape can evolve to favour incumbent technologies via, for example, the phase-out or elimination of inefficient fossil fuel subsidies that do not address energy poverty or just transitions.

Mechanisms that mitigate these risks include guarantees against expropriation and facilities to reduce the cost of currency hedging. However, over the longer term, there is no substitute for efforts to tackle the underlying issues by strengthening national institutions, reducing inflation, reforming pricing systems and deepening local capital markets and financial systems.

There are also project- and sector-specific issues that can be addressed directly by energy policy makers and regulators. In the case of clean energy generation projects in the power sector, for example, key issues relate to sector regulation, the reliability of revenues – dependent mainly on the off-taker's ability to pay on time – the availability of transmission infrastructure or land, and how all these issues are defined in contracts. Such project- and sector-specific elements can account for 20-30% of the higher cost of capital in developing economies.

Scaling up clean energy often requires adjustments elsewhere in the energy sector, putting a premium on integrated policy approaches and system-wide thinking. In the power sector, for example, bringing in new sources of generation, especially variable ones like solar PV and wind, requires the flexible operation of other generation assets and determined efforts to expand and modernise grids. In countries with large coal-fired fleets, this means repurposing coal-fired power plants to provide balancing services or making provision for the early retirement of plants to allow clean sources to expand, prioritising the retirement of older, less efficient units.

Transition finance is a key tool for supporting a broad range of investments to address the energy transition. Investments are required not only in clean energy but also in technologies that are necessary to provide or enable zero emissions energy or energy services, and in technologies that provide emissions reductions but do not themselves deliver zero emissions energy or energy services. Developing regional energy transition pathways and attracting international capital flows to developing countries can be facilitated by enhancing the interoperability and equivalence of regional taxonomies and roadmaps with other regions and enhancing cooperation among the finance industry.

The international community needs to support efforts by governments in developing economies to create a strong enabling environment for clean energy investment, including by strengthening the institutions that are responsible for energy sector governance and

deepening local capital markets. Getting on track for national and global climate goals will also require a significant expansion of the concessional finance available to developing economies, especially for the LDCs that will otherwise struggle to find a foothold in the clean energy economy.

As explored in more detail in the next section, not all projects or countries require this kind of support, and it cannot replace the needed policy actions or institutional reforms. However, used strategically, it can help countries remove barriers that are slowing clean energy investment – including weaknesses in project preparation, data quality and energy sector policies and regulation that push up the cost of capital – and bring in much larger volumes of private capital.

De-risking solutions and innovative instruments to unlock capital

Closing the clean energy investment gap in developing economies requires mobilising capital for sectors that present different degrees and types of risks to investors, with each country having its own context and circumstances. For instance, the challenges and business models in play for a utility-scale solar PV project with a long-term contract are different from those of a transmission line financed on-balance sheet by a state-owned utility, or an electric car that is paid for by a household with consumer finance or their own savings. Risks can also vary for different projects within a single sector. Among renewables, for example, geothermal power has particular exploration risks, environmental and social risks can be large in hydropower projects, and transmission bottlenecks can be barriers for solar and wind. Risks also vary among countries, from governance factors – like political stability or the rule of law – to macroeconomic policy – including fiscal spending, debt levels and central bank independence – these issues also impact risk perceptions of capital providers, affecting investment decisions in energy and beyond.

The attractiveness of clean investments depends mostly on the clean energy policies, regulatory frameworks, public resources and institutional settings of the different countries. Changes to all of these are required in most developing countries to raise projects' risk-adjusted returns and meet the requirements of private investors. These changes include a range of pricing and non-pricing measures: measures to mitigate risks and enhance returns, as well as measures to strengthen energy sector institutions. The pricing measures include removing fossil fuel subsidies and introducing carbon pricing or an equivalent. The non-pricing measures include a wide range of regulatory measures, targets and policies that lower the cost of capital as well as raise the returns on clean energy investment.

Box 3: The role of carbon markets to support clean energy investments in developing countries

Carbon pricing can be an important tool for mitigating emissions, as it can encourage investment in low-carbon technologies, reduce demand for emissions-intensive activities and channel finance flows to developing countries. One form of carbon pricing is compliance carbon pricing instruments (CCPIs), which include carbon taxes and emissions trading systems (ETS). Another form is baseline-and-credit systems, which generate carbon credits from emissions reductions or removals. While carbon

pricing cannot put the world on a net zero pathway on its own, and a host of complementary policies instruments are needed, it can raise important revenue for governments and play a role in attracting private capital.

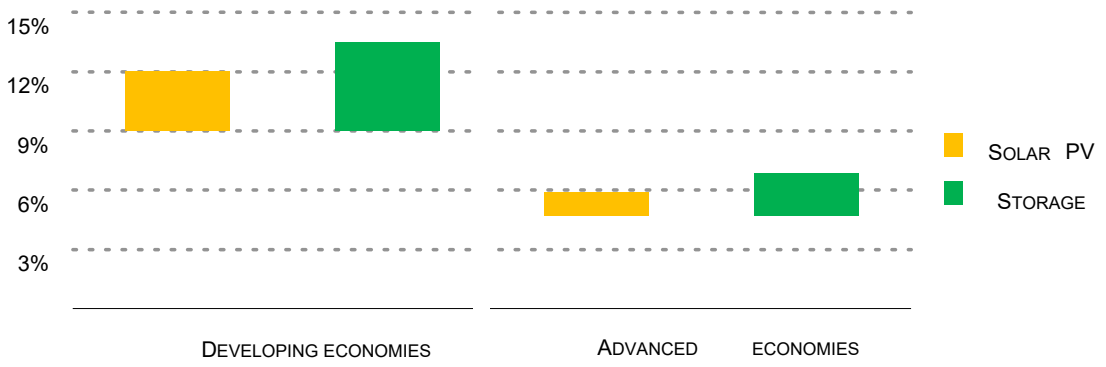
As of October 2024, 75 CCPIs have been implemented, covering around 24% of global emissions. The applied carbon price ranges from around USD 0.46/t CO_2-eq in the Indonesian ETS to around USD 167/t CO_2-eq in Uruguay's CO_2 tax. Innovative CCPI designs are emerging, with intensity-based ETS and a hybrid combination of ETS and carbon taxes on the rise, deviating from the traditional cap-and-trade or carbon tax blueprint.

Over the last 20 years, carbon credit markets have established a cross-border funding infrastructure to channel private and public funding from advanced economies to EMDE through pay-for-performance projects. The outcomes of COP 29 negotiations on Article 6 will significantly impact the credibility and effectiveness of voluntary carbon markets, determining their ability to attract additional funding for clean energy transitions in developing countries.

The cost of capital is a measure of real and perceived risk. It is the minimum return that a company requires to justify a decision to invest: the riskier the project, the higher the rate of return required to justify investing. IEA's survey of leading financiers and investors confirms that the cost of capital for utility-scale solar PV projects in large developing economies is well over twice that in advanced economies. This reflects higher real and perceived risks at the country, sectoral and project levels. As a result, developing countries can end up paying more for clean energy projects or they can miss out altogether. Solar PV plants and other clean energy projects tend to involve a relatively higher share of upfront expenditure and a lower share of operating expenses in total project costs. If countries cannot afford high upfront costs, they can be locked into polluting technologies that might initially be less expensive but require persistent spending on – and combustion of – fossil fuels for their operation.

Reducing the cost of capital and improving risk-adjusted returns for clean energy projects in developing economies depend on improving access and transparency around project data to address the perceived risks and mitigating sector- and country-related risks.

Figure 11: Cost of capital ranges for solar PV and storage taking final investment decisions in 2022



Source: IEA (2024), Reducing the Cost of Capital.

The cost of capital for solar PV and storage projects in developing economies is at least twice the value in advanced economies, despite relatively larger interest rate hikes in advanced economies

The following sections discuss different measures needed to address these risks. First, we focus on the need to develop national capacities and policies, with particular attention on **robust energy planning**, an aspect that is key to improving policy and regulatory predictability and providing a strong signal for long-term investment. Second, we discuss different **financial instruments and de-risking mechanisms that have been critical to mobilise investments** for different clean energy projects. We divide this discussion into three technology- and country-risk groupings (privately led, facilitated interventions and publicly driven), a framework introduced and explained below. Last, we discuss **measures needed to reduce country-related risks**. These risks are beyond the control of energy policymakers and regulators, but they are still critical to get projects approved.

Developing national energy transition capacity and policies

Public sector efforts have a strong impact on attracting more investment and helping more projects reach financial close. Strengthening government capacity to develop and execute energy transition plans provides the private sector with a stable framework to assess investment decisions and reduces bureaucratic burden, facilitating investments. The key areas to focus on for capacity building will vary by country, but include data provision, energy sector planning, policy and legal frameworks, regulatory capacity and implementation capacity.

Effective data collection and evaluation. Accurate, reliable and timely data enable policymakers, energy companies and investors to assess the energy sector's current and

future state, establish credible plans and targets and assess the financial prospects for various investment decisions. Many countries can build upon their established national statistical systems for the collection, validation, and analysis of key energy and economic data. Improving data quality in EMDEs requires developing and administering new surveys for data collection, and international support can help to train statisticians, provide initial funding to develop the necessary frameworks and troubleshoot them in their early years. Data are also important for the monitoring and evaluation of energy policy effectiveness, which determine future policy measures. While nothing can supplant a robust national statistics process, satellite images of buildings and lighting, real-time demand monitoring, weather trackers, cell phone data use and e-commerce data can be used as proxies in estimations. One example is the IEA's Building-Level Electricity Access and Demand Estimation Model, which combines utility data with satellite imagery to accurately map electricity access and estimate demand at the building level with over 80% accuracy.

Energy sector planning. National energy sector planning can take many forms, including least-cost power system capacity expansion plans, transmission plans, electrification and clean cooking access plans, energy sector climate resilience and adaptation plans, and nationally determined contributions. Developing such plans can help send strategic direction for the sector, providing the foundation for procurement decisions and co-ordinating diverse private-sector actors. It also helps countries engage the international community, financiers and investors on various topics. Planning exercises should rely on established, vetted energy planning frameworks and models, and use the latest data on deployment, technology costs, climate impact and economic data – much of which are available freely from the IEA. Robust plans typically explore how systems may evolve across multiple scenarios to explore sensitivities and include public consultation and stakeholder engagement processes.

Policy planning and implementation. Globally, countries have implemented a number of policy tools and measures to attract investors to their energy sectors. These include feed-in-tariffs, regulated returns, guarantees, tax credits and other incentives. They can also include other measures like standards, energy performance regulation, structured procurement processes and carbon pricing. Not all of these measures fit all contexts. Knowledge exchanges between countries on what policy tools have been employed elsewhere and how to design and set them up can help countries understand which actions to take and how to develop the needed legal frameworks to implement these policies.

Procurement. The procurement of energy infrastructure can be based on the outcomes of the planning process. Using competitive tendering and auction processes can help attract a wider set of project developers and reduce project costs. Well-structured contracts with standardised terms that provide long-term clarity on compensation, as well as other standard assessments of the creditworthiness and performance of various firms are also important components of a successful procurement process. Together, these measures can help improve the efficiency of the procurement process and reduce the perceived and real risks to

financiers. International support to build this capacity includes knowledge exchanges, project preparation support and other technical assistance.

