Sciences Po Energy Review

Financing Global Energy Transitions: Past, Present, and Future Trends

March 2025 - Issue 2

SciencesPo
EUROPEAN CHAIR FOR SUSTAINABLE DEVELOPMENT AND CLIMATE TRANSITION

About the European Chair for Sustainable Development and Climate Transition

The mission of the Chair is to advance education, innovation and public dialogue for the design and practice of policies for sustainable development and climate transition, within and outside of Europe. Challenges of climate change adaptation, decarbonisation, safeguarding planetary boundaries, green financing, biodiversity depletion and geopolitical environmental risks need to be understood and overcome in order to advance ambitions of the European Green Deal.

The Chair's mission is to drive education, innovation, and public discourse in the development of sustainable policies and climate transition, both within Europe and globally. We are dedicated to addressing critical challenges such as decarbonization, climate change adaptation, implementing the energy transition, green finance and minimising environmental risks. Our ultimate goal is to support the European Green Deal's ambitious objectives.

Our work centres on facilitating social and environmental transitions. We focus on analysing the content and governance of policies, partnerships, and actions needed to create transformative pathways for regions and cities. Our aim is to strike a balance between economic growth, social progress, and environmental protection.

We are committed to establishing a broad network of actors who will contribute to research, education, and discussions on important topics such as regional well-being, just transition, climate mitigation and adaptation, energy transition, and climate-resilient infrastructure. Our approach embraces various perspectives, including economic, sociological and technological, overcoming traditional disciplinary boundaries.

Hosted at the Paris School of International Affairs (PSIA) and the School of Public Affairs, the Chair is governed by two committees with the help of a team. The Chair is funded by: Hermès International, HSBC and the European Investment Bank (EIB).

About the Sciences Po Energy Review

The Sciences Po Energy Review is a graduate student-led publication to advance dialogue about energy. Motivated by the pressing global need for energy transitions, the journal primarily employs a social scientific approach without being constrained by any single discipline, featuring graduate student writing and expert analyses.

By placing contributors in conversation with peers and experts, the publication seeks to strengthen existing debates and research about energy at Sciences Po and beyond and welcomes submissions from all around the world.

The Sciences Po Energy Review is hosted by the European Chair for Sustainable Development and Climate Transition.

Table of Contents

Foreword

Foreword by Marc Ringel

Dr. Marc Ringel is the Chairholder at the European Chair for Sustainable Development and Climate Transition at Sciences Po, Paris. Dr. Ringel is also professor at Nuertingen Geislingen University, Stuttgart, Germany. He is a senior associate researcher with the University of Brussels, Belgium (Vrije Universiteit Brussel) and an affiliated lecturer with Université d'Aix en Provence/Marseille, France. He leads multidisciplinary research on green transitions in the energy and climate field, focussing on the role of public governance.

One is a start, two is the start of a series. As scientific advisor of the Sciences Po Energy Review, it is with great pleasure to introduce the second volume of this journal. This edition brings together insightful analyses from both master students and professionals, fostering an interdisciplinary conversation on one of the most critical challenges of our time: financing the global energy transition. Through a diverse range of perspectives, the contributors delve into the complexities and potential pathways forward in mobilizing the necessary capital to shift towards sustainable energy systems.

By putting the spotlight of this volume on financing the global energy transition, the editorial team of the Energy Review are touching upon a topic that deserves far greater attention. The realities of climate change demand urgent and decisive action, and the financial engagement needed to implement the transition is enormous, especially in times of tight public budgets. The transition to cleaner energy sources requires vast financial resources, and finding the most effective ways to mobilize these resources is paramount.

Within this volume, two key debates emerge as central to the discussion of financing the energy transition. The first debate centers on whether financial institutions should immediately cease providing loans and underwriting services for fossil fuel projects or, alternatively, whether they should adopt a more gradual approach that balances environmental imperatives with current economic and energy demands. This discussion weighs the need for stringent policies to drive the energy transition against concerns that a rigid, all-or-nothing stance may hinder progress or overlook important socioeconomic factors. This debate is highly relevant within the EU and globally, with implications that will shape the pace and feasibility of the energy transition while balancing economic stability and environmental responsibility.

The second debate explores the effectiveness of innovative financial instruments, such as carbon markets and green bonds, in closing the global financing gap for the energy transition. Contributors examine the potential of these tools to mobilize resources and strengthen climate finance, while also addressing the shortcomings and regulatory challenges that may impede their widespread success. By analysing the current frameworks, this debate highlights the trade-offs between innovation and practical implementation, weighing the urgency of scaling private finance against concerns over transparency, accountability and long-term effectiveness. As the need for scalable and effective finance grows, the insights from this debate will contribute to shaping policies that maximise impact in driving the energy transition forward.

Beyond these debates, the journal features a series of essays that cover a wide range of issues relevant to the energy transition and its financing, as well as interviews with key experts in the field, rounding off a comprehensive and stimulating review of the financial aspects of the global energy and climate transition.

In closing, I would like to express my appreciation to the founding editors, Gabriele Romeo and Ernest Lee, and the current editorial board — Natalia Feinberg, Isha Hiremath, Clara Klint, and Madeleine Tron — for their dedication in compiling this thought-provoking collection of articles. Their hard work, alongside the contributions of the authors, has resulted in a volume that offers valuable perspectives on the financing of the global energy transition. I trust readers will find this issue both informative and stimulating, as it explores the complexities and opportunities that lie ahead in the pursuit of a sustainable energy future.

Editorial Introduction

By Founding Editors Ernest Lee & Gabriele Romeo

Gabriele Romeo is a graduate student in International Energy Transitions at the Sciences Po Paris School of International Affairs. He holds an honours degree in Economic History from the University of Edinburgh. He has worked at the intersection of Economics, Energy, and Policy in various capacities, including at Enel and the European Roundtable on Climate Change and Sustainable Transition. He is currently working in the Directorate of the Chief Energy Economist at the International Energy Agency.

Ernest Lee studies international energy transitions under the dual master's programme between Sciences Po Paris and Columbia University's School of International Affairs. His current research investigates the energy history of the postcolonial 'Third World', with a focus on West Africa and Southeast Asia. He received a BA in History and Politics from the University of Oxford (2021), where he read urban and economic history and topped the cohort. At Columbia Climate School, he helps teach a graduate course on the history of the climate crisis and is a research assistant on a project employing large language models to detect obstructionism within the textual corpus of international climate negotiations.

