PRISM

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Policy brief

Financing a Fair and Affordable Global Energy Transition

Why financing conditions shape climate ambition and equity

Date: October 2026

Key messages

- Unequal financing conditions can make otherwise competitive clean technologies uneconomic in developing countries.
- Convergence in financing conditions could accelerate renewable energy deployment and improve electricity affordability.
- Country- and sector-specific investment risks raise modelled mitigation costs by approximately 9% compared with a uniform low-risk benchmark.
- Climate finance should be judged by how much it reduces investment risks and unlocks additional investment—not solely by the volume committed.
- Climate-energy models need to integrate regionally and technologically differentiated, dynamic costs of capital and explicit financial-policy scenarios.

Executive summary

The global energy transition is increasingly a challenge of financial access as well as technology deployment. Renewable generation, electricity networks, green hydrogen and industrial decarbonisation often involve high upfront expenditure (CAPEX), but lower operating expenditures (OPEX) compared to fossil fuel-based options. Their competitiveness is consequently sensitive to the weighted average cost of capital (WACC) considered for the investment. Yet countries and sectors do not face equal financing terms. Higher sovereign and sector/technological risks increase the required return on investment, particularly in emerging and developing economies.

Two complementary peer-reviewed studies provide new quantitative evidence. Calcaterra et al. (2024) embed country- and technology-specific financing costs in five climate–energy–economy models and test convergence of risk premiums and the impacts on global energy transition. Waidelich et al. (2026) extend differentiated financing costs to eight energy and industry sectors in the IMAGE model. Together, they show that more realistic financing assumptions change investment patterns, technology choices, energy prices, emissions and the costs of climate mitigation.

The central implication is that governments and development finance institutions should prioritise targeted de-risking, credible investment frameworks and finance for networks and industrial transition alongside renewables. International support can deliver climate and development gains when it lowers the cost of capital faced by real-world clean energy projects.

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1. The policy problem: clean technologies face unequal financing terms

A low-carbon technology may be technically identical in two markets but have a very different delivered cost because its initial investment is financed at different rates. Higher WACC disproportionately affects capital-intensive assets with long lifetimes and relatively low operating costs. This makes renewable electricity, grids and electrolysers as well as other low- and zero-carbon technologies particularly exposed to financing barriers. By comparison, some incumbent fossil technologies are less sensitive to upfront financing costs, even when their fuel and emissions costs are higher.

Differences in financing terms reflect sovereign risk, currency exposure, macroeconomic stability, project revenue certainty, regulatory quality, the maturity of domestic financial markets and the characteristics of individual sectors and technologies. These drivers are not interchangeable: a guarantee addressing payment risk cannot, by itself, solve a persistent currency mismatch or weak network planning.

The distributional consequence is substantial. Countries with strong renewable resources and rapidly growing demand may pay more to finance the infrastructure and technologies required to exploit those resources. The result can be slower deployment, higher energy bills, continued dependence on fossil fuels and fewer opportunities for clean industrial development.

2. From pledges to bankable investments

The policy debate is moving from announcing climate targets in the form of nationally determined contributions (NDCs) and (long-term low-emission development strategies) LT-LEDS to implementing investable transition plans. Under the Paris Agreement, new and updated national climate commitments increasingly require massive capital expenditure, enabling infrastructure and financing strategies. The 2024 New Collective Quantified Goal (NCQG) set a developed-country-led target of at least USD 300 billion per year for developing countries by 2035 and called for scaling climate finance from all sources to at least USD 1.3 trillion annually by 2035. The policy challenge is whether these flows change the effective price and availability of capital or financing barriers constrain capital availability and increase capital costs.

This question also matters for the reform of multilateral development banks, sovereign-debt discussions, the EU Global Gateway agenda, and efforts to develop clean hydrogen and low-carbon industrial supply chains. Policymakers deciding how to deploy scarce public guarantees and concessional resources need evidence about where a marginal reduction in risk delivers the greatest additional clean investment.

The two studies developed in the PRISMA project sharpen the public discourse on climate finance: finance quantity is important, but financial terms, risk allocation and sectoral coverage can determine whether promised investment translates into real-world bankable projects, emissions reductions and affordable energy.

The NCQG established a developed-country-led mobilisation goal of at least USD 300 billion annually by 2035 and a wider call to scale developing-country climate finance from all sources to USD 1.3 trillion annually. These are distinct commitments: the larger figure is a collective scaling ambition, not a pledged public-finance budget. The Baku-to-Belém Roadmap, developed around COP30, identifies concessional finance, debt sustainability, private capital and affordable cost of capital as implementation priorities. Its 2026–2028 early actions create a near-term opportunity to define credible indicators of financing quality, not merely aggregate flows.