Regulatory capacity. As in all sectors, sound regulation ensures an even playing field for enterprises, certainty for investors, and adequate protection for consumers. It also establishes clear rules and processes for dispute resolution and settlement. Important areas for energy sector regulation include grid access terms, market power detection, pricing, performance standards and environmental performance standards. Regulatory institutions need to be adequately resourced, staffed with capable officials and independent of external interference. They should also provide opportunities for public consultation and clear procedures for changes in rules. At the same time, regulations that are excessively burdensome can slow energy transitions and be counterproductive to their objective of protecting the environment. Overly burdensome permitting processes for renewable energy projects in many countries have decreased investor appetite without materially improving environmental and social protections. Knowledge exchanges on regulatory best practices and the adoption of familiar terms and modes of regulation can help reduce the perceived regulatory risks for investors in these countries.

There are many examples of how countries proceeded from planning to adopting clear policy approaches rooted in those plans that helped engage investors. India's Renewable Energy Roadmap from 2015 set out ambitious yet achievable targets for the country's renewable development. It included recommendations that the Government of India adopted, including the central planning of grid expansions to help interconnect new solar power plants, standardise contracts and facilitate land access and the overall co-ordination of India's federal and state jurisdictions. What emerged were solar parks, which identified target sites for new solar projects alongside state governments. Once identified, they developed land with all the needed clearances and extended transmission systems, water access, road connectivity and communication networks, all of which reduced uncertainty for bidders in these new projects. As of April 2024, 50 solar parks with 22.5 GW of capacity have been awarded as "plug and play" solar parks, i.e. those that require minimal additional connection work. These were awarded through reverse auctions, with volumes derived from robust planning, along with additional guidelines from the Ministry of New and Renewable Energy for competitive bidding provisions to help reduce the off-take risk and address the revenue shortfall from curtailment.

Increasingly, industrial policy is interlinked with national energy planning and the identification of opportunities vis-à-vis other countries' plans for the energy transition. For instance, Morocco, home to the world's largest reserves of phosphate – a key material for lithium-iron-phosphate EV batteries – has seized opportunities in the growing market for EVs. Rather than simply exporting the raw material, Morocco is building on the automotive manufacturing base it has developed since it introduced its Industrial Acceleration Plan in 2014, which includes subsidies, free trade agreements, special economic zones, and public investments in roads and ports for exports. In 2022, foreign direct investment in the country's

greenfield automotive factories surged to USD 15.3 billion, almost as much as the previous 5 years combined. Morocco's free trade agreements with the United States allow its lithium-iron-phosphate cathodes to count towards the procurement targets required for EVs sold in the United States to receive subsidies under the US Inflation Reduction Act. IEA analysis found that pursuing net zero strategies can produce significant increases in employment. Under a global net zero scenario, by 2030, Africa could add 1.6 million more energy-related jobs than under the current energy transition policy scenario.

International collaboration has helped strengthen domestic capacity in energy planning and policy implementation. For instance, Kenya has worked with a diverse set of partners to develop long-term energy plans and identify key policies to attract more energy investment. As a result, the country has seen a significant increase in energy investment in recent years. One area is geothermal, in which Kenyan companies have built a strong foundation with the support of multilateral and bilateral technical assistance and lending. Since 2000, Kenya's geothermal capacity has increased more than ten-fold, and it ranked ninth in the world for geothermal generation in 2023. Kenya Electricity Generating Company (KenGen), the state-owned generation utility, is now considered a leader in geothermal and an example for other countries in the region. It has also developed the Geothermal Centre of Excellence, which holds training programs to build the capacity of geothermal experts in the region.

Capacity building for long-term planning can also support international political agreements and investment pledges. Jointly with the Ministry of Energy and Mineral Resources of Indonesia, the IEA supported the development of a net zero roadmap for Indonesia's energy sector, which was launched at the G20 Energy Transitions Ministerial in Bali in 2022, along with a joint statement on the importance of net zero targets. The roadmap has formed the basis for Indonesia's Just Energy Transition Partnership and its related investment plan.

Recommendations to improve national domestic capacities for energy policies and planning

Develop credible and comprehensive national strategies. Countries without energy sector strategies should work with established actors to develop energy data and modelling capacity within national planning institutions. These should rely on up-to-date national data and reasonable national and global assumptions (e.g. on GDP growth). Planning should be updated periodically and involve a wide stakeholder engagement process and peer review process. Planning should be the basis for future energy targets, procurement decisions and the energy sector components of other national plans, including nationally determined contributions, National Adaptation Plans, and Just Energy Transition Partnerships. National capacity building should be done with credible institutions and could be carried out through the upcoming Global Coalition for Energy Planning.

Develop new capacity building programmes for developing economies within the framework of partnerships aimed at mobilising more investment in the clean energy

economy. International actors should commit more resources to providing education and training opportunities in the space of energy system regulation, financing, procurement and operations for developing country ministries, regulators, enterprises and academia. To effectively organise international partners and donors, a country platform approach could be useful to ensure country leadership and prioritise needed forms of capacity building. This capacity building could include training, funding for local training facilities, secondments, study exchanges, and the co-development of relevant curricula with local universities. These steps should be integrated with broader efforts to mobilise more energy investment in developing countries, including efforts from development partners, DFIs and MDBs.

Build robust energy data systems at the national level to ensure timely tracking. Countries should develop plans for expanding their energy data coverage, including the improved collection and publication of timely data. This can be supported by international efforts to set up new processes based on international best practices that can be replicated by local governments. The data collection should prioritise information that is valuable for planning processes, investor decision-making and regulatory and performance assessment processes. Implementation will be most effective when it comes with data disclosure regulations and transparent procurement, tendering and planning processes, which help ensure the timely and accurate reporting of key energy data.

Greater and better use of financial instruments needs to mobilise capital for clean energy investments

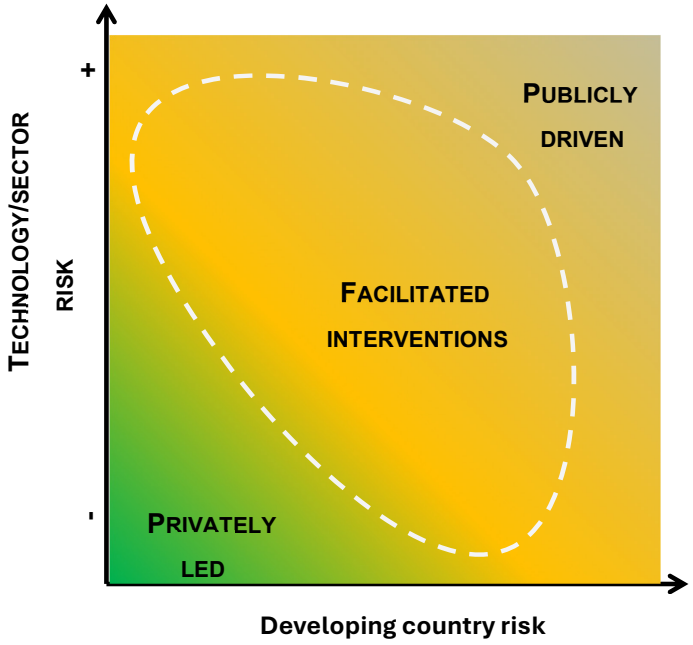
To simplify the complex matrix of regions and sectors, this Roadmap introduces a framework to group clean energy investment needs by technology and country risk. The framework essentially breaks down investment needs into three main groups to better reflect the types of interventions that should be prioritised:

- **Privately led** investments are those in clean energy technologies that are relatively low risk and mature, such as solar and onshore wind, in countries with relatively good credit ratings. An example is utility-scale solar PV in Brazil or India. Both countries have been mobilising capital for these projects, especially from the private sector, for several years already and now generally require only limited interventions for project structuring (to increase capital flows from international source) or in specific cases.
- **Facilitated interventions** are investments of two broad types:
  - in technologies that have reached commercial maturity in other jurisdictions (in both advanced economies as well as some developing economies) that have yet to be widely established in developing countries and need additional de-risking for the first projects (like utility-scale solar PV in Cambodia) or where the country's creditworthiness is low and a binding constraint to investors

- in emerging technologies in relatively low country-risk jurisdictions within developing economies that require additional support for the first commercial-scale projects, such as hydrogen projects in Chile.

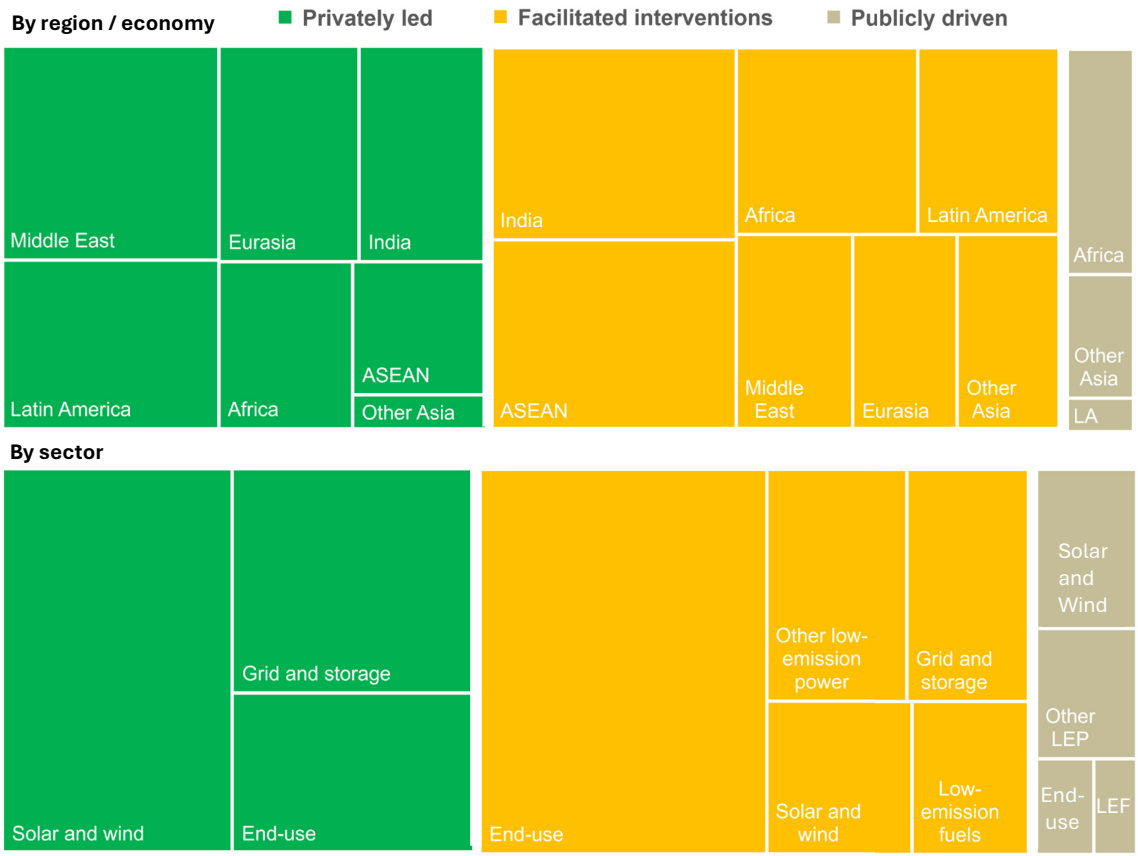
- **Publicly driven** investments are clean energy investments in the LDCs with low credit ratings, where commercial capital is either absent or too costly to access, or those in nascent technologies that require substantial public support to lower costs – for instance, projects in regions of conflict, or CCUS projects.