Financing global energy transitions entails meeting investment needs to satisfy both current and future demand. Today's challenge lies in the fact that the energy infrastructure built now will likely shape human development well into the watershed decade of the 2040s, with far-reaching consequences for future generations. Total energy investments are steadily increasing, surpassing USD 3 trillion globally last year. Beneath this aggregate growth, a tectonic shift is unfolding: the ratio of clean technologies to fossil fuels has risen from less than 1:1 in the previous decade to 2:1 in 2024.[1] Fatih Birol, executive director of the International Energy Agency, reminds us that "we are now in a world where almost every energy story is essentially a China story" - and energy investments are no exception. China's rapid industrial policy has driven formidable learning curves in clean technologies such as solar PV and batteries, making them more abundant in global markets. However, this concentration of value chains is also prompting geopolitical reconfigurations. At a time when trade between geopolitically distant economies accounts for nearly 40 percent of global trade in highly concentrated products, energy investments are becoming instruments of power dynamics and channels of vulnerability.[2] Just as aggregate investment figures mask complex underlying

[1] IEA (International Energy Agency), *World Energy Investment 2024*, June 2024. https://www.iea.org/reports/world-energy-investment-2024.
[2] McKinsey Global Institute, *Geopolitics and the geometry of global trade*, January 2024. https://www.mckinsey.com/mgi/our-research/geopolitics-and-the-geometry-of-global-trade#/.

shifts, this issue unpacks energy financing at a critical juncture - where net-zero aspirations intersect with economic realities, political frictions, and the strategic imperatives shaping the global energy landscape.

It is virtually a truism to suggest that the window to reach a "just, orderly and equitable" transition towards 'net zero' continues to narrow with each passing year.[3] However, Trump's return to the American presidential office marks a dramatic structural shift in the global architecture for energy transitions and requisite financing, exemplified in the US withdrawal from the Paris Agreement that had previously served as an ambitious organising principle under the UNFCCC. Merely 13 out of 195 parties to the Paris Agreement submitted their new nationally-determined contributions (NDCs) – emission reduction plans for 2035 – by the February 2025 deadline.[4] Even this dismal figure includes the Biden administration's pre-inauguration contribution, making the UK the only G7 country to submit a NDC on time; meanwhile, other states like Argentina have mulled their own withdrawal from the Paris Agreement, foreshadowing their own exit from an international climate regime that has structured energy finance flows.[5] In the meantime, private actors such as the world's 16th-richest individual have pledged to help make up financing shortfalls and ensure progress, but in an era of retreating appetite for ESG and perceptions of decreasing profitability in the decarbonisation sector, will these developments endure?[6]

The contributions to this issue can be aggregated into four thematic areas.

Revising existing paradigms

Every lighthouse casts its own shadow. What are the shortcomings of existing paradigms that have historically evolved to meet energy and climate finance needs, and how can they be addressed? Our interview with Thierry Watrin "The Role of Debt in Financing the Energy Transition" explores the tensions between quantitative and qualitative approaches to sustainable debt financing. Watrin argues that for existing debt instruments – such as debt-for-climate swaps, sustainability-linked bonds, and blended finance – to truly unlock sustainable growth, a fundamental shift in their structuring and application is required. Similarly, Linus Mehl's essay "Bridging the Gap: Enhancing Climate Finance Mobilization for the Green Transition in Low- and Middle-Income Countries" critically examines the frictions in climate finance implementation. Low- and middle-income countries, in particular, suffer from fragmented and uncoordinated financial support, making a strong case for the establishment of National Climate Finance Institutions (NCFIs).

Adopting a comparable normative lens, the first debate question considers whether financial institutions should halt fossil fuel financing. The arguments put forward by Hugo Kapteijn, in

[3]UNFCCC. 'COP28 Agreement Signals "Beginning of the End" of the Fossil Fuel Era', 13 December 2023. https://unfccc.int/news/cop28-agreement-signals-beginning-of-the-end-of-the-fossil-fuel-era.
[4] Dunne, Daisy. "Analysis: 95% of Countries Miss UN Deadline to Submit 2035 Climate Pledges." *Carbon Brief* (blog), February 10, 2025. https://www.carbonbrief.org/analysis-95-of-countries-miss-un-deadline-to-submit-2035-climate-pledges/.
[5] Nugent, Ciara, and Attracta Mooney. "Javier Milei Eyes Exit from Paris Climate Deal." *Financial Times*, January 23, 2025, sec. Argentina. https://www.ft.com/content/4957bc54-5b7b-496d-8c98-ba42ff508e85.

[6] Volcovici, Valerie. "Michael Bloomberg Steps in to Help Fund UN Climate Body after Trump Withdrawal." *Reuters*, January 23, 2025, sec. Sustainability. https://www.reuters.com/sustainability/bloomberg-philanthropy-cover-us-climate-dues-after-paris-withdrawal-2025-01-23/.

favour, and David Difrancescomarino, against, revolve around an intertemporal optimisation problem. How do we weigh the risks of severe supply disruptions that could slow global economic growth – potentially hindering the prosperity needed for an energy transition today – against the long-term, unpredictable, and potentially catastrophic consequences of missing climate targets, which would exacerbate economic and societal burdens for future generations? The debate also highlights the seemingly conflicting relationship between supply- and demand-driven fossil fuel abatement.[7] Finally, existing paradigms are challenged in the context of the public sector's role in financing the energy transition. Kian Akhavan's essay "Funding the Energy Transition: Public-Private Partnerships as a Lever to Increase Private Climate Finance" examines this dynamic, focusing on the opportunities presented by public-private partnerships (PPPs). If effectively implemented, PPPs offer more than financial support; they can incorporate de-risking mechanisms and crowding-in approaches, thereby extending their impact beyond monetary contributions.

How to get a transition right?