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What is coming next? In the run-up to COP31 in late 2026 and the first formal NCQG progress reporting expected in 2028, governments and development banks face decisions on tracking methodologies, additionality, concessionality, guarantees and the allocation of scarce public resources. The COP30 Presidency's 2026 implementation work and Xingu Finance Talks explicitly discuss fiscal space and lowering the cost of capital for climate mitigation and adaptation through risk-sharing and guarantees. These processes offer a concrete policy entry point for the studies' findings.

The European Commission's March 2026 Clean Energy Investment Strategy places de-risking and private-capital mobilisation at the centre of investment delivery. Internationally, Global Gateway and EFSD+ use guarantees and risk-sharing instruments to support investment in partner countries; the Council also adopted changes to improve the flexibility of the External Action Guarantee in March 2026. The key design issue is whether these instruments measurably reduce financing costs in riskier markets, especially for renewable energy, electricity grids, green hydrogen and industry, rather than merely financing projects that would have proceeded anyway.

Climate finance negotiations often focus on whether promised amounts are sufficient, who should contribute, and how much should be grants versus loans. Developing-country representatives and researchers also emphasise debt burdens, unequal borrowing costs and the need for fair access to finance; donor governments stress fiscal constraints and the mobilisation of private investment. The research adds a testable economic dimension to this debate: two packages with similar headline dollar volumes can deliver different emissions, electricity-price and equity outcomes if their risk-sharing terms differ.

The decision facing policymakers. A finance ministry, development bank or EU guarantee facility must decide where to deploy one additional euro of scarce public risk-bearing capacity. Should it guarantee a solar project, a grid investment or a green-hydrogen facility? Which risks—offtaker default, policy uncertainty, currency mismatch or technology risk—actually raise the financing rate? The papers do not rank individual financial instruments or provide project-level benefit–cost ratios. They do show why decisions should be informed by country- and sector-specific cost-of-capital baselines and by modelled changes in investment, energy prices, emissions and distributional outcomes.

The PRISMA analysis develops a rigorous approach to compare a baseline pathway with explicit de-risking scenarios, specify which risk premium each instrument could plausibly affect, and track the incremental change in deployment, mitigation cost, electricity affordability and regional equity. Sensitivity analysis should vary the size, timing and persistence of risk reduction and consider possible fiscal and contingent-liability costs. This translates the two papers from a general case for fair finance into a decision framework for choosing, monitoring and revising climate-finance interventions.

3. Evidence from five integrated assessment models

Calcaterra et al. (2024) introduce empirically estimated country- and technology-differentiated costs of capital into a series of leading Integrated Assessment Models (GCAM, IMACLIM, IMAGE, TIAM and WITCH) used to inform climate policy analysis. The analysis compares alternative financing assumptions and investigates a stylised scenario in which developing regions' risk premiums converge toward those of advanced economies over time for a series of low-carbon technologies.

Across models, more favourable financing conditions support greater renewable electricity deployment and lower electricity prices in regions initially facing high costs of capital. The study reports an approximately 10% median reduction in electricity prices in high-cost regions and closure of around 30% of the 2050 renewable-generation gap between NDC and 1.5°C pathways. These indicators concern different comparisons and should not be added together.