Figure 12: Indicative diagram to represent the framework



We have included an illustrative mapping of future investment needs against these three groupings, over 40% of clean energy investments in 2035 are categorised as privately led, half are facilitated and slightly over 5% is publicly driven. Latin America and the Middle East are the regions with the largest shares of privately led investments, followed by Eurasia and India. Latin America has historically attracted relatively high shares of private financing, as it led the way to the unbundling of the power sector and introduction of competition with long-term auctions for independent power producers (IPPs), the privatisation of distribution, as well as high shares of private sector participation in transmission in various countries.

Figure 13: Investment spending across the three clean energy groups in the 1.5 °C scenario in 2035



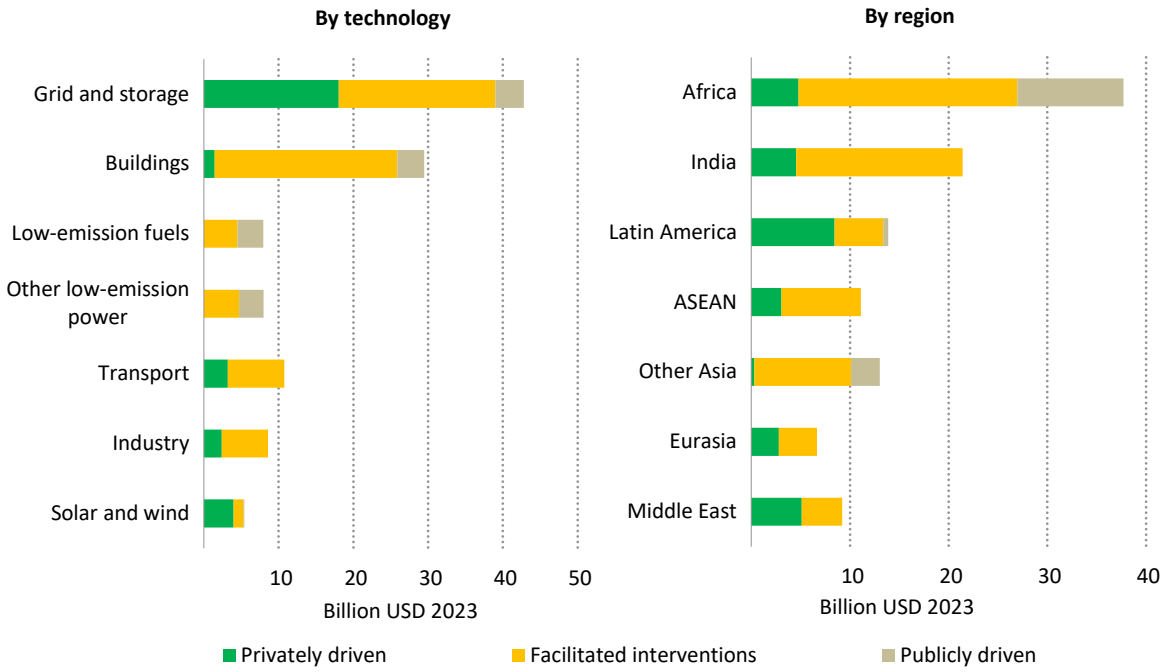
IEA. CC BY 4.0.

Note: ASEAN=Association of Southeast Asian Nations; LA = Latin America; LEF = low-emissions fuels; LEP = low-emissions power.

The use of concessional funds differs across the three groupings and should be targeted at meeting specific gaps or barriers. For instance, concessional finance should be concentrated in managing risk in the case of facilitated interventions, such as through the provision of concessional finance, guarantees for project de-risking, and grants for technical assistance to support project preparation and pipeline development. For privately led markets, the focus should be on using small amounts of grant funding to support project structuring and secondary financing. In the markets with the greatest risks, either for nascent technologies or for high-risk countries, a much greater share of highly concessional debt and equity is needed to meet the shortages of both at affordable levels. This section goes into more detail on the instruments and interventions best suited to each of the three groups, while the Action Plan helps prioritise these interventions towards areas that can have the largest impact over the next decade to bridge the funding gap.

By far, the largest portion of concessional funding is required for facilitated interventions, where focusing on project de-risking through the use of guarantees or first-loss, and supporting project preparation, can yield the largest impact. India, followed by ASEAN and Latin America, with more mature economies, represent the largest regions where facilitated interventions are most needed. Africa and other Asia, with the LDCs – many of which have inadequate financial sectors and high country risks – see publicly driven interventions as the largest share of concessional funding needs. Many of the poorest countries will require a high level of concessional finance to meet universal energy access by 2030. This is estimated at USD 20 billion per year for electricity access and USD 5 billion per year for clean cooking.

Figure 14: Concessional funding needs based on technology and country risk in the 1.5 °C scenario in 2035



Note: Concessional funding estimates for other low-emissions power do not include nuclear.

Low-income economies will need substantial international public support, while interventions in middle-income economies should target de-risking

At the sector level, the largest portions of concessional funding are required for grid and storage investments, buildings and other low-emissions power and low-emissions fuels and CCUS. With different utility models and electricity market structures, a variety of interventions will be needed to support these investments depending on the creditworthiness of the utility, whether it is privately or publicly owned (or managed) and depending on whether tariffs provide for adequate cost recovery. As outlined earlier, households play a dominant role in building investments and ensuring just energy transitions. About 45% are assumed to be

publicly driven with high levels of concessional funding targeting the lowest-income households or countries, and the remainder through facilitated interventions.

Concessional support for investments in transport is split between privately led and facilitated interventions supporting both investments in public transportation and the rollout of e-mobility. The latter is a mix of support to fund charging infrastructure, electric buses, electric two- and three-wheelers and, to a lesser degree, EVs, as uptake for passenger EVs is most likely limited to high-income households in developing economies, and limited concessional funding should target mobility services for lower-income households.

Solar and wind investments require the lowest share of concessional funding as these mainly privately driven markets already have access to commercial finance in many developing countries. Interventions in these sectors should focus on the LDCs or where these technologies have yet to be established.

The following sections discuss each of these three groupings in more detail.

Privately led investments

As mentioned earlier, privately led investments accounted for about two fourths of clean energy investments in developing economies in 2023. By sector, these were concentrated mainly in solar and wind and to a lesser extent in grids and storage, as well as end-use in transport. Geographically, they were concentrated in Latin America, followed by India, the Middle East and Eurasia.

Brazil and India provide successful examples of how renewables, in particular solar and onshore wind, moved from requiring facilitated interventions around a decade ago to being mostly privately led investments today. Brazil attracted about USD 75 billion to utility-scale solar and onshore wind from 2010 (when auctions of renewables started, focusing on wind) to 2023. Almost three-quarters of this was focused on wind projects. India attracted over USD 130 billion to these two sectors over the same period, but this was concentrated more on solar (60% of the total cumulative investment).

Starting with the Brazilian case, Brazil's national development bank (NDB), the BNDES (Brazil's main federal source of development finance), played a major initial role in providing low-cost and long-term debt to projects. However, solar and wind power markets matured as regulation improved, commercial banks became more comfortable and better at financing these projects, and developers became more well-known and experienced and equity investors more interested. This shifted the role of the NDB from direct finance to catalysing projects. In 2017, the BNDES adopted a new financing strategy to gradually bring its concessional rate towards a market-based long-term rate. At the same time, bonds became increasingly more popular to finance renewable power, commercial sources of capital became the norm and companies tapped more into the capital market.

The adoption of green finance policies and practices, complemented by fiscal incentives, also helped grow the green infrastructure market. For instance, beginning in 2012, the Brazilian government and other important actors developed various key green finance initiatives, including Brazil's Green Bond Guidelines in 2016, increased visibility for green bonds through a separate listing by Brazil's largest stock exchange and a proposed fast track for sustainable infrastructure debentures. Infrastructure debentures, a form of debt, are highly utilised in Brazil. The government also promoted income-tax free debentures for individual investors, making this instrument very attractive for retail investors. The Action Plan for the Brazilian Sustainable Taxonomy was launched in December 2023 at COP 28, and a first version of the final taxonomy will be presented for consultation at COP 29 in 2024. By the end of 2023, almost USD 37 billion of green debt had been issued in Brazil.

NDBs have also played an important role in refinancing and supporting new structures to expand the sources of funding for banks outside deposits, such as the structuring of innovative financing vehicles or funds for green projects. One such case is Brazil's Green Receivables Fund (Green FIDC), a form of green securitisation. These instruments allow companies to raise capital by securitising receivables through asset-backed securities, combined with a green certification framework. The instrument starts by providing bridge finance during the construction and development stage through the Green FIDC, and once the project is operational (and risks reduced), it is refinanced in the capital market through shares of the FIDC. As projects become more mature, the public capital is paid back and used again.

DFIs can also play a role in securitising assets. For instance, the International Finance Corporation (IFC), the private arm of the World Bank Group, is working on securitising its own assets via a new warehouse-enabled securitisation platform. The platform aims to mobilise more private capital in Paris-aligned loans and start an originate-to-distribute model, bringing in assets from other MDBs and DFIs.

India's green debt market is also very strong, one of the largest among developing countries, with almost USD 50 billion issued by the end of 2023. At the same time, Indian companies have moved towards tapping more into capital markets to find alternative sources of finance. For example, ACME Solar – which currently operates around 1.3 GW of solar capacity – filed a USD 350 million initial public offering (IPO) in mid-2024 to finance its expansion. The company is planning to build an additional 1.5 GW in solar and 150 MW of wind over the coming years. Half of the proceeds of the IPO will be used to repay its debt and the rest for general corporate purposes. This offering will bring in both institutional and individual investors. Most of the net offer (75%) will be available to institutional investors, 15% to non-institutional ones and 10% to retail investors. This shows that good incentives can help expand the supply of finance from both domestic and international sources.

Another example of an innovative structure to bring in private capital to clean assets is the partnership between BlackRock, one of the world's largest asset managers, and ALTÉRRA, one of the world's largest private investment vehicles for climate change. At the end of 2023,

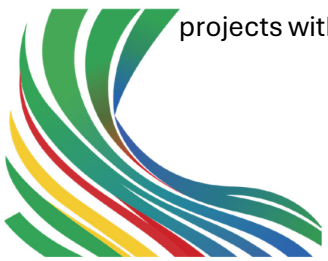
BlackRock and ALTÉRRA announced a partnership to invest USD 2 billion in the energy transition through BlackRock's private debt and equity strategies to allocate capital to infrastructure assets, the BlackRock Climate Transition Vehicle. The vehicle will be capitalised with investments from two ALTÉRRA funds, Acceleration and Transformation, half of which will focus on private debt in the low-carbon transition and half on transition-related equity infrastructure. A considerable portion, USD 350 million, is committed for infrastructure in the Global South, of which ALTÉRRA Acceleration committed to co-invest USD 100 million in BlackRock's Climate Finance Partnership, a public-private finance vehicle to invest in climate-related infrastructure in developing economies. The Climate Finance Partnership's blended finance structure uses catalytic capital to bring in other sources of capital to the energy transition in developing economies. ALTÉRRA Transformation has also committed USD 250 million in catalytic capital to a forthcoming BlackRock managed strategy. The BlackRock Climate Transition Vehicle, backed by ALTÉRRA, will leverage BlackRock's experience of investing in climate-related projects across the world, including in Africa, Latin America and Asia, to target similar opportunities in a more systematic and accelerated manner.