Zooming in on specific technologies and political realities, a set of contributions examines key avenues in transition finance that offer promising returns. Amidst the current erosion of political certainties in various constituencies, our interview with Dario Traum, "Market Volatility, Policy Shifts, and the Future of Clean Investment," offers crucial insights into the fundamentals of energy investments. He argues that despite political volatility, the underlying economics of the energy transition remain robust. While often characterised as a "petrostate" locked into fossil fuels, the United States benefits from strong cleantech momentum, particularly in sectors driving demand for clean electricity such as artificial intelligence. Arina Khotimsky's essay, "It Takes a Village: Embracing the Opportunity for Oil and Gas Industry Expertise to Lead Next-Generation Geothermal Development," highlights the promise of a nascent zero-emissions, baseload energy technology. She also presents a compelling case for leveraging knowledge transfer from the oil and gas sector, particularly its technological expertise in well stimulation and drilling techniques. Beyond technology, integrating social considerations into energy investments can improve resource allocation through the lens of a just transition. Lindley Saffeir explores this dimension in her essay, "The Risk of Financing Conflict: Why the Energy Transition and Peacebuilding Efforts Must Align." In conflict-affected states, renewable energy investments are frequently deterred, while new conflicts disrupt ongoing projects and discourage future financing.

Decarbonizing the fossil state

Energy finance arrangements are glaringly insufficient when they fail to engage with the political economies of fossil fuel-producing states, as well as their infrastructural and environmental contexts. Marína Kováčová's essay "Security Dressed in Green: What Motivates the UAE's Push for Sustainable Energy" argues that the United Arab Emirates will play a bigger role regardless of whether the future continues to be driven by fossil fuel-based development or makes steady progress towards a deep decarbonization. Domestically, the UAE continues to invest in renewables towards its own net zero by 2050 goal, while

[7] Prest, Brian C. "Partners, Not rivals: The power of parallel supply-side and demand-side climate policy." *Resources for the Future, April 2022.* https://media.rff.org/documents/Report_22-06.pdf

internationally its investment and partnerships reach far and wide. The political and economic pragmatism that Kováčová identifies as driving the UAE's sustainable energy push are also evident in developing oil-producing economies like Qazaqstan, as discussed in Nargiz Shantayeva & Alibek Sembayev's essay "The Role & Potential of Sovereign Wealth Funds in advancing the Energy Transition: Case-study of the Republic of Qazaqstan". The authors argue that these sovereign wealth funds (SWFs), like their more established counterparts, offer significant potential to harness transition finance. Amidst uncertain regulatory and investor environment, monetary and fiscal uncertainty, they argue SWFs should continue to issue green financial instruments and seek out alternative investment methods. Reducing coal dependence remains a perennial challenge for countries reliant on a fleet of lower-cost yet emissions-heavy thermal plants, and Leo Gordon's essay "Show me the money (and outcomes): the promise and progress of Indonesia's JETP experience" analyses the Just Energy Transition Partnership model for the world's fourth-largest exporter of coal. In observing how pledged finance significantly underserves Indonesia's planned needs for retiring coal plants and renewable investment, the author calls for a streamlined process of JETP applications, earlier pilot projects, and more grant-based and concessional finance for countries already under JETPs and future projects.

Novel frameworks for energy finance

Finally, various contributors explore new approaches towards energy finance, motivated by the inadequacy of existing climate finance paradigms and thinking. One debate question hence asks: "Are innovative financial mechanisms, such as carbon markets and green bonds, effective in bridging the financing gap for the energy transition globally?" Andrea Bonzanni argues *yes*, noting with regret how the new collective quantified goal at Baku's COP29 removed "carbon markets, green bonds and debt-for-climate swaps" from the text's draft version. Despite the many real shortcomings of carbon markets, he notes the promise of the Paris Agreement Crediting Mechanism (PACM) under the UNFCCC and the necessity of innovation in combating the climate crisis. Conversely, Trishant Dev zooms in on the hopes pinned on voluntary carbon markets making a case for their opacity, and a lack of additionality due to the low integrity of credits. Hence, relying on such mechanisms to substitute for other processes in the energy transition undermine the mobilisation of other resources. Wenxi Jiang and Romain Cabanes turn to the still-expanding frontier of artificial intelligence and its potential to stimulate energy finance in their essay "From Pledges to Practice: Using AI-Driven Real-Time Risk Analytics to Improve Investor Confidence in EMDEs". Emerging economies face a problem of 'bankability', owing to their higher risks and unpredictable revenues, and the authors detail how AI can help aggregate country-level risk and analyse future profitability, while they remain clear-eyed about the limitations of these emerging technologies. A highly productive interview with Alissa Kleinnenhuis, "Uniting the front for climate finance" begins with making the case for climate finance for developed economies, which lie in avoided climate damage and adaptation costs; turning to JETPs, she calls for grant finance for less-developed economies to engage in whole-of-country transitions. Reflecting on the role of economic knowledge in addressing the climate crisis and furthering an energy transition, she concludes that bridging the "triangles" of public, private, and academic sectors work continues to require active effort.

The need for a sustainable, equitable and just energy transition persists amidst strong global headwinds. Our premier issue revolved around the broader lens of the narratives and sequencing of the energy transition, and the second issue of the Sciences Po Energy Review now commences a deeper dive into the energy transition through more focused subject areas.

We extend our deepest gratitude to the contributors to the Sciences Po Energy Review through their lively, informative interviews, critical essays, and debate participation. Diversity remains a key value of the journal, and we are heartened that contributions hail from well beyond Saint-Germain-des-Prés. Opportunities for dialogue between academics, practitioners and graduate students can seem frustratingly fleeting …

We remain indebted to the Editorial Board members for their invaluable and patient support, and further thank our Scientific Advisor, Prof. Mark Ringel, for their positive and proactive belief in our project. It is gratifying to see a new generation of students take up the helm of this initiative with dedication and intellectual curiosity. Our auspice is that the Review will continue to foster an informed, open, and candid forum for dialogue in the years to come. It is with a heavy heart that we note the retirement of Prof. Giacomo Luciani as Scientific Advisor to the Master of International Energy Transitions. His vision and steadfast support were instrumental in the conception and realisation of this initiative.

Editorial Board 2024-2025

Madeleine Tron is a graduate student in environmental policy and international political economy under the dual master's programme between Sciences Po Paris and the London School of Economics. She holds a Bachelor of Arts and Sciences from University College London, where she majored in Environmental Engineering and Political Sciences. Her professional experience includes ESG analysis, consultancy on climate risk pools with Allianz Reinsurance, and sustainability at Equinor.

Isha Hiremath is a graduate student in the International Energy Transitions Programme at Sciences Po. She holds a diploma in environmental law from the National Law School of India University. Her passion for climate policy began during her time as a legislative aide to a Member of Parliament in India, where she engaged closely with policy development and governance. She also worked with the Institute for Governance and Sustainable Development (IGSD), on issues related to short-lived climate pollutants (SLCPs) and voluntary carbon markets.