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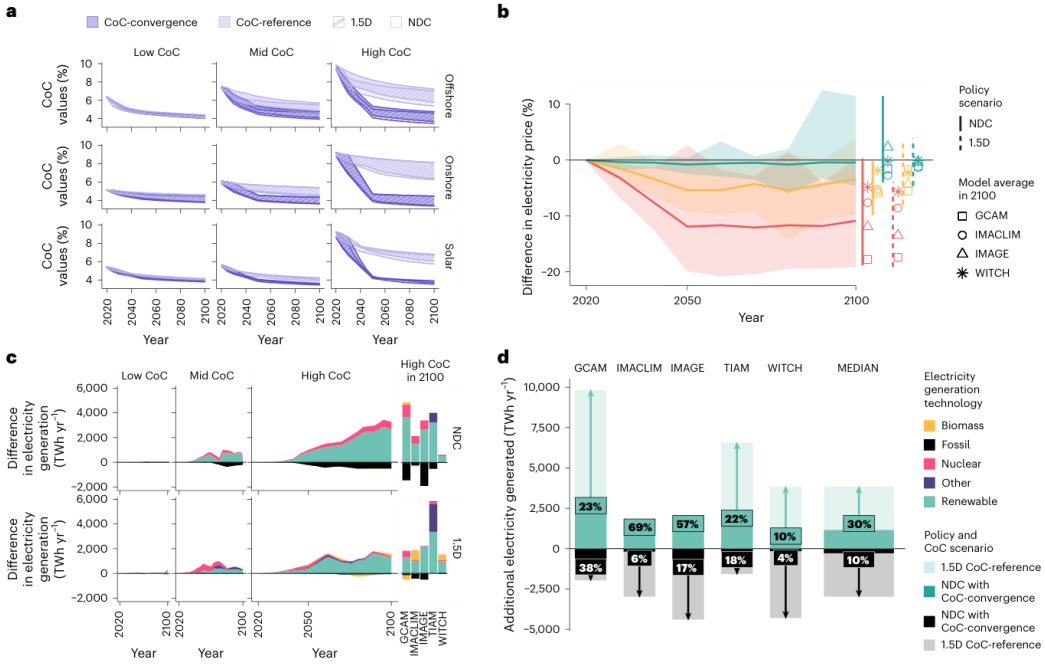

Fig. 1 | Energy consequences of CoC convergence. a, Projected CoC for technologies and scenarios with learning. **b**, Percentage difference in the price of electricity between the CoC-reference and CoC-convergence scenarios over time. Left: the lines report the aggregated median value across models, region and policy scenario. The shading represents, for each macro-region, the range of generation between the CoC-reference and CoC-convergence scenarios across macro-regions and time for both NDC and 1.5D scenarios, expressed as the median values across models. Right: breakdown by model for high-CoC countries in 2100 under the NDC and 1.5D scenarios. 'Renewable' includes solar and wind, 'Fossil' includes coal, oil and gas, and 'Other' includes geothermal, hydro and

Figure 1. Energy consequences of cost-of-capital convergence: financing pathways, electricity prices and generation outcomes. Reproduced from Calcaterra et al. (2024), Nature Energy, Fig. 1, https://doi.org/10.1038/s41560-024-01606-7. © The authors; reuse subject to publisher licence.

The significance is broader than deployment volume. By reducing the cost of electricity and improving the competitiveness of clean generation in underserved markets, financial de-risking can advance affordability and international equity alongside mitigation. Results vary across models, regions and scenarios; they do not imply that any single financial instrument will reproduce the full hypothetical convergence effect.

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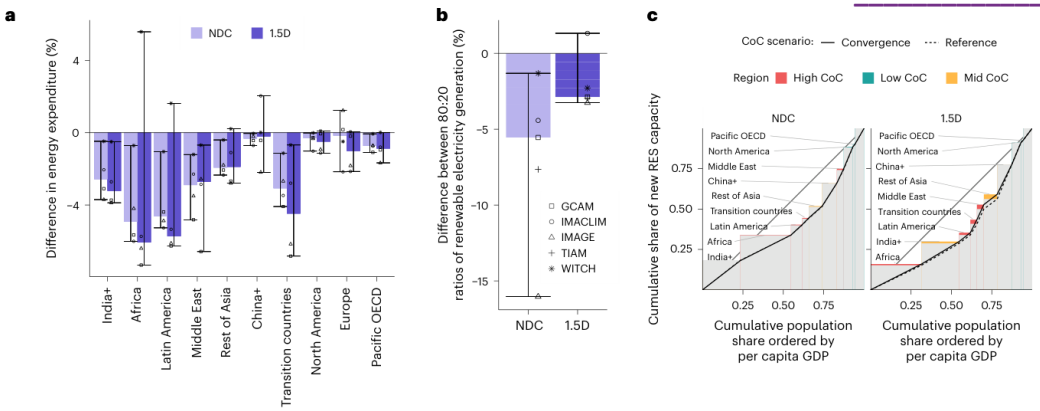