Brazil and India's solar and wind sectors show a relatively similar trajectory: the starting point is a strong banking sector (loans; generally first with lots of DFI/concessional support, with an emphasis on NDBs or similar institutions) and eventually a larger role for capital markets. As these sectors continue to evolve, and given that current investment levels still fall short of future investment needs despite their relative successes, the challenge is to continue expanding the domestic alternatives while also attracting more international capital.

Recommendations to mobilise larger shares of capital to privately led investments

Implement instruments and structures to attract new sources of finance, from institutional investors to domestic retail investors. Countries that already have a good presence of commercial banks and experience with capital markets could promote or continue expanding ways to diversify their sources of finance through different mechanisms. For example, fiscal incentives for investors of green debt (like bonds that are free of income tax or similar alternatives) are instruments that have been tested and are being used in other countries to attract, in particular, domestic retail investors. These allow individual investors to contribute to the energy transition, provide an alternative source of investment to households and small businesses, and new financing alternatives for developers and asset owners. Shares in IPOs can also include similar characteristics.

Other instruments aim to attract capital from institutional investors. A larger presence of these investors, such as sovereign wealth funds, pension funds and insurance companies, increases market liquidity and frees up capital from primary lenders (mainly banks). They can also help to increase domestic currency financing by providing both equity and debt to projects with long lifetimes and large tickets like green infrastructure projects. One alternative



to mobilise capital from institutional investors is by **securitisation models** that bundle assets, especially illiquid ones like infrastructure projects, and create new instruments backed by their cash flows. Another is to establish a **first-loss equity fund**, or a similar facility like the BlackRock Climate Transition Vehicle, backed by large amounts of public funds, including blended finance structures, to invest in climate-related projects in developing economies through large private investors that can, at the same time, tap into a larger pool of investors through the capital market or private investments. This will likely require strong support from international finance institutions, especially DFIs.

Expand project finance for low-carbon power projects. Countries that are overall relatively low-risk jurisdictions but not as experienced as Brazil or India could benefit from expanding project finance for less risky projects like utility-scale solar and onshore wind to maximise the leverage of existing equity.

Facilitated interventions

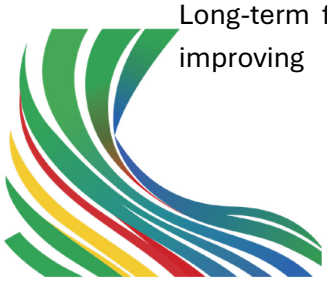
Investments grouped as "facilitated interventions" accounted for about half of the clean energy investments in developing economies in 2023. In terms of sectors, these were concentrated mainly in grids and storage and renewable power and, to a lesser extent, in end-use sectors. Geographically, these were concentrated in India, Southeast Asia, Latin America and Eurasia. This grouping is the largest and most diverse of the three, so we discuss some of the key sectors in detail.

Transmission and distribution grids

Investment in transmission and distribution grids in most developing economies is included in this grouping. However, there are some exceptions, mainly in Latin America, where there are considerable privately led investments, and the LDCs, where grid investments are mainly publicly driven. An IFC survey found that of 47 low-income to upper-middle income countries, 38% financed domestic energy projects through capital markets (bonds and institutional investors), 26% through commercial financing and 36% through public financing.

Today, grids are primarily financed through state-owned utilities' balance sheets, which involve commercial rate and concessional debt from DFIs and export credit agencies. As grid investments are generally not structured on a project finance basis, the financing capacity and cost of funding are directly linked to the financial health and liquidity of the SOE rather than the grid project itself. Investment costs are typically recouped through regulated tariffs. In particular, the design of tariffs also emerges as a significant factor in the financial well-being of SOEs and is crucial to scale up grid investments in developing countries from both public and private funding (and is crucial to expanding access to electricity, which is covered below for both facilitated interventions and public projects).

Long-term financial sustainability depends on broader structural reforms. These include improving corporate governance, ensuring transparent and predictable regulatory



environments, and aligning utility operations with national energy transition goals. While market structures vary – ranging from vertically integrated utilities to those with unbundled generation and distribution – what matters most is creating a supportive environment that enables utilities to operate efficiently and recover their costs. For example, utilities in countries with well-designed regulatory frameworks and tariff mechanisms have shown better financial performance and are more resilient to the demands of the energy transition. Apart from direct lending, DFIs have also been critical in providing technical assistance and financing to support SOE reform.

Kick-starting privately financed business models can also help mobilise more capital to grids and alleviate the financial burden of the public sector. This is in fact the path taken by various developing countries that have upgraded from "facilitated" to "privately led" grids, introducing, both in distribution (mainly through concessions) and transmission (through concessions or project finance models). In concessions, the concessionaire bears the responsibility for financing and operating the grid infrastructure for a certain period in a geographical zone and bears the regulatory and demand risk. In a project finance model, the investor bears the responsibility for financing and operating one transmission line or a package of lines. This latter case is known as independent power transmission (IPT), a new asset class like the IPP model in generation. In IPTs, revenues are mostly determined upfront in the winning bid and are not adjusted over time. The IPT is modular and a business model that can be tested while most of the grid continues to be operated and financed by the SOE. This model is used mainly in South American countries – notably Brazil, Chile, Colombia and Peru – and in India (for intra-state lines).

Private sector participation in grids in Africa has been very low, along with most developing economies. Over the years, there have been a few countries tendering out concessions for distribution, transmission or both, though these have been mostly exceptional, and in most cases, they have not worked well. However, the IPT model is starting to be introduced. Kenya is pioneering two IPTs for around 230 km, with construction starting soon. Gridworks, a subsidiary of the UK DFI British International Investment, is a platform for development and investment in Africa's transmission and distribution grids that is also moving forward with the IPT model and has a pipeline of projects in the continent. They are also mandated to invest through other models, such as concessions, in both on- and off-grid solutions.

One challenge for grid developers like Gridworks is that there is very little appetite for development equity to get grid projects off the ground. These projects have long lead times compared to solar farms, or even onshore wind, so patient capital during the construction and development phase is key to unlocking more investment in grids, especially projects with private sector participation. Poor network development planning and complex permitting requirements for new transmission or distribution projects can also be major obstacles.

Access

About 760 million people globally, primarily in sub-Saharan Africa, still lack access to electricity. The issue is particularly acute in countries like the Democratic Republic of the Congo, Ethiopia and Nigeria. This widespread lack of access to modern energy services significantly hampers economic development, health and overall quality of life. Moreover, the situation is further compounded by the fact that over 900 million people in the region still rely on traditional biomass for cooking, with severe health and environmental consequences. Despite the critical need, access to clean cooking remains severely underfunded by both public and private sources. To meet the ambitious goal of universal energy access by 2030, annual investments in electricity need to increase by a factor of seven and reach USD 55 billion per year, while investments in clean cooking solutions require a twenty-four-fold increase, amounting to an additional USD 10 billion annually of public and private finance. However, current investment levels fall significantly short, jeopardising the attainment of universal access to both electricity and clean cooking by the end of the decade.

Given the substantial investment gaps and the high-risk nature of many energy access projects, facilitated interventions are essential to bridging the divide between limited public funding and the private sector's cautious approach to high-risk investments. Facilitated interventions, such as blended finance (a combination of concessional funds from donors and commercial funds from private investors and development finance institutions), public-private partnerships (PPPs) and concessional financing, can play a crucial role in mobilising the necessary capital. These mechanisms help mitigate risks, making it more attractive for private investors to engage in projects that would otherwise be deemed too risky or unprofitable. By strategically leveraging these financial tools, it is possible to unlock significant private sector investment and ensure that critical energy access initiatives, including those for clean cooking, receive the funding they need to succeed.

Energy access can be improved by deploying a range of technologies tailored to specific national needs. These technologies are suited to different contexts and come with varying investment requirements.

Table 1: Suitability and investment requirements by energy access alternatives

Technology	Suitability	Required investment
Grid expansion	Urban and peri-urban areas where population density supports large-scale infrastructure	Requires significant capital investment and long-term planning, often supported by large-scale public or blended finance; investments recouped via regulated tariffs
Mini-grids	Rural or remote communities where grid extension is not feasible or cost-effective	Financing options include PPPs, concessional loans and tariff structures to make energy affordable

Technology	Suitability	Required investment
Stand-alone systems	Remote and underserved populations with no grid access	Can be financed through micro-financing schemes, pay-as-you-go models and grants, making systems affordable
Clean cooking solutions	Rural and urban low-income households relying on the traditional use of solid biomass, kerosene, or coal as their primary cooking fuel	Investment in infrastructure, end-use equipment and distribution networks; often requires concessional funding and subsidies to make technologies like liquefied petroleum gas stoves, renewable-based clean cooking solutions or improved biomass stoves accessible

Energy access can also be financed through different business models, financial mechanisms and sources of finance. For instance, PPPs have proven crucial in mobilising private sector investment in energy infrastructure projects, particularly where government resources alone are insufficient. In Kenya, the Off-Grid Solar Access Project has utilised PPPs to develop mini-grids in remote areas, bringing electricity to communities that were previously underserved. Such partnerships help to share the financial burden and risks between the public and private sectors, incentivising more efficient and sustainable project delivery through the inclusion of key performance indicators in PPPs.

Guarantees and risk mitigation instruments are also important to enhance the bankability of energy access projects. For instance, Nigeria's Electrification Project employed partial risk guarantees to backstop off-grid solar projects, providing investors with the confidence needed to fund projects in a politically and economically uncertain environments. Similarly, InfraCredit has played a key role in mobilising NGN 159 billion (Nigerian naira) (USD 206 million) for infrastructure projects by providing local currency guarantees, which have attracted significant investments from domestic pension funds.

In terms of sources of finance, blended finance and grants or results-based financing have also been important to mobilise capital for energy access. Blended finance has been effectively used in several countries to attract investment into energy access projects by combining concessional finance from public or philanthropic sources with commercial finance. The Renewable Energy Fund in Rwanda, supported by the World Bank, leverages blended finance with partial grants to off-grid solar companies. The partial grants are disbursed to the companies through results-based financing when they distribute their solar home systems to the poorest market segments, enabling broader access to clean energy in rural areas. This approach reduces investment risks and makes projects more attractive to private investors. Results-based financing is another effective mechanism that ties funding to the achievement of specific outcomes, thereby incentivising efficiency and impact. The Global LEAP results-based financing pilot in Kenya for clean cooking technologies is a prime

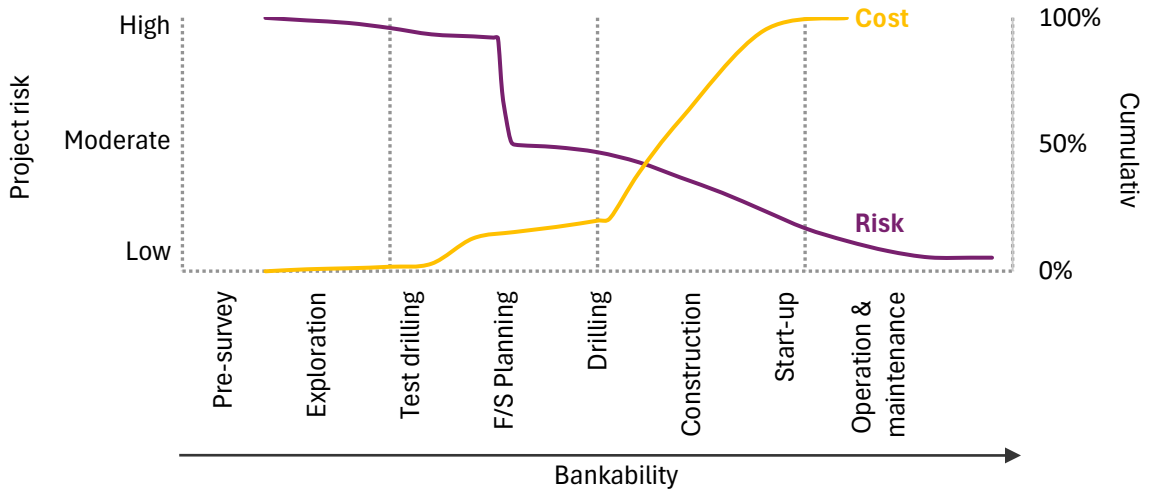
example. This initiative provided incentives based on the achievement of specific milestones, such as product procurement, shipment, and sales, thereby encouraging companies to scale up their operations and reach more consumers.