Clara Klint is a master's student in International Energy Transitions at Sciences Po and holds a bachelor's degree in political science from the London School of Economics. She is particularly interested in industrial and energy policy to support a resilient, decarbonised economy. Clara has experience in FDI and trade consultancy, as well as energy research at the Ratio Institute in Stockholm, where she analysed the economic and policy conditions shaping the energy transition.

Natalia Feinberg is a first-year master's student at Sciences Po in International Economic Policy. She worked as an International Trade and National Security researcher at Morgan, Lewis, & Bockius after graduating from The George Washington University with a bachelor's in international development and economics. As an undergraduate, she interned with DC-based think tank The Council on Foreign Relations, the U.S. Department of State, and the American Red Cross' Humanitarian Law Team. Natalia is particularly interested in innovative debt refinancing instruments and green bonds.

The Board acknowledges early editorial support by Ana Diaz Vidal.

Cover page photo credits: Milton Lee.

Section 1
EXPERT INTERVIEWS

Interview with Thierry Watrin - The Role of Debt in Financing the Energy Transition

Thierry Watrin is the current Lead of the UN Economic Commission for Africa's Sustainable Debt Coalition. As former Chief Advisor to the Minister of State for Public Investment and Resource Mobilization in the Government of Rwanda, he has been instrumental in shaping a consolidated public investment portfolio, the use of innovative metrics like Green GDP, and public policies to ensure sovereign debt sustainability.

Interviewed by Natalia Feinberg and Madeleine Tron

NF: Thank you so much for joining us today. *Could you start by introducing for our readers the relationship between public debt and the ability to address climate change and development issues?*

> **Thierry Watrin:** Thank you for inviting me. I'm very happy to participate in this interview. The relationship between public debt and the ability to address climate change and development issues is directly tied to the climate landscape and the global energy transition goals. Currently, debt is often seen as a limiting instrument for countries to deliver on their energy needs. The global energy demand is increasing, especially with the rise of new technologies like AI, and this demand often correlates with GDP and population growth.
>
> We need to rethink debt not only as an obstacle but as a tool for leverage. There is no way to achieve the Paris Agreement targets without clean energy. The climate finance gap for Africa between 2020 and 2030 is $2.8 trillion, with annual financing needs of $277 billion. However, only 11% of this is currently being financed. Africa has the fastest-growing middle class, projected to reach between 2 and 2.5 billion people by 2050. If we cannot ensure that their energy sources are green, it will become a global issue, exacerbating disparities between developing nations. Many African nations are already spending more on interest payments than on education or health, which highlights the tension between debt and development.

NF: Could you tell us more about the role of the Sustainable Debt Coalition within that framework, particularly looking forward?

> **Thierry Watrin:** The Sustainable Debt Coalition is a group of 20 countries working together to rethink and reframe debt as a driver of growth rather than a

burden. Debt should be an engine for development, not a constraint. These countries are leading in innovative ways, rethinking the role of debt with a clear sense of purpose.

Some member states have already implemented innovative financial instruments such as debt-for-climate swaps, sustainability-linked bonds, and debt-for-climate conversion mechanisms. These instruments not only provide financial flexibility but also strengthen the technical capacity of Ministries of Finance and Environment. When countries innovate, they must develop strong frameworks for disbursement, accountability, and sustainable taxonomies. Over time, this enhances sovereign capabilities in delivering development goals.

For example, Uruguay has achieved 98% renewable energy. Its transition strategy differs from that of a developing nation struggling to reach even 50% clean energy. At COP29, Uruguay presented their sustainability-linked loan, which offers flexibility in how climate finance is disbursed. Investing in development financing within energy is about adopting a results-oriented mindset.

MT: You mentioned governance frameworks and taxonomies. Could you elaborate on which frameworks you find most necessary to ensure that debt financing aligns with energy transition goals while also avoiding the reinforcement of structural inequalities?

Thierry Watrin: Climate diplomacy involves balancing the conditionality of public funding with the sovereign needs of countries to deliver on their targets. Different countries have different needs, which is why I emphasize a results-oriented mindset in public spending. Rather than simply allocating public funds to general budgets, a strategic approach ensures that financing delivers tangible results.

For example, we often discuss the amount of climate finance committed versus the amount actually received. Instead of focusing solely on the funding gap, we should maximize the impact of the current financing available. This requires a directional mindset—one that prioritizes multiplying the effects of investments.

Regarding frameworks, green bonds typically adhere to strict environmental criteria, such as decarbonization targets. However, sustainability-linked frameworks offer more flexibility by allowing countries to define their transition pathways. The EU taxonomy, for example, considers nuclear energy and gas as transition fuels, whereas Germany does not. Ultimately, it is about balancing national financing needs with global decarbonization goals. Without green energy, achieving the Paris Agreement targets is impossible.

NF: Building on this, which innovative instruments do you find most effective in financing the climate transition? Are there specific instruments better suited for developing versus developed nations, particularly in managing risk?

Thierry Watrin: In the Global South, achieving a multiplier effect requires a comprehensive approach to green energy financing. Funding a solar panel or a mini-hydro project is one step, but ensuring access to these technologies is equally important. For instance, a cold storage facility in East Africa, powered by solar panels, was established but remained inaccessible due to poor road infrastructure. Farmers struggled to reach it, rendering the investment ineffective. A comprehensive approach would have included climate-resilient roads and capacity-building initiatives to educate farmers on its importance.

Regarding financial instruments, green bonds are highly effective in developed countries due to their established regulatory frameworks. However, they have been less accessible in the Global South. Sustainability-linked bonds offer a more flexible alternative tailored to development needs. Additionally, debt-for-climate conversions and debt-for-nature swaps have been successful in countries like Seychelles and Ecuador, where debt structures align with environmental objectives.

For highly indebted countries, debt-for-climate swaps can be essential, whereas those with fiscal space may benefit more from blended finance approaches. In Barbados, for example, a debt conversion initiative leveraged support from the European Investment Bank, the

Inter-American Development Bank, and the Green Climate Fund to refinance debt at lower rates while freeing up fiscal space for blue economy investments.

MT: How can climate diplomacy help debt-burdened countries balance immediate energy needs with long-term resilience, particularly in climate-resilient infrastructure?