Fig. 3 | Inequality consequences of CoC convergence. a, Percentage change in energy expenditure as a proportion of GDP for CoC-convergence with respect to CoC-reference in 2100 for the NDC and 1.5D scenarios. The bars indicate the median reduction across models and the error bars show the minimum and maximum across four models (the model TIAM is absent as it does not report the price of energy). **b**, Percentage difference in the 80:20 ratio of per capita renewable electricity generation for CoC-convergence with respect to CoC-reference across models for the NDC and 1.5D scenarios. The ratio is obtained by calculating the electricity per capita generated by the two regions with the highest per capita GDP (Europe and Pacific OECD) and dividing it by the amount generated by the two poorest regions (India+ and Africa) in 2100. Then the percentage difference between the CoC-reference and CoC-convergence scenarios is calculated. The bars indicate the median across models and the error bars show the minimum and maximum across five models. **c**, Lorenz curves of the renewable capacity in 2100. The differences in the bars and curves show the additional RES generation in the CoC convergence scenarios, helping to close the gap to an equal distribution of renewable sources (line at 45°). In the NDC scenario, the two scenario lines almost overlapping.

the context of the climate transition, given the tilted distribution of historical responsibilities, physical climate risks and access to energy among industrialized and developing economies.

The ambition of reducing the CoC in developing countries towards that of today's developed world should not be underestimated. The country risk premium depends on factors such as the quality of institutions, macroeconomic stability and financial sector maturity[51], which

Our analysis must be complemented by a more detailed analysis on a case-by-case basis for a tailored set of policies focused on access to and deployment of energy finance. In particular, the absence of possible risk spillovers to the CoC of the Global North is a limitation of the current design. However, we partly explored this in the sensitivity analysis. In particular, we assumed the empirical CoC to increase in the European Union and the United States, thus also impacting the CoC-convergence

Figure 2. Inequality consequences of cost-of-capital convergence: energy expenditure, renewable generation disparities and capacity distribution. Reproduced from Calcaterra et al. (2024), Nature Energy, Fig. 3, https://doi.org/10.1038/s41560-024-01606-7. © The authors; reuse subject to publisher licence.

4. New evidence beyond renewable power

Waidelich et al. (2026) estimate dynamic, country- and sector-specific costs of capital for eight energy and industrial sectors and implement them in the IMAGE Integrated Assessment Model. Their uniform benchmark assumes a 5% low-risk cost of capital, while the differentiated case reflects country and sector risks. They explore both current-policy and well-below-2°C pathways, allowing climate policy to adjust in the latter case to meet the temperature objective.

Relative to the uniform low-risk benchmark, differentiated financing costs increase cumulative global mitigation costs over 2030–2100 from approximately USD 77 trillion to USD 84 trillion, a rise of about 9%. Country risk is the principal source of the increase. In cases without an additional climate-policy response, the study estimates approximately 60–70 Gt more cumulative CO_2 emissions through 2100. These are modelled scenario differences, not projections of unavoidable future emissions.

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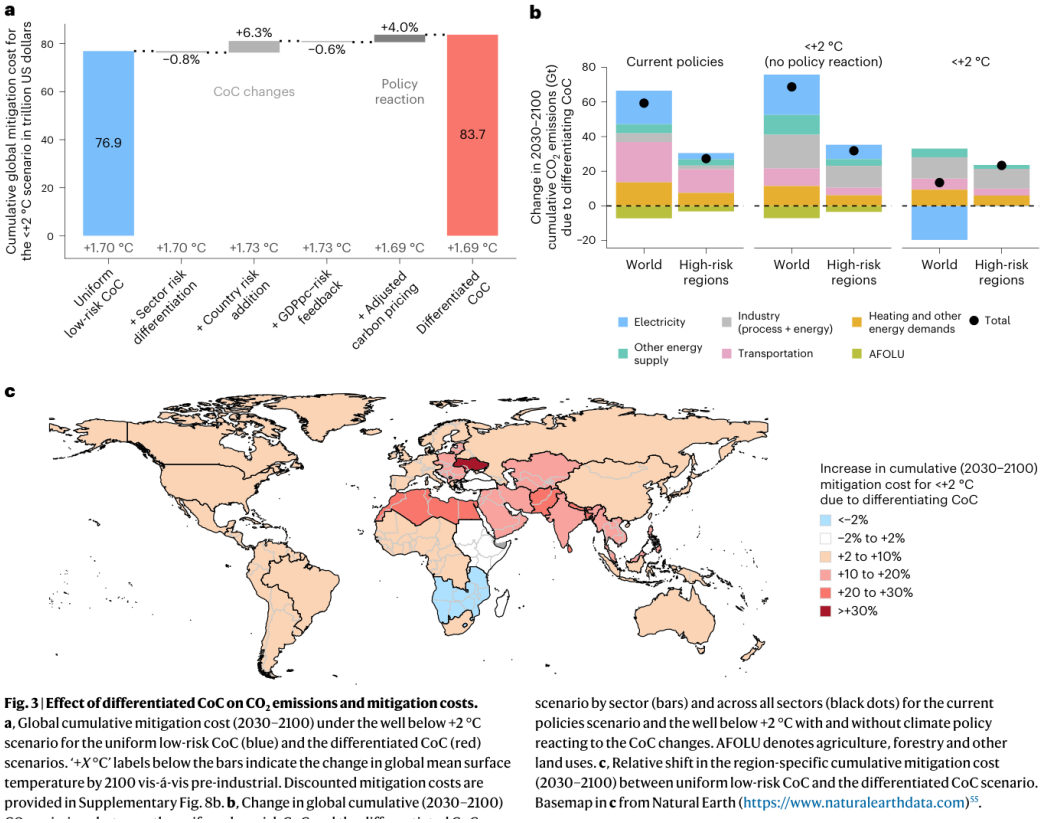