Low-carbon power generation

Large-scale dispatchable power

State-backed financing and ownership play an important role in large-scale dispatchable renewables, such as hydropower and geothermal. A similar case is true of nuclear power, a dispatchable, low-emissions source of electricity. The nature of these technologies demand the management of sensitive natural resources and land, which have large social implications and generally involve high-risk perceptions among investors and financiers. For instance, hydropower projects are assets with lengthy construction periods and lifetimes of up to 100 years. These projects tend to rely, at least to some extent, on public finance and not exclusively commercial capital, even in advanced economies.

Figure 15: Project cost and risk profile for geothermal projects



Note: F/S = Feasibility study.
Source: IEA (2021), Financing Clean Energy Transitions in Emerging and Developing Economies.

Hydropower and geothermal projects are generally financed under long-term PPAs, as with utility-scale solar PV and wind. However, they face other specific risks, like challenges around the projects' environmental and social impacts. This is why the permitting and environmental licensing process can take long, sometimes leading to cost overruns and delays. Geothermal, for example, is a very important existing and potential resource in many developing countries, such as Indonesia and the Philippines in Southeast Asia or Ethiopia and Kenya in Africa. However, covering the early-stage project risks is key to getting private investors interested, and commercial lending is generally absent at this stage, especially in countries with a poor

track record. The output and returns of a geothermal project are generally defined only after an important capital expense in exploration and drilling, leading to developers requiring very high returns (20-30%).

Various developing countries have managed to mobilise private capital for long-lead, dispatchable projects like geothermal, mostly with the help of risk-sharing financial mechanisms and the technical and financial support of DFIs. Indonesia, for example, aims to develop up to 24 GW of geothermal by 2030, from an installed capacity of 2.6 GW today. The government is implementing various initiatives and policies, including financing drilling or assigning the survey and drilling exploration to a private company in return for becoming a preferred bidder once the steam resources are confirmed. In 2024 the government auctioned out, and announced winners, for four geothermal working areas and three preliminary survey and exploration areas, with a potential development capacity of 320 MW and financing of over USD 1.5 billion. Some of these companies already engage with PT SMI (a state-owned entity under the Ministry of Finance that finances infrastructure projects) to support some of the project exploration and power plant development. African governments and European donors have also came together in East Africa to create risk mitigation facilities which co-finance up to 80% of surface studies and up to 40% of drilling programmes.

Box 4: Financing nuclear in emerging markets – unlocking potential

Nuclear energy offers a clean, reliable option for baseload electricity and heat for the developing economies that choose to pursue it. To reach a net zero energy system, the International Atomic Energy Agency estimates that developing economies require on average more than USD 50 billion in annual nuclear energy investment by 2050 (more than double the annual average from 2017 to 2023). However, many developing economies face significant barriers in financing nuclear energy, including limited domestic savings, public budget constraints, high financing costs and the need for nuclear infrastructure and robust regulatory frameworks.

Addressing these challenges presents opportunities for policy reforms and international partnerships to bridge the financing gap and accelerate the clean energy transition; all of which are discussed in depth in the International Atomic Energy Agency's 2024 edition of *Climate Change and Nuclear Power: Financing Nuclear Energy in Low Carbon Transitions*. For example, concessional financing and guarantees from major financial institutions like MDBs or export credit agencies have significant potential to accelerate the implementation and mitigate the financial risks of nuclear energy projects in developing economies.

Emerging technologies, such as small modular reactors, may also be particularly well suited to developing economies, helping to overcome financing barriers. Beyond

providing flexible, scalable and dispatchable low-carbon energy, small modular reactors are suitable for remote locations, smaller grids and non-electrical applications like desalination and industrial processes. Their scalable nature and reduced initial capital requirements make them attractive to investors, potentially accelerating the transition to a low-carbon future in developing economies.

Key considerations for new nuclear energy projects in developing economies:

- Capital intensity: Nuclear projects require substantial upfront investment and have long lead times before revenue generation, posing a significant financial burden for developing economies, including the risk of creating new dependencies. Effective project and risk management are also key in managing project costs and delivery.
- Regulatory frameworks: Robust legal and regulatory frameworks are essential to ensure safety and public trust. National legislation must cover all aspects of the nuclear programme and adhere to international standards to guarantee quality in construction and safe operations.
- Human resource development: Developing and maintaining a skilled workforce is crucial. Developing economies need to invest in education and training to build national capabilities in nuclear technology and safety.
- Stakeholder engagement: Transparent communication and education activities are vital for building public trust and understanding. Engaging with stakeholders, including the public, is key to the successful implementation of nuclear projects.

By addressing these challenges and leveraging international co-operation, developing economies can unlock the potential of nuclear power to meet their energy needs. The IEA is currently undertaking a new study on policy solutions to finance nuclear expansion for release in early 2025.

Utility-scale solar and wind

Countries with relatively low credit risk that have managed to mobilise capital for utility-scale solar and wind have done so by combining financial and non-financial instruments. Among the financial instruments, two have been critical: low-cost debt and payment guarantees or other credit enhancement arrangements to cover payment risk, especially for the first projects.

Senegal, for example, has mobilised over USD 1 billion to IPP projects over the last decade for almost 700 MW to more than ten IPPs. Of this, 160 MW corresponded to wind and 150 MW to solar PV, reaching financial close between 2014 and 2022. In 2022, renewables represented 30% of the share of overall installed capacity in Senegal. Wind and solar power have been

growing since 2017 and reached a share of 23% in electricity generation in 2021, thanks to rising investment. Most of the capital provided for these projects came from international institutions, and over 60% was from DFIs in the form of debt, much with very attractive terms. The first solar projects reached financial close in 2016, and later the country also became part of the IFC-sponsored Scaling Solar programme, which provides an all-in package of technical assistance, support with standardised power purchase agreements, pre-approved financing and blended finance instruments like guarantees or insurance. The financing package of the two solar projects awarded under Scaling Solar included EUR 38 million in low-cost debt in the local currency and a EUR 6.9 million 15-year guarantee for non-commercial risks.

Utility-scale solar PV in Cambodia also provides a good example of how a regional MDB helped kick-start the sector, leading to record-setting low generation prices. The Government of Cambodia, the Asian Development Bank (ADB) and the Climate Investment Fund designed a national solar park programme to attract capital to the first solar projects of this kind in the country. Through competitive auctions, the programme's first phase managed to secure a 60 MW project that reached a price of USD 39/MWh, a record tariff in Southeast Asia. In the second phase, for a total of 40 MW, tariffs reached an even lower price of USD 26/MWh. ADB's support included transaction advisory as well as concessional and grant funding for these first projects. This experience also created positive spillovers, with ADB establishing a regional programme, the ASEAN Scaling up Renewables Plus Storage Initiative, to deploy renewables and storage by supporting project development and private sector participation.

When looking also at how India and Brazil upgraded from facilitated interventions to the case where the solar and wind sector is currently privately led, as discussed above, concessional debt was key to getting the sector moving and catalysing private capital. Onshore wind and solar investment accelerated through a combination of competitive auctions, with long-term PPAs denominated in local currency and concessional loans with tenors of up to 20 years for projects meeting local-content and environmental requirements, as in the case of Brazil. In South Africa, the Development Bank of Southern Africa played a similar role under the Renewable Energy Independent Power Producer Procurement Programme.

Countries with very low sovereign risk credibility also relied substantially on guarantees to reduce the cost of capital and reach financial close. For instance, in 2017, the Argentinian government launched the RenovAR auction programme with the objective of augmenting renewables from about 2% in 2015 to 8% of the generation mix in 2017 and 20% in 2025. The Development of Renewable Energy Fund (FODER in Spanish) provided financing and a guarantee that covered risks of delayed or non-payment by the utility, and termination risk. This was key to reducing investors' worries over Argentina's high political risk and lack of experience developing solar and wind assets. Thus, the World Bank offered an additional guarantee to backstop the fund in case of shortfalls, an option that was used by around 60 projects and about 1 GW, half the total capacity, awarded in the first two rounds of the programme. Argentina managed to mobilise over USD 3 billion in investment, almost 80% from commercial sources, through this novel, programmatic approach.

Box 5: Lessons learned from IRENA's project facilitation platforms

IRENA's Energy Transition Accelerator Financing Platform (ETAF) and Climate Investment Platform (CIP) are dedicated to building a robust pipeline of renewable energy projects by offering thorough project reviews, providing technical assistance and connecting projects with financiers. These activities help developers secure financing efficiently and enable investors to build stronger portfolios.

ETAF: A multi-stakeholder platform that has mobilised USD 4 billion from 14 partners and supported 897 MW of projects in Uzbekistan, with 15 more projects in financing talks.

CIP: A joint initiative by the United Nations Development Programme, Sustainable Energy for All, and the Green Climate Fund addressing the financing gap for small- to medium-sized renewable projects. The CIP has closed 64.8 MW worth USD 85 million, positively impacting 4 million lives.

Financial tools and support:

ETAF: Uses concessional lending, equity and guarantees to reduce capital costs.

CIP: Conducts project reviews, ensures feasibility and provides assistance for development.

Challenges:

ETAF: The platform faces challenges such as high risks associated with new technologies, difficulties in securing sovereign guarantees, and political and economic instability. To address these issues, ETAF emphasises the early identification of project risks and leverages a diverse range of financial products to manage and mitigate these risks effectively.

CIP: The platform encounters funding challenges for small-scale projects (1 MW to 5 MW) due to low investor interest and high transaction costs. In response, the platform promotes bundling strategies to make these smaller projects more attractive to investors by increasing their scale and impact.

Lessons learned:

Risk preferences: ETAF can guide higher-risk projects to meet financier standards.

Impact demonstration: Crucial for attracting philanthropic and grant funding, especially for small-scale projects.

Partnerships: Expanding to include government bodies boosts investor confidence.

Capacity building: Broaden technical assistance to cover the entire project development process.

Alignment: Explore innovative financing to match project needs with partner offerings.

Energy efficiency and electrification in buildings

Investment in buildings is quite low around the world, accounting for 12% of total global energy investment in 2023, but is expected to grow to 17% in 2035 under a climate-driven scenario. However, the majority of this (about 67%) is concentrated in advanced economies and China. These investments are heavily facilitated by regulations and incentives and require support from development and concessional finance for technical assistance (to develop business models, train the banking sector or create innovative finance mechanisms), on-lending (either to commercial banks in developing countries or to domestic DFIs), as well as improved regulation.