Thierry Watrin: Climate diplomacy is a crucial component of development diplomacy. We need to rethink geopolitics, trade, and financial partnerships. The debt-to-GDP ratio in Africa exceeds 60%, whereas in Europe, it is around 80%. However, tax collection in OECD countries is around 36% of GDP, while in Africa, it remains at just 16%. The question, then, is how to finance a sustainable transition while increasing domestic resource mobilization.

Commercial debt in Africa has risen by 43% in the last decade, highlighting the urgent need for a sustainable financial architecture. Discussions at global forums increasingly focus on reimagining financial structures to make them more development-friendly. Climate diplomacy must shift from a zero-sum

mindset to a cooperative approach where financing development benefits all parties.

NF: How do you see the roles of regional cooperation, multinational forums, and domestic institutions like central banks evolving to support climate finance?

Thierry Watrin: Central banks are increasingly integrating climate-conscious policies, stress-testing economies for climate risks. Regional green funds, such as those in Africa and Southeast Asia, bridge the gap between Ministries of Environment and high-level governance, ensuring that policies are implemented effectively at the local level. Without such mechanisms, there is a risk of disconnect between policy decisions and on-the-ground realities.

Localized institutions are essential for maintaining public engagement in climate issues. Without them, people may feel detached from climate policies, leading to scepticism and disengagement.

MT: Finally, what do you foresee as the future trends in sustainable finance, particularly in Africa, and how do these trends align with evolving climate diplomacy?

Thierry Watrin: The future of climate diplomacy lies in innovation and action. My hope is that young professionals, like Sciences Po Alumni, will drive solutions forward, as seen in the 10th Edition of the Youth Leadership Summit. As financial structures become more intertwined, diverse perspectives will facilitate negotiations and foster greater empathic attunement in climate diplomacy.

Innovative financial instruments are increasingly addressing obstacles that once seemed insurmountable. The expansion of international forums and mixed professional backgrounds will enhance mutual understanding, making climate agreements more feasible. I remain optimistic about the direction we are taking in sustainable finance and climate diplomacy.

Interview with Alissa M. Kleinnijenhuis - Financing the Green Transition: Bridging the Public-Private Divide

Alissa M. Kleinnijenhuis is a visiting assistant professor of finance at the Cornell SC Johnson College of Business and is affiliated with the finance department at the Imperial College Business School of Imperial College London. She is a research associate at the Institute for New Economic Thinking at the Oxford Martin School of the University of Oxford, a non-resident fellow at Bruegel, a RPN member of Sustainable Finance at the Centre for Economic Policy Research, and a faculty fellow of the Cornell Atkinson Center for Sustainability.

Her research examines how finance can advance the public good, focusing on leveraging the financial sector for a climate change solution. Her research in her primary area of focus, climate finance, examines how financial incentives can be aligned with limiting climate risks and financing the transition to a carbon-neutral and sustainable economy. Her research is all about making the triangular sectors of finance – the public, private, and academic sectors – work for the green transition.

Interviewed by Ernest Lee and Madeleine Tron

EL: 2024 was our warmest year on record, with temperatures at 1.55°C above pre-industrial levels. Within this increasingly narrow window to reach net zero, emerging markets and developing economies have a big role to play in decarbonisation. One policy you have advocated for is a substantial phaseout in coal via conditional financial support from advanced economies[8]. In a recent paper, co-authored with Patrick Bolton and Jeromin Zettlemeyer, you argue that there is a significant net benefit for the advanced economies too. *Could you briefly introduce to our readers what roadmaps for coal benefits look like? What are the benefits accrued by EMDEs, and advanced economies that finance these phaseouts?*

> **Alissa Kleinnijenhuis:** As you have rightly said, we have at least temporarily overshot the 1.5°C limit. But temperature increase is measured as a 10 year average, so on average we're not exceeding that limit yet. But today, we are still seeing rising global emissions and heading in the wrong direction. The 1.5°C goal is really a physical limit beyond which, for every 0.1°C, we are exposed to much more extreme weather events and the potential crossing of climate tipping points, including the possibility that the Atlantic marine and ocean circulation would collapse, the dying of the Amazon, a huge source of biodiversity that can also can act as a carbon sink. We are headed for a world that is increasingly

[8] Alissa M. Kleinnijenhuis, Patrick Bolton, and Tobias Adrian, 'The Great Carbon Arbitrage'.

hostile to humanity, and we will be suffering really big losses. Climate damages are starting to escalate much faster than in the previous years: we had big floods in Europe, in Valencia, with losses of hundreds of billions. Hurricanes Helene and Milton hit the US coast, amounting to some 300 billion dollars, and there are recent massive wildfires in LA which might reach up to 1 trillion dollars.

If you tally up these losses, excluding the massive damages in developing countries from natural disasters, they already exceed 500 billion dollars in just half a year, while the climate finance we currently provide to developing countries amounts to only 100 billion dollars per year. The mathematics are out of sync. Without giving you the mathematics or the models, we're already suffering more losses than what we are currently willing to provide. The Oxfam Shadow Climate Report 2023 makes it very clear that the $100 billion currently provided is not primarily in the form of grants, which would constitute true climate finance.[9] Instead, much of it consists of loans, with only around $25 billion actually qualifying as genuine financial support, an amount that is vastly insufficient.

The reality is that even if developed countries achieve net zero on time, they will still face a climate disaster if they fail to support developing countries in transitioning at the necessary scale and pace. Most of the emissions in the 21st century are going to come from emerging and developing market economies. It is thus paramount, not just on the basis of the principle of common but differentiated responsibilities as articulated in the UNFCCC 1992 agreement and the Paris Agreement, but also from an economic self-interest perspective of developed countries to offer climate finance at the necessary scale to help decarbonize developing economies.

So, what is the climate crisis? It is really a fossil fuel crisis. Out of the 42 gigatons of annual emissions, about 37 gigatons come from fossil fuels. Carbon taxation alone is not going to be sufficient. We need climate finance to be geared towards financing the phase out of fossil fuels and the phase in of renewables to replace those fossil fuels. I spoke with [Swedish climate scientist] Johan Rockström yesterday, who told me we need a one for one kilowatt to guarantee that countries get back what is phased out.

The fossil fuel industry likes you to believe that all actions are equal. They are absolutely not equal. What they want is to just let renewables meet the growth

[9] Oxfam. 'Climate Finance Shadow Report 2023: Assessing the Delivery of the $100 Billion Commitment', 2023. https://policy-practice.oxfam.org/resources/climate-finance-shadow-report-2023-621500/.

in energy demand. We need to phase out fossil fuels, because that is what is going to overshoot the carbon budget by far, far, far.