Fig. 3 | Effect of differentiated CoC on CO_2 emissions and mitigation costs. **a**, Global cumulative mitigation cost (2030–2100) under the well below +2 °C scenario for the uniform low-risk CoC (blue) and the differentiated CoC (red) scenarios. '+*X* °C' labels below the bars indicate the change in global mean surface temperature by 2100 vis-à-vis pre-industrial. Discounted mitigation costs are provided in Supplementary Fig. 8b. **b**, Change in global cumulative (2030–2100) scenario by sector (bars) and across all sectors (black dots) for the current policies scenario and the well below +2 °C with and without climate policy reacting to the CoC changes. AFOLU denotes agriculture, forestry and other land uses. **c**, Relative shift in the region-specific cumulative mitigation cost (2030–2100) between uniform low-risk CoC and the differentiated CoC scenario. Basemap in **c** from Natural Earth (https://www.naturalearthdata.com)[55].

Figure 3. Effects of differentiated financing costs on cumulative CO_2 emissions and global and regional mitigation costs. Reproduced from Waidelich et al. (2026), Nature Climate Change, Fig. 3, https://doi.org/10.1038/s41558-026-02756-0. © The authors; reuse subject to publisher licence.

The sector-level findings are highly consequential. Higher financing costs constrain grid expansion in developing countries; raise electricity prices; increase green-hydrogen production costs; and slow electrolysis uptake. Capital-intensive technologies in steel and cement, including electrification and carbon capture, also become less attractive. Indirect effects spill into heating, transport and other energy users through changes in energy-carrier prices.

5. What the studies do and do not establish

The 2024 paper explores the benefits of reducing financing disparities across multiple models, with particular attention to renewable electricity. The 2026 paper measures the consequences of representing existing country- and sector-specific financing differences in a single model across a wider range of sectors, including industries.

Both approaches show that financial assumptions matter for climate outcomes. However, WACC is not a direct proxy for every barrier to investment. Permitting delays, grid connection queues, skills shortages, supply-chain constraints and policy credibility can persist even when borrowing rates decline. Furthermore, the 2026 analysis does not explicitly differentiate financing for all sectors, including transport and agriculture, and holds future sector-risk factors relatively stable. Financial instruments themselves are not comprehensively simulated.

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The evidence therefore supports testing and prioritising de-risking mechanisms, not an unconditional claim that all public subsidies are cost-effective. Policy appraisal must also consider fiscal exposure, contingent liabilities, additionality, distributional outcomes and the risk of subsidising investments that would have occurred anyway.

6. Five policy priorities

Priority 1 — Target financing costs, not just finance volumes

International climate-finance strategies should define explicit outcomes for reductions in clean project WACC, improved loan tenors, lower currency risk and increased investment additionality. Track the financing terms received by projects before and after support. This provides a more direct test of whether public resources are correcting a market barrier.

Priority 2 — Use guarantees and concessional capital selectively

Guarantees, first-loss facilities, subordinated debt and concessional loans can improve risk allocation. They should be deployed where a clearly identified risk prevents a commercially or socially valuable investment. Selection should be based on transparent counterfactual analysis, climate impact, expected leverage and fiscal cost, rather than maximum private-capital mobilisation alone.

Priority 3 — Finance grids and industrial transformation

Move beyond a narrow emphasis on renewable electricity generation. Grid capacity, flexibility, storage, hydrogen supply chains and industrial process transformation are interconnected investments. Country platforms and sector investment plans should identify sequencing needs and ensure that financing improvements in one part of the system are not neutralised by bottlenecks elsewhere.