Investment in buildings – construction, retrofits and appliances – is typically carried out by either companies, on balance sheet (using mainly equity), or by households with their own savings. These investments are comprised of two clusters: the initial envelope investment (the construction cost of a new building) and the retrofit of existing buildings. The split between these two varies by country, depending on the state of development of the housing sector, urbanisation and industrialisation. The envelope investment accounts for a larger share of the overall spending in buildings.

The adoption and implementation of obligatory, strict building codes are key to accelerating investments in green buildings. Despite a growing number of stronger building energy codes being put into action, there are still regions where big wins can be made by putting regulations into place. For example, in many countries in Africa, South America and Asia, building energy codes are yet to be developed, remain voluntary or are limited in scope and stringency. Few countries in South America have adopted mandatory building energy codes, and the majority are either in development or mandatory performance standards are generally not available. In Southeast Asia, several countries, including Malaysia and Singapore, have had building codes and standards for many years, and many others are in the process of developing them. Africa is set to embark on one of the biggest expansions of building floor area in the world, driven by growing populations and increasing incomes, with the residential building stock projected to double to almost 50 billion square metres by 2050. However, most countries in Africa do not have building codes, with only a few in development and a handful of mandatory codes.

Developing economies that have piloted innovative investment structures for energy efficiency in buildings have done so by using low-cost debt from DFIs, both domestic and international. On-bill financing schemes with utilities have also been successful in mobilising capital for efficiency in buildings, though these are less common in developing economies, where it is harder for state-owned utilities to take on this role.

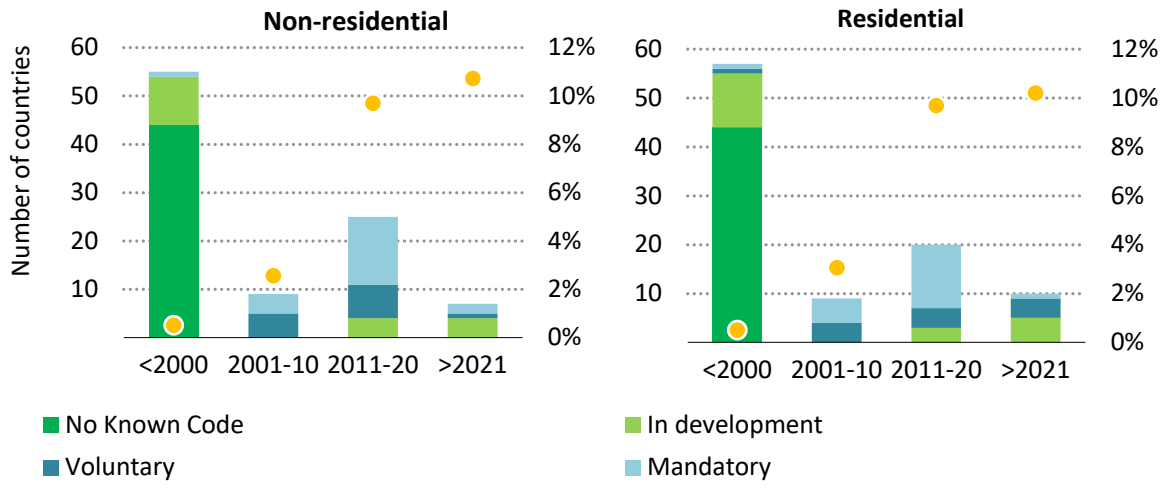
Financial institutions are a key actor. In some countries, banks have been established with the specific objective of investing in green infrastructure, including the building sector, offering green mortgages with concessional characteristics or first-loss guarantees. For example, the Government of Mongolia, with support from the Green Climate Fund, created

the Mongolia Green Finance Corporation to expand financing for building insulation, energy efficiency for businesses and mortgages for green affordable housing.

Green building certification schemes can also be harnessed to facilitate the refinancing of green construction projects. For instance, in 2017, two banks in Colombia issued USD 260 million in green bonds focused on financing certified green housing developments and two environmentally friendly office buildings. This initiative showcased the feasibility of securitising investments in green buildings, effectively marketing them to private investors.

Despite some good examples and experiences, the financial alternatives are not yet available in all developing countries, and even where they do exist, they are generally still nascent. Sharing best practices among countries will be important, especially among the financial sector, to promote the diversity of local and easily available financing options. Apart from financing, improved regulatory frameworks will continue to be a key factor in promoting investment in buildings.

Figure 16: Building energy codes in developing countries



IEA. CC BY 4.0.

Source: IEA (2024), Reducing the Cost of Capital.

Decarbonisation of transport

Electric mobility, as well as the adoption of sustainable biofuels, is a critical way to reduce emissions associated with the transport sector, both for personal mobility as well as mass transit. It is also key to improving air quality and reducing associated health risks.

Sales of EVs have increased in developing economies over the last years, though they are still low compared to what would be needed in a climate-driven scenario and low compared to advanced economies. Large upfront costs are a big reason for this.

The affordability and feasibility of a considerable scale-up in electric mobility depends largely on:

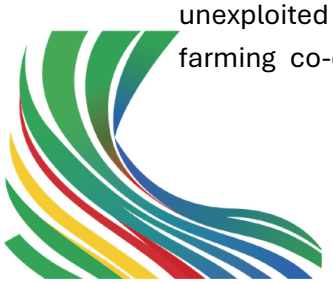
- How EV prices compare to internal combustion engine cars (upfront costs) and the subsidies on gasoline and diesel (fuels costs over the lifetime of the vehicle).
- The availability of debt financing options to help fund upfront expenses.
- The fiscal incentives to promote the adoption of e-mobility alternatives.

Where e-mobility has expanded more rapidly, access to different financial alternatives and service models have been important. On the personal mobility side, tailored financing instruments like leasing or auto loans are typically less common in developing economies compared to advanced ones. Households in advanced economies generally finance the majority of the car price through debt. Financing terms to be less favourable in developing economies, where households have lower saving rates and face higher financing costs.

Financial institutions in India and the United Arab Emirates have launched dedicated green auto loan programmes, offering low-cost loans for vehicles with certain criteria. For instance, the State Bank of India offers loans at reduced costs (of 20 basis points compared to conventional loans) for EVs, while the United Arab Emirates' NDB offers a similar discount for loans to buy qualified hybrid vehicles and EVs as part of its Vision 2021 plan. In addition, these institutions plan to finance 10 000 EV charging stations by 2030 and to more than double their sustainable finance portfolios, which include clean mobility-related products, by 2025.

Concessional support has also proven very important to accelerate the electrification of mass transit public transportation. In India, for instance, DFIs have supported the government in the procurement of e-buses and the associated charging infrastructure. In Latin America, Chile and Colombia have had similar experiences. In Chile, a group of co-lenders – IDB Invest (the private arm of the IDB Group), the IFC, and Banco del Estado de Chile (one of Chile's state-owned banks) – will provide long-term financing of up to USD 344 million over 14 years to a special-purpose vehicle responsible for supplying almost 1 000 electric buses. The project also incorporates a new business model, separating fleet ownership from the operation, where Chile's Ministry of Transport and Telecommunications will operate the e-buses under a 14-year bus supply leasing contract. Chile's e-bus fleet is set to become the second-largest in the world, after China.

Liquid biofuels can also play an important role in decarbonising transport. They are especially useful in sectors like aviation or long-distance freight where other options, such as electrification, are not suitable, and they can sometimes be used with existing engines with little to no modification. Investment in liquid biofuels reached USD 8 billion in 2023, excluding feedstocks, with around half being in developing economies other than China. Much of the investment has been concentrated in Argentina, Brazil and Indonesia, but there is still large unexploited potential in these and other developing countries. Project developers range from farming co-operatives to large international companies, some of which do "pure play"



businesses (those focused on a specific activity), while others include this business segment as part of a larger portfolio. One of the main risks identified by investors is the technology risk and the fact that in many jurisdictions, the sector is still nascent, and it is not always easy to secure long-term off-take agreements, which in turns means project finance is typically out of reach. Feedstock availability is also a concern for many financiers. Countries that have successfully started to develop this sector offer financial mechanisms – like grants, loan guarantees or tax incentives that improve cash flows – to manage such risks, though clear, predictable policies are also a key long-term signal for investors. RenovaBio, a framework introduced by Brazil to encourage the development of biofuels, is a good example of this, as it ties the reward of tradeable decarbonisation credits to certified life-cycle assessments.

Emerging technologies

Emerging technologies comprise projects with technologies that still need to mature or that are in sectors without viable business models, both in advanced and developing economies. These technologies include hydrogen, hydrogen-based fuels, advanced biofuels and CCUS. Unlike other sectors, such as solar PV, that have been largely financed through long-term contracts and project finance, or grids, where investment costs are generally recouped through regulated tariffs and passed on to consumers, financing models for emerging technologies have not yet been fully tested. Banks have less experience of analysing the risks of such projects, and equity investors also tend to be more reluctant to invest capital as there is still a limited track record, even in countries with relatively good credit ratings. Investors also worry about high production costs (e.g. the high capital costs of electrolysers in the case of hydrogen), uncertainty about future demand and the limited specialised workforce.

Emerging technologies included in "facilitated interventions" are projects in relatively low-risk countries within developing economies, like first-of-a-kind hydrogen projects in Chile. Chile's sovereign credit rating is categorised as investment grade with a considerable track record of private sector participation in the economy, as well as substantial experience in attracting international capital in the form of foreign direct investment. In the power space, for example, various companies from across the globe own, operate and finance Chile's generation, transmission and distribution assets.

Chile has also been a first mover in the low-emissions fuels space, and the country's latest Energy Agenda places green hydrogen as an opportunity to transition away from fossil fuels (hydrocarbons still accounted for about two-thirds of the total primary energy supply and three-quarters of the country's total GHG emissions in 2022. In 2020, Chile launched its National Green Hydrogen Strategy in the aim of becoming a global leader in green hydrogen production and taking advantage of the country's low-cost renewable energy potential. The main objectives of the strategy include (i) an electrolysis capacity of 5 GW under construction by 2025, (ii) being the lowest-cost producer of hydrogen in the world by 2030, and (iii) being a top-three hydrogen exporter by 2040. The country is also updating and improving its regulatory framework to ensure a good enabling environment for investment.

Given that the hydrogen ecosystem is still at a nascent stage across the world, Chile worked together with several DFIs to design the Green Hydrogen Facility to crowd in private capital for green hydrogen projects in Chile by helping to mitigate risks and reduce project costs. For instance, the World Bank is providing a loan of USD 150 million to Chile to finance green hydrogen production (including electrolysis systems, compression and storage), implement risk-sharing mechanisms to boost market confidence in the technology and debt payments to private lenders and financiers, and capacity building to help with the overall implementation. Other DFIs are also providing loans, guarantees and other financial instruments to projects. The government is providing strong public support to kick-start the sector while using innovative ways to tap into climate-related funds and partner with DFIs to increase domestic technical capacity. It is not planning to be the main investor in green hydrogen projects but instead use the limited public funds to catalyse money from the private sector. The prospects for these projects depend on how quickly demand for low-emissions hydrogen evolves around the world.