Our paper analyses the cost to decarbonize these developing countries and the benefits to them and to developed countries. We estimated empirically the costs of phasing out fossil fuels early, which are essentially the stranded asset value of fossil fuel-fired power plants, the risk-free free cash flows, plus any losses of opportunity cost related to workers that lose their jobs and need to be retrained. We use the reasoning of [Nobel Memorial Prize winner] Ronald Coase that it's actually in our economic interest to simply pay polluters to stop polluting, to offer them grants, because the grant money that is needed to close that early is so much smaller than the of the climate damages that the West would otherwise suffer.

Alternatively, you can pay for early fossil fuel phaseout by selling carbon credits for avoided emissions. Yet, at best that leads to additionality: people might pay to avoid emissions but in reality it is not clear that this mechanism results in diminished emissions in total. A more foolproof way is to simply pay grants. What's left is the cost of renewables, which is a lot more expensive. That's where the majority of the climate finance costs come from: the upfront cost in renewables like solar and wind, but also batteries and grid extension.

What are the benefits? For developed countries, they stem from avoided emissions from fossil phaseout and replacing it with renewables. We can estimate this from their share of the global social cost of carbon, essentially what the developed country's social cost of carbon is. This gives an estimate of what their avoided economic climate damages and adaptation costs are by avoiding every ton of CO2 in developed countries. If you multiply it with total avoided emissions, we can estimate avoided climate damage and escalating adaptation costs. What we find is that climate finance costs to bring about decarbonisation of all developed countries, excluding China, are far smaller than the benefits to developed countries in terms of avoided climate damage and adaptation costs. For the developed countries themselves, their big economic benefits are avoiding air pollution, which is much more localised and one of the leading costs of death. Paying for the transition in the medium, long and current run also help retain a livable country for themselves: it's simply in everyone's interest to advance a new sustainable green value chain and have a carbon border adjustment mechanism.

EL: It seems like you favour the Coasian framework, rather than relying on carbon markets. Still, today's climate finance arrangements seem less and less durable today. In the time since your paper, we've not seen progress on Just Economic Transition

Partnerships (JETPs), for example for South Africa or Indonesia. *With the election of Trump, the US has withdrawn from the Paris Agreement again. Do you see major problems ahead for the climate finance architecture going forward - in terms of political economy, not just economic models?*

Alissa Kleinnijenhuis: My view is that JETPs are a good idea in principle, but they have not been executed in the right way. It doesn't take away their promise. To stay within the 1.5C carbon budget, we need to solve this scale and speed problem of climate change. The current model of finance, which is project based finance, does not serve that purpose. Phasing out fossil fuels without replacing capacity will simply not happen for energy security reasons. If we want to build a renewable plant, but we don't have a plan for how to connect it to the grid, or how to have sufficient batteries, it also will not work. Moreover, if we want to do this at the speed and scale that is required to limit the worst consequences from climate change, it cannot be ad-hoc. It's thus absolutely essential to have a country wide transition planned at the country level, which specifies a phaseout and phase-in pipeline.

So, what we need is system wide finance that actually pays for that phase out and phase in pipeline. JETPs are the first to recognize the need for a country-wide platform and the necessary financial support for a comprehensive transition. They also recognize that the public sector cannot pay everything, and hence bring in the private sector. Think of the Indonesia deal which amounted to 20 billion or so, of which 50% was from the public sector developed countries and some multilateral development banks that helped to channel those funds. These funds are also meant for compensation, namely the opportunity cost of phasing out COVID early.

But what did not go right? Firstly, these deals are actually not of the right size for Indonesia. The Indonesian government alone estimates 100 billion dollars, far more than the 20 billion offered. In fact, our own estimate is closer to 350 billion to achieve the Paris Agreement target reductions in coal. This finance was provided according to the old multilateral development bank model of concessional loans which is not the right way to attract private sector loans. Rather, you want the public funds to be used as catalytic climate finance which reduces the high risks that have made the cost of capital of developed countries prohibitively expensive.

In addition, you need enough grants. Only 2% of Indonesia's inflows were grants, and the majority of that was used as Technical Support Assistance. Consequently, Indonesia is still struggling to close its first coal plant. They're trying to now do it via carbon credits, but it's not clear that will work. At the same

time, Indonesia's grid is already oversupplied, so they cannot just expand renewables without bringing coal-fired capacity offline. Similarly, South Africa received funds for electric buses and other projects, but none of this finance was tied to a specific plan of phase out and phase in. JETPs were limited, but that doesn't mean the country-centric, blended finance approach doesn't work. Here, the World Bank and other developments, multilateral development entities can act as intermediaries between developed and developing countries away from project-based finance.

What about the actual provision of sufficient climate finance to developed countries? Multilateral development banks themselves are not sufficiently funded by wealthier countries to offer countrywide deals at scale. We need developed countries to step up the amount of public funds that they are willing to contribute. This was the discussion at COP 29 in November 2024, where, as part of the commitments under the Paris Agreement, participants aimed to establish a new quantified climate finance goal by 2025, one that goes beyond the $100 billion target to better reflect the actual needs of developing countries.

But what happened at COP? A unanimous agreement must be agreed. The Arab negotiation group essentially refused to agree to any agreement that targeted the fossil fuel sector. Conversely, developed countries and their top [EU and US] negotiators like Bucha and John Podesta have actually read my work and understand that developed countries will reap economic benefits from large-scale climate finance—provided it is tied to emissions reductions through fossil fuel phaseouts.

Developed countries are willing to offer some money for charity and some money out of this principle of “common but differentiated responsibilities”, but not trillions. But as William Nordhaus, who won the Nobel [Memorial] Prize winner, says, climate change is a trillion-dollar problem. Solving it needs a robust incentive structure. But my suspicion is that these negotiators weren’t sure their money was going to be spent well. They ended up agreeing to offer $300 billion a year by 2035, of public, private and other funds, and then to try to leverage $1.3 trillion by 2035 of public, private and other funds.

Is this too little or too late? We currently have 190 gigatons of carbon budget left for one half degrees. If we go linearly to net zero from now, we need to be net zero by 2034; if you allow for negative emissions, perhaps 2038. We need climate finance from developed countries flowing to developing countries to help implement their nationally determined contributions (NDCs) this year, if they don’t, they will not set NDCs aligned with the Paris Agreement goals.