Priority 4 — Reduce structural country risks

Development finance should complement institutional reforms that improve revenue certainty and creditworthiness: transparent tariffs, credible procurement, utility financial health, stable regulation, debt sustainability and sound macroeconomic management. These reforms take time, so transitional risk-sharing facilities remain important.

Priority 5 — Put financing realism into climate scenario analysis

Require climate-policy scenarios and assessments to disclose WACC assumptions and test sensitivity to country risk, sector risk, financing instruments and future changes in institutions. Scenario outputs should include energy prices, public-finance exposure and equity outcomes alongside emissions and aggregate mitigation costs.

7. An implementation agenda for EU and international institutions

For the EU external action, the key question is not simply how much investment can be announced under Global Gateway or related programmes. It is whether these programmes remove the financing barriers that prevent clean investment from proceeding in partner countries. Comparable reporting on financing terms would improve accountability and allow learning across instruments and regions.

For development banks, balance-sheet optimisation and expanded guarantees can be particularly

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useful where private lenders are willing to invest but are constrained by specific risks. Yet public support must be accompanied by safeguards, transparency and country ownership. A financing facility that shifts risks to public budgets without delivering additional decarbonisation is not a successful climate intervention.

8. Monitoring success: a practical results framework

A policy package should be assessed against a baseline that captures financing conditions and expected investment without intervention. The following monitoring structure distinguishes inputs from outcomes and helps avoid mistaking commitments for real-world progress.

Indicators should be disaggregated by country, sector and income group. Ex-post evaluation should examine whether reductions in financing costs persist after concessional support ends, and whether project risks are being sustainably reduced or merely transferred to the public sector.

9. What this means for PRISMA and integrated assessment models

For PRISMA, these findings underline the importance of linking financial conditions to energy-system and climate-economy pathways. A model that assumes identical financing terms everywhere may understate the difficulty of decarbonising high-risk markets and misidentify the least-cost geographical distribution of mitigation effort. Conversely, an assumed high uniform rate may misrepresent investment opportunities in lower-risk regions.

The relevant research agenda could proceed in three stages. First, construct consistent country-, sector- and technology-level WACC assumptions with documented data sources and uncertainty ranges. Second, design and develop scenarios that distinguish baseline financing risks from explicit financial interventions such as guarantees, concessional lending and regulatory reform. Third, evaluate not only projected technology deployment and global mitigation cost, but also electricity affordability, investment distribution, public-finance needs and the effects of climate-finance cooperation.

Inter-model comparisons would be valuable because differences in model assumptions, foresight, endogenous growth, investment behaviour and sector representation may change the magnitude of the effects. Reporting a range of plausible financing pathways is likely to be more decision-useful than assuming one universal discount rate.

The two papers demonstrate that finance is part of the underlying economics of decarbonisation, not an afterthought. Financing differences influence which technologies are competitive, where investment occurs and how costly mitigation becomes. Better financing conditions in developing economies could make the energy transition faster, more affordable and more equitable, while realistic representation of country and sector risks makes policy scenarios more credible.

Three immediate decisions follow. Climate-finance institutions should identify high-impact opportunities to lower project risk premiums. Governments should coordinate de-risking with grid, industrial and regulatory planning. Modellers and policy analysts should disclose differentiated financing assumptions and assess the distributional consequences of alternative financing arrangements.

The overarching message is straightforward: mobilising more money matters, but making clean investment financeable—at a cost countries and consumers can afford—is equally important.

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References and further reading

Calcaterra, M. et al. (2024). “Reducing the cost of capital to finance the energy transition in developing countries.” Nature Energy. https://doi.org/10.1038/s41560-024-01606-7

Waidelich, P., Crassier, C., de Boer, H. S. et al. (2026). “The impact of financing cost differences on global energy and industry decarbonization.” Nature Climate Change. https://doi.org/10.1038/s41558-026-02756-0

UNFCCC (2024). COP29 outcomes on the new collective quantified goal on climate finance. https://unfccc.int/cop29

Policy-context sources (accessed October 2026): UNFCCC COP29 NCQG; COP29/COP30 Baku-to-Belém Roadmap; UNFCCC Xingu Finance Talks; OECD NCQG monitoring; European Commission Clean Energy Investment Strategy (10 March 2026); Council of the EU Global Gateway / External Action Guarantee update (30 March 2026). Official sources: unfccc.int/cop29; cop30.br; oecd.org; energy.ec.europa.eu; consilium.europa.eu.

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