Singapore also provides another example where the government is bringing together public, private and philanthropic partners to finance the energy transition. The Financing Asia's Transition Partnership (FAST-P) is a Singapore blended finance initiative that aims to mobilise up to USD 5 billion to de-risk and finance transition and marginally bankable green projects in Asia. The focus areas of FAST-P will include (i) energy transition projects, such as the early phase-out of coal assets to be replaced with renewable energy, and decarbonisation projects in hard-to-abate sectors, and (ii) marginally bankable green projects, such as renewable energy and storage development, EV infrastructure, sustainable transport and water and waste management.

Recommendations to mobilise larger shares of capital to facilitated interventions

This grouping comprises the largest amount of investment as well as the most diversified portfolio in terms of sectors. For this reason, the recommendations are tailored to the specific sectors.

Transmission and distribution grids

Expand the use of concessional debt to scale up grid investments and improve SOEs' financial health. DFI financing is key to accelerating the expansion of long-term infrastructure, notably to transmission and distribution. **DFI direct lending to grids** has been an important source of capital for utilities, especially as these domestic utilities tend to have limited, if not no, retained earnings, their balance sheets (and those of the governments backing them) are weak and capital markets are generally not an option. DFIs can also help create innovative financial approaches to attract more commercial resources for grid investments and design **targeted funding tied to specific and measurable results**, encouraging improvements in SOEs' performance and sector planning.

Kick-start business models for private sector participation in transmission. Complete restructuring or privatisations are not politically feasible or desired in many developing economies. Yet, increasing private sector participation in grids can expand the current sources of capital and alleviate the financial burden on the public sector. **Business models such as IPTs** can facilitate investments in grid infrastructure, offering investors a public-private alternative that is financed through project finance and that has been tested successfully in many developing economies.

Access

Increase the provision of concessional finance, mainly from DFIs, for clean cooking programmes to facilitate clean cookstove market expansion to reach the remaining 2.1 billion people that still need to gain access from now to 2030. Many energy access projects are undertaken by local SMEs, which generally have a hard time accessing affordable capital. Grants or other highly concessional funding will need to play a substantial role given this financial challenge. For instance, to achieve universal access to clean cooking, about USD 5 billion per year is needed in concessional funding (most needed in sub-Saharan Africa and other Asia) to facilitate another USD 5 billion per year in private finance.

Strengthen the existing dedicated facilities that finance off-grid projects, with a focus on expanding the provision of equity capital. Obtaining debt to finance off-grid projects in developing economies, especially the LDCs, is often hard, but equity is even harder. For electricity, this means there is no growth equity for mini-grids and not much start-up equity for smaller companies, especially in sub-Saharan Africa, other Asia and the Pacific Island States. Finding ways to strengthen the existing channels (facilities or special funds) or create new ones could be a game-changer.

Low-carbon power

Increase the availability of risk-sharing mechanisms to address early-stage and technology-specific risks. Some renewable technologies, such as dispatchable technologies like hydropower and geothermal, have long lead times and face very specific risks during the stages of development and construction. Some developing economies have large geothermal and hydropower potential, and these technologies could be a big part of their decarbonisation pathways. However, exploration risk is a big impediment to the development of geothermal in many of these geographies, as are the environmental or social issues regarding hydropower projects. Risk-sharing mechanisms have proven important in attracting more investment to these sectors, especially from the private sector, and expanding these solutions would help accelerate capital mobilisation. These mechanisms include funding to cover drilling costs (e.g. investors can recoup a large portion of their expenses if wells are unsuccessful), financial support for pre-feasibility and feasibility studies, as well as concessional debt to finance expenses until financial close. These models have been tested across various developing countries, mostly with the support of DFIs and NDBs.

Support the development of project finance models for less risky technologies to leverage as much of the existing equity as possible. Concessional finance focused on project de-risking has helped mitigate some perceived risks in new markets and attract lower-cost private capital to projects in technologies that are relatively mature in commercial terms, and with less technology-specific risks, like solar PV and wind. Extending debt alternatives to such projects that are majorly financed through project finance models is also a way of making as much use as possible of the existing – and generally limited – equity that can be attracted to infrastructure projects in developing economies. DFIs have considerable experience in helping governments kick-start solar and wind, and it is important that this continues to be replicated and accelerated in new markets, ensuring also that there is an exit strategy for when markets mature and concessional finance is no longer needed.

Expand payment-related guarantees, especially to get the first batch of projects off the ground or in relatively low credit risk countries. Payment-related risks were identified by investors and financiers as among the top three sector-specific risks in power projects in developing economies (together with regulatory and transmission risks). Increasing the availability of guarantees that cover payment delays or payment defaults (e.g. covering the non-honouring of financial commitments by SOEs) would help reduce risk perceptions and financing costs. One way of doing so, with the support of DFIs, would be to review the reach and ambition of the existing multilateral institutions that currently provide these instruments, as has been highlighted by the Sustainable Finance Working Group and several independent studies.

Energy efficiency in buildings

Allocate greater funds to on-lending programmes to promote local and easily available financing options. Reliance on public, highly concessional financing will be high, especially in countries where energy efficiency in buildings is an emerging sector and where little to no return is expected, which is the majority of developing economies. Transactions will typically be conducted by very specialised companies, such as energy services companies, often tied to public utilities. With a bigger market and appropriate enabling mechanisms in utility regulation, public companies can start using on-bill financing mechanisms with the support of credit lines from DFIs. The signalling impact of procuring energy-efficient public buildings also serves as a pioneering influence.

Energy efficiency in transport

Expand consumer access to low-cost auto loans and leasing models. EV prices have reduced considerably over the last years, driven by strong reductions in battery costs. However, purchasing an EV is still a significant effort for consumers in developing economies, where much of the car market is based on second-hand cars, and EVs represent a very small to inexistent share. Thus, lowering financing costs is key to motivate the uptake of EV purchases, with standardised low-cost financing or mainstreaming of the use of leasing programmes where consumers only pay a small fee per period.

Roll out charging network infrastructure to boost demand for EVs. The development of well-planned and reliable charging infrastructure is a key signal for accelerating the adoption of EVs, both for individual consumers as well as mass transit. This infrastructure has been kick-started largely by public entities across the world, with DFI financing – and technical support – being very important in developing economies. Once there is critical mass, the private sector is generally more inclined to participate.

Emerging technologies

Increase patient capital for privately financed projects for emerging technologies with long lead times, like low-emissions fuels, in countries with relatively good credit scores. These types of projects often require additional capital to be locked in for long periods before inflows of cash arrive, or simply carry greater risk because of their limited track record. Governments, with financial and technical help from DFIs, philanthropies and other similar entities, can provide patient capital (capital with below-market conditions or longer return periods) to bridge the finance gap or kick-start the sector.

Box 6: Tripling concessional funding to support clean energy transitions in developing countries

Achieving a sixfold increase in clean energy investments in developing countries is a major task, and developing economies alone will not have enough capital domestically to fund this rapid growth and meet other development goals. Greater international support will be needed to meet this funding gap. Total concessional funding needs for the energy sector are estimated at around 115 billion in 2030 and 2035. This represents more than a tripling in concessional funding needed by 2030 compared to current levels of support. The bulk of these funds is targeted at mobilising private capital for investments in mainly mature clean energy technologies. A further USD 10 billion in concessional funding will be required for state-owned utilities in the LDCs that are not able to access commercial funding.

Current private capital mobilisation ratios remain far below what is required and assumed in these estimates. For every USD 1 of bilateral and multilateral funding reported to the OECD, just USD 0.30 is mobilised in third-party commercial finance. While a number of individual projects have demonstrated that well-structured interventions can yield ratios of USD 3 to USD 7 of third-party commercial finance, these tend to be in cases where blended finance structures have provided de-risking in the form of first-loss equity or debt or through a guarantee instrument.

A detailed review of the instruments used by DFIs when reporting to the OECD showed that over 90% of all interventions reported in the energy sector were in the form of

debt, with few guarantees reported. While the reporting of guarantees is voluntary, exchanges with DFIs and developers confirmed a bigger focus on direct funding than on project de-risking and mobilisation.

This trend could change with new facilities and partnerships with commercial finance institutions being set up with a strong focus on private capital mobilisation. As clean energy technologies expand in developing economies, markets are maturing, and commercial finance institutions are gaining experience and comfort with these markets and requiring less direct interventions from DFIs. This in turn allows these institutions to focus on new markets and technologies.

With the bulk of clean energy investments in developing economies over the next decade focused on decarbonisation of the power sector and energy efficiency and end-use electrification, these two groups also account for nearly all of the concessional funding needs. International public support prioritising the COP 28 goal of tripling renewable capacity and doubling energy efficiency improvements globally by 2030 is needed to meet climate and energy security goals. This includes support for investments in grids and storage, which are critical for expanding renewable capacity.

Africa requires the largest share of concessional funding, followed by India and Latin America. The share of concessional funding by technology varies substantially based on market maturity in each region and the mix of technologies required to 2035 for the transition. In regions that are still far from meeting universal electricity and clean cooking access, such as Africa and other Asia, support is highly geared towards the power sector. Overall, the largest amounts of concessional funding across different regions are required for buildings and for grids and storage. With energy efficiency investments falling behind, targeted programmes to spur investments in buildings can help to accelerate energy efficiency implementation.

Table 2: Annual concessional finance requirements by sector and region in 2035 (billion USD)

	Africa	India	Other Asia	Latin America	ASEAN	Middle East	Eurasia	Total
Solar and wind	2	1	1	0	1	1	0	5
Other low-emissions power	2	1	2	1	2	1	1	10
Grids and storage	9	8	4	6	4	2	3	37
Buildings	10	9	4	2	2	1	1	29
Transport	3	2	1	2	1	1	1	11
Industry	2	2	1	1	1	1	1	9
Low-emissions fuels and CCUS	5	1	0	1	2	3	1	13
Total	34	24	13	14	13	9	8	113

Publicly driven projects

The category of publicly driven projects covers clean energy projects where commercial finance is not a viable option, even with risk mitigation instruments, and that, therefore, require public finance (as a government investment or as concessional finance from a DFI). Publicly driven projects are most often in the LDCs, where their very low credit rating makes commercial capital either absent or too costly to access. Many developing economies that are considered "fragile" or that are in conflict are included. It also includes projects in lower-middle-income countries or LDCs using nascent technologies that require substantial public support to lower costs. Some examples are low-carbon fuels or CCUS projects. About 10% of the clean energy investments in 2023 were publicly driven. While this falls to around 6% in 2035, in absolute terms, this represents a fourfold increase.

For many low-income countries, it is very difficult to attract private finance, even with risk mitigation instruments. This is mainly due to elevated country risk (discussed below) and, in the energy sector, off-taker risk due to the weak financial situations of utilities. Most utilities in sub-Saharan Africa still do not fully recover their costs, and the median utility is not profitable (see Box 7 below). For instance, many investors looking to develop renewable energy IPPs in these countries are unable to develop bankable projects as the level of non-payment is so high that risk mitigation measures are too expensive. Public or concessional finance is required to address the supply and access deficits in these countries. This financing should be used strategically to improve the financial position of utilities. For example, investments in the reinforcement of transmission and distribution lines can reduce technical losses and increase consumption, improving the utilities' revenues.

Box 7: Enhancing the financial sustainability of utilities

The financial sustainability of utilities is a crucial enabler for advancing clean energy transitions in developing countries. While utilities play a central role in the electricity supply chain, ensuring they can manage both immediate financial pressures and long-term investments is essential for the success of clean energy initiatives. However, many utilities, particularly in low- and middle-income countries, face significant challenges that hinder their ability to support these transitions effectively.