Another point is that climate finance was not provided in the right form. The idea was that there would be a core of public funding, the so-called inner quantum, and that that $300 billion was public funds in grant equivalent form. Ideally, this would leverage $1.3 trillion and actually pay for fossil fuel phase out. But they did not actually commit necessarily to their own public coverage, so it's not clear they can get to the $1.3 trillion without actually committing themselves $300 billion in public funds, which they haven't done.

We have a new paper that's coming out soon, which finds that it's indeed turning out very hard to strike a global agreement with unanimous agreements among parties. With holdouts being inevitable, you get a deal that is the lowest common denominator. Instead, we take a leaf from the climate club idea of William Nordhaus, who saw difficulties in forging a global agreement on carbon taxation. We believe that the climate club model of carbon taxation, which makes it in the interest of smaller groups of countries to partake, could be applied in real life. You could create climate clubs of carbon taxation where a smaller coalition of developed countries, acting in their own self-interest, commit to financing the credible conditional nationally determined contributions (NDCs) of developed countries given that they are aligned with a 1.5°C target, or at least present credible climate plans.

Indeed, the reality is that after Trump, the US is also refusing to honor any commitments made under the UNFCCC agreement, and we don't really expect any contribution from the US during these four years. Still, we argue that even without the US, there's a very strong economic case for the EU and other developed countries to take up a leadership role and do what it takes to finance those countries that are credibly committing to decarbonization. This would also be fiscally responsible. If they were to pay for all developing countries except for China and the oil states like Bahrain and Qatar, it would be only 0.3% of their GDP. In practice, not all developing countries will commit to credible decarbonization so they would not end up paying for all of it. This money could be raised through sovereign debt, without making their debt unsustainable or by raising climate finance levies on shipping for example.

EL: Let's pivot towards the idea of fiscal space and affordability that you mentioned. Climate is introducing an unknown factor for many different countries' financial systems. *Are countries today focusing a lot on the macro and sums of money flows needed, without thinking too much about the stability and how to even measure the stability of financial systems?*

Alissa Kleinnijenhuis: Developed countries should offer climate finance in grant equivalent form, not just in loans. Many developing countries are heavily

indebted and are fiscally not in a stable position. It's essential that they're not further loaded with that. Most developing countries have increased their debt a lot after COVID, but they still have some fiscal space and can raise taxes. So it is absolutely affordable.

What is not affordable is not to take action. What is really expensive is not to transition. That is very expensive. When you talk about financial stability, I don't think the issue at stake is financial stability issues, unless it is provided in debt form. The real financial stability issue is from physical risk and if we cross these climate tipping points. The primary focal point should be mitigation finance to take away the underlying risks and diminish the costs of adaptation finance and loss and damage finance.

EL: Following up on the interrelation between mitigation and adaptation, for example, looking at the $100 billion goal of the Copenhagen Agreement, when that target was reached, about 60% of the financing was allocated to mitigation and around 28% to adaptation. *In addition, academic discussions often emphasize mitigation over adaptation, but your argument is that the two are deeply interconnected, with mitigation having significant knock-on effects on adaptation. Could you expand on this idea?*

Alissa Kleinnijenhuis: I'm not saying that adaptation is not important—it absolutely is. However, if we do not prioritize mitigation, adaptation costs will spiral out of control. Moreover, there are limits to adaptation. For example, the World Bank's approach of committing 50% to adaptation and 50% to mitigation, as well as the emphasis on balance in the new Common Quantified Goals, is not a sound strategy. Again, I'm not suggesting that we shouldn't provide sufficient adaptation funds for those in urgent need, but the priority must be mitigation.

MT: *Could you elaborate on how you think the private sector could step in to manage this critical climate loop and address the gaps created by the accelerating catastrophe? How does this situation place additional burdens on developing countries? Do you have any opinions on how the private sector, through stress testing and other methods, including blended finance, could play a role?*

Alissa Kleinnijenhuis: I will tell you what can and what cannot make a difference. What we are essentially saying is that we need to create almost a new asset class to finance whole-country transitions.

What we have seen thus far are some early, somewhat successful stories. For example, in 2018, the Amundi Planet Emerging Green One fund was established by Amundi in collaboration with the International Finance

Corporation (IFC), the financial arm of the World Bank. This was a blended finance fund, the first green bond fund dedicated to funding sustainability projects in developing countries. They used public funds from the IFC to reduce risk, making it easier for private finance to step in from a traditional risk-return, good-business perspective. And those higher up in the financial hierarchy could get de-risked assets, which ended up with AAA ratings anyway. They also collaborated with local banks to identify and fund the right sustainability projects. This was a $2 billion fund, and it even won several prizes.

Now, $2 billion is nowhere near enough. Again, this is an example of a blended finance fund that does project-based finance. What we really need is a fund at the country level—or multiple funds at each country level, or even regional funds—that finances a whole-country transition. What we need to work towards, and what does not yet exist, is a fund at the right scale that uses some degree of public funds to crowd in private finance, funding most of a country's transition away from fossil fuels and towards renewables. The idea is that such a fund would primarily finance the phase-in pipeline, but there would also be public funds allocated to phase out the fossil fuel pipeline entirely[10].

The important part is that we are asking private finance to step in and not simply because they are “ESG” investors or “impact investors.” Those are relatively small pools of capital, especially impact investors, who are willing to sacrifice returns to do good. In this case, any private investor can participate simply by pursuing good business opportunities.

Why does this matter? Because we’ve seen, particularly in the U.S., but also elsewhere, a degree of backlash against ESG investing, with some arguing that it potentially breaches fiduciary duty. If we need a trillion-dollar climate change solution, we cannot just rely on the goodwill of private finance to “do the right thing.” It has to be in their economic interest as well. If public funds commit enough, it becomes economically viable for private investors because their commitment will ultimately be lower than the cost of avoided damages. If governments provide a strong public commitment to climate finance, it creates a clear incentive for private finance to engage. From their perspective, it becomes a sound financial decision.