The role of cost recovery and market structures

Addressing challenges to improve the performance of utilities requires a balanced approach that differentiates between immediate interventions and long-term structural reforms. In the short-term, utilities often need access to targeted financial support to maintain operations and ensure the continuation of essential network expansion and upgrades. Mechanisms like results-based lending can be crucial in this

phase, as they tie financial support to the achievement of specific, measurable outcomes.

However, these short-term solutions must be seen as complementary to, rather than a substitute for, long-term reforms. Over the long term, the financial sustainability of utilities hinges on achieving cost recovery – ensuring that revenues from electricity sales cover operational costs and debt servicing and provide a reasonable return on investment. This involves improving tariff structures, enhancing operational efficiency and reducing system losses. For instance, utilities that can implement cost-reflective tariffs and reduce grid losses are better positioned to achieve financial stability and attract the necessary investments for clean energy projects.

Strengthening innovation policies and programmes and enhancing international collaboration to support technology transfer and knowledge sharing are important drivers for accelerating the development and adoption of emerging clean energy technologies in developing economies. Collaboration between the Research and Innovation Working Group and the Energy Transition Working Group can help identify priority areas and best practices for clean energy innovation policies in developing economies.

Public investments also have an important role in introducing emerging technologies into developing countries. There is growing interest in low-emissions hydrogen around the world, including in some developing economies, especially in countries with low-cost solar or wind (for production via electrolysis), but commercial viability is still in its early stages, and supply-side initiatives in most developing countries are not yet matched by firm commitments on the demand side. The lack, or uncertainty, regarding off-take arrangements for low-emissions hydrogen is an issue even among advanced economies, but it is a much larger constraint in the LDCs of the world, which have an additional risk premium. The same is the case for other emerging technologies in these countries, like CCUS or other low-emissions fuels.

Private investors, understandably, require such a premium to compensate for the risk of investing in these projects. This often means there is virtually no private investment or, when there is, it requires many finance and de-risking mechanisms by DFIs to cover both the sector- and country-specific risks. As discussed in Box 8, country-related risks are sometimes the most binding constraint in these cases. For many private investors and financiers, the country-level risk is so high that it surpasses the acceptable threshold, and clean energy projects – whether in emerging technologies or others – are simply not even considered.

Given how rare some of these investments are, we also include some mature technologies in our modelling results for this category. This means that in very high-risk countries with low

fiscal and administrative capacities, some of the mature technologies may also need substantial public and concessional support to get the very first projects with private participation off the ground.

Recommendations to mobilise larger shares of capital to publicly driven investments

Track clean energy innovation policies and identify priorities for enhancing technology collaboration. Maintain an annual report on the tracking of clean energy innovation policies and targets for the co-development, transfer, dissemination and diffusion of knowledge, developed under the Research and Innovation Working Group with the help of other international institutions.

Provide targeted first-loss equity, or similar de-risking instruments, for first-of-a-kind projects. First-of-a-kind projects often require additional capital and carry great risk. Governments, with support from DFIs, can provide targeted first-loss guarantees or refundable grants that reduce risk perceptions and flip the investment proposition.

Provide more credit enhancement to lower the cost of debt financing for the first clean energy projects in very high-risk countries. High credit risk perception is a major impediment for private investors in many countries in Africa, other Asia and Pacific Island States. Mitigating these risks to investment, including by adapting existing credit enhancement facilities to lowering the cost of debt financing for the first clean energy projects, can help accelerate the otherwise small to non-existent clean energy sectors in the highest-risk developing countries.

Expand the provision of concessional funding towards off-grid energy access projects in markets with low returns and high risks. Energy access projects, which have important socio-economic benefits, generally still present high revenue uncertainty and low financial returns, given much of future electrification will take place in more rural and generally poorer areas of some of the poorest countries of the world. There is a need for more concessional funding for these projects, of at least USD 20 billion per year.

Macroeconomic and other country-related risks

Investment decisions and the cost of capital depend largely on the assessment of two sets of risks:

(i) macroeconomic and other country-related risks (risks that apply to any investment in a jurisdiction), and (ii) risks specific to the project or sector involved. The sections above have mainly discussed ways of mitigating the latter – that is, issues around energy policies and regulation and the different financial instruments and mechanisms that can help scale up investments in low-carbon power, low-carbon fuels or demand-side assets. These generally fall within the scope of actions by energy ministries, regulators and other energy-related

policy makers. However, a comprehensive approach to mobilising capital for clean assets in developing economies demands attention across country-related factors too. In fact, improved macroeconomic conditions are imperative for reaching the levels and acceleration of investment required in the energy transition. Improved fiscal accounts should also be accompanied by better rule of law for upholding existing contracts and improving governance and transparency.

Box 8 summarises some of these issues, especially currency-related risks, which are a big impediment to mobilising capital for developing economies.

The main country-related risks that hinder bankability in developing economies are the following:

- political risks (including risks of asset expropriation, destruction of assets or interruption of business due to war or civil conflicts, and breach of contract)
- currency risks (risk of foreign exchange fluctuations, domestic inflation or convertibility)
- debt sustainability issues that affect the creditworthiness of state-owned utilities.

Investors can access guarantees or insurance products that can cover, among others, liquidity, termination and other political risks. For instance, the Multilateral Investment Guarantee Agency (MIGA) provided a guarantee to cover breach of contract, currency inconvertibility and transfer restrictions for a total of USD 24 million for 20 years for the Golomoti Solar project in Malawi. The project constitutes a 20 MW solar PV installation with a 10 MWh battery energy storage system, the first hybrid of its kind in Malawi.

In addition to tackling the risk premium perceived by investors and, hence, reducing their equity return expectations, it is important to tackle the cost and terms of project finance debt. In a project finance scheme, IPPs have the option to finance their projects with local lending or hard-currency international lending. To avoid the foreign exchange risk – characterised by a currency mismatch between the payments from the off-taker to the IPP and the repayments to the shareholders and the lenders,[2] the main mitigant is a strong domestic currency market where IPPs can access local currency debt under adequate terms and, hence, sign a PPA in the local currency.

While some developing countries have successfully developed a domestic infrastructure lending market, such as India or Thailand, **most developing countries**

[2] Matching of the currency of the capital expenditure with the debt currency can be covered with a one-time fixed foreign exchange rate, which is known at the moment of construction just before reaching financial close.

are facing major local currency financing challenges, such as short tenor or high base interest rates, due to recurring macroeconomic issues that have been unsolvable in the short term. The fundamental approach to deepening local currency financing for renewable energy is through increasing the capacity of existing local financiers and crowding in local and international financiers, which in turn are supported by sound macroeconomic, financial, money and capital market policies and key enablers. The approach includes ensuring that capital market policy and regulatory and institutional conditions support long-term infrastructure investments (e.g. through prudential and investment regulations).

Regulations that require financial institutions to prudentially measure and manage risks and hold adequate capital and liquidity also impact the availability of capital for clean energy projects in developing economies. The Basel III regulation on a standardised approach to credit risk places a risk weighting of 100% (BB+) and 150% (below B-) compared to 30% (AAA to AA-) to 50% (BBB to BBB-) for investments rated "investment grade" (BB+ or above), effectively limiting most investments in developing economies.

In addition to the long-term strategies, MDBs such as the World Bank Group can develop innovative and scalable financing solutions and instruments and co-investment vehicles, including de-risking instruments and facilities to address the risk concerns of investors. The instruments available include loans (e.g. climate financing) and guarantees to financial intermediaries focusing on infrastructure projects or credit lines from local financial institutions backed by an MDB.

When local lending under the expected terms is not available, IPPs will turn to international markets, creating a mismatch between the revenues and the debt payments. The foreign exchange risk is said to be borne by the off-taker when the PPA is denominated in hard currency (i.e. the off-taker takes the risk of currency devaluation between its revenues and what it will pay the IPP) but by the IPP when the PPA is in the domestic currency, as it is one or the other bearing the risk of currency fluctuations.

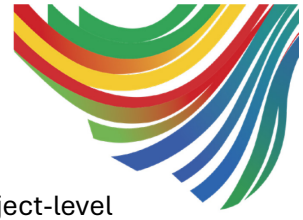
Investors can use forward foreign exchange markets or cross-currency swaps to hedge against unfavourable exchange rate fluctuations when both currencies are in hard currencies, or for very short timelines. However, most developing countries' currencies are not hard currencies and project financing usually has tenors of 15 years or more. The Currency Exchange Fund aims to cover that gap by providing currency hedging products and services in these geographies. It has been very successful in funding SMEs, but there are some limitations and high costs for larger investments requiring long tenors, such as renewable energy projects.

In addition to currency fluctuations, which can increase the cost of a project or reduce the financial viability of a utility, other foreign exchange issues can occur related to transfer restrictions and convertibility when hard currency is not available in a country. Transfer restrictions and convertibility are risks that can be covered by DFI guarantees or insurances. However, to address risks related to a country's limited availability of hard currency, a guarantee is not enough. Innovative instruments are being developed to target this risk via a revolving fund that can be hosted at the central bank, with the sole purpose of allowing IPPs to tap into the fund when US dollars are not available. For example, Ethiopia is poised to implement such a solution in the near future. Through a USD 20 million revolving fund funded by a Green Climate Fund grant (SRMI-2), the mechanism aims to ensure that 700 MW of solar projects are able to convert the payments received in local currency into US dollars even when the macro-fiscal situation in the country does not allow the central bank to meet those needs (as it would not have enough US dollars in its accounts). This is an interim solution to allow projects to reach financial close while the fundamentals of the sector are improved to solve the currency availability issue. Brazil has announced the Eco Invest programme, which focuses on providing blended finance to lower long-term currency hedging costs.

Support from the international community, notably the DFIs, is key as many developing countries do not have the balance sheets or fiscal capacity to face these challenges alone. In fact, debt sustainability is a worrying concern across developing economies, where three-quarters of these economies have debt-to-GDP ratios of at least 75%. This in turn affects the creditworthiness of state-owned energy utilities, which are the main counterparts to private investors, and financiers of infrastructure projects, as governments are the ultimate owners and capital providers of utilities. Therefore, mobilising a greater share of private finance in these markets is imperative, and this will require the financial and technical support that DFIs and similar institutions can provide.

Need for more and better data

High-quality and available data are key underlying principles for any investment decision and are used by investors to evaluate projects, as well as by policy makers to ensure that they provide a fair level of compensation. As discussed above, the cost of capital is a critical benchmark for assessing the risk and return requirements of investors, but it is seldom available in developing economies. While in advanced economies the cost of capital for different technologies is relatively easy to obtain or estimate, this is not the case in developing economies. Financial markets are less developed (so there is little or no information on



publicly listed companies), and there is a lack of transparency around sector and project-level risk premiums. Improving the availability of cost of capital estimates has implications for the orderliness of energy transitions.

At the same time, enhancing data availability on project default rates for clean energy projects in developing countries can help overcome the perceived risks. The release of the Global Emerging Markets Risk database is a good first step to better evaluating default levels in developing countries, but as many of these projects include a high level of de-risking from MDBs, this needs to be supplemented by data from privately led transactions to better reflect market conditions.

IEA Publications
International Energy Agency
Website: www.iea.org
Contact information: www.iea.org/contact

Typeset in France by IEA - November 2024
Cover design: IEA
Photo credits: © Shutterstock


G20
BRASIL 2024
BUILDING A JUST WORLD
AND A SUSTAINABLE PLANET