Furthermore, if fossil fuel ownership communities are compensated for the earnings they would have made under business-as-usual conditions, transitioning away from fossil fuels also becomes in their economic interest. Climate finance can be structured in a way that creates a win-win for all parties

[10] Recommended reading for more information on system-wide blended finance : Patrick Bolton, Alissa M. Kleinnijenhuis, and Jeromin Zettelmeyer, ‘The Economic Case for Climate Finance at Scale’, and Patrick Bolton and Alissa M. Kleinnijenhuis, ‘COP29 - The Economic Case for a New Common Quantified Goal of Climate Finance (NCQG) at Scale’.

involved. The reality is that private finance has more than enough assets under management to power the global transition. The key is to align their economic interests with climate action—and that is exactly what we are proposing.

MT: Data and research from private finance remains limited in the public domain, which notably stands as an important obstacle to System-Wide Stress Testing as you have highlighted in your work for the Handbook of Financial Stress Testing. *What steps can be taken to ensure greater disclosure and information-sharing without compromising competitive advantage?*

Alissa Kleinnijenhuis: I'm fully on board with the idea that disclosing climate risks is useful, but it will not solve the climate crisis. There's a paper by Lasse Heje Pedersen, who asks whether green finance can fill the gap left by incomplete carbon taxation.[11] He defines green finance as the cost-of-capital differential between brown and green firms. In theory, with good disclosure, you could have a higher differential between the cost of capital for brown and green firms. But what he shows in this paper is that the cost-of-capital differential between brown and green firms would have to rise so much that it becomes unrealistic—at least an 18 basis point differential to reach $180 per ton of CO2, which is the global social cost of carbon. This is unlikely to be achieved.

So yes, we should do carbon disclosure, but that alone won't deliver the scale we need. What we truly need is financing along the lines of what we've discussed. Likewise, stress testing is useful, but it just looks at risks—it doesn't actually mitigate the risk. Again, we need climate financing at scale, following the approach I've proposed.

EL: *How can we bridge the gap between policy analysis, academia, and the wider world of policymaking and financial decision-making, particularly in the context of climate change and finance? How productive are the conversations between different subdisciplines of academia, and is there fluidity between the academic, public, and private sectors? To what extent are these different parties willing to engage with one another, and how can academics ensure their research leads to real-world impact?*

Alissa Kleinnijenhuis: Let me start with the academics. There are quite a few academics who, even though they might work on climate finance, don't actually focus on making an impact. Their priority is publishing well and presenting their papers at top conferences, and while I'm glad they're working on these topics, they aren't going beyond their academic sphere. I think that's partly because the academic incentive structure doesn't truly reward you for anything beyond

[11] Pedersen, Lasse Heje. 'Carbon Pricing versus Green Finance'. SSRN Scholarly Paper. Rochester, NY: Social Science Research Network, 9 March 2023. https://doi.org/10.2139/ssrn.4382360.

publishing in top journals. I try to engage with policymakers and make a real-world impact, but I'm not necessarily rewarded for that. If anything, I might have lost some academic impact by spending time on this.

So, to what extent do the public and private sectors listen to you? From my experience, the answer is yes, they do listen, but it requires you to actively reach out. Everyone is really busy, so if you, as an academic, want your work to be known, you need to engage and bring together the right people to turn these ideas into reality.

But I don't think there's an inherent unwillingness from the private or public sector to engage with academics. They are often very grateful to receive well-researched ideas because, realistically, policymakers are too busy attending meetings to engage deeply with academic scholarship.

When it comes to solving climate change—specifically through solving the climate finance puzzle—the difficulty lies in the need to bring together many parties. For example, we're currently considering setting up a high-level profile event on how to create these funds. But for that to work, you need to involve the highest-level public policymakers, not just those in the middle chain, because they don't have the power to implement such new ideas.

It requires buy-in from developing countries that are willing to commit to credible decarbonization plans. It also requires developed countries to offer finance, because without the financial commitment from developed nations, MDBs can't scale their actions. There also needs to be proper execution, with the help of renewable companies and people on the ground.

So, the difficulty in doing this is that it's a coordination problem. You need the right coordination between all parties, and if one party steps out, the whole thing could collapse. For instance, if developed countries don't offer enough climate finance, even if the rest is willing, they won't be able to act.

To conclude, my answer is that I think it is very possible to make these "triangles" of public, private, and academic sectors work. But it's not something that happens automatically. It's certainly not something that happens just because you write a paper. It requires conscientious and active effort, and even then, you might not succeed. But that's what I'm trying to do—make that triangle work in reality.

Interview with Dario Traum - Clean Energy Investments amid Market and Policy Volatility

Dario joined Macquarie in 2021 to form the Climate Intelligence Unit after a decade working across the energy transition. The unit supports Macquarie in its ambition to further its role as a financier of the transition to a low carbon economy, by advising its senior leadership and generating actionable insights for the business. Dario also helps coordinate and deliver Macquarie's contribution to major climate initiatives, including work to accelerate sustainable investments in emerging markets. Prior to joining Macquarie, Dario was the Head of Energy Transition at BloombergNEF where he worked for over 7 years, and a trainee in the German development cooperation's MENA energy transition mission. Dario holds a Masters in International Energy from Sciences Po Paris and a BSc in Environmental Economics from the University of York.

Interviewed by Isha Hiremath and Gabriele Romeo

Question 1

GR: The ongoing energy transitions are impacting commodity markets, sparking repercussions such as heightened volatility driven by supply-demand imbalances and the divergence between business-as-usual scenarios and net-zero pathways. This volatility adds layers of uncertainty to an already precarious landscape. As of January 2025, natural gas price benchmarks have surged by over 60% year-on-year, while key materials like uranium, aluminium, and lithium have seen declines of 20-30%.

At the same time, infrastructure investments - particularly in the clean energy sector - must scale up dramatically to support the transition. A critical assumption underpinning such investments is the expectation of stable returns on assets. However, heightened market volatility undermines this stability. While risk hedging mechanisms can mitigate some effects, they often lead to higher premiums borne by the private sector, potentially dampening investment levels, or by public budgets, which are already under strain.

How can the tension between escalating market volatility and the need to scale clean energy infrastructure investments be resolved?

> **Dario Traum:** Maybe I'll break my response into two parts: first, the broader energy markets, and then renewables specifically.

On the broader energy markets, yes, there is volatility right now. But to be fair, things have quieted down a little bit if we compared to the volatility seen during COVID, followed by the invasion of Ukraine. If you look at oil and gas prices today compared to right before the Ukraine invasion began - particularly in Europe - gas prices are still high; however, we're well below that peak. Nonetheless, over that period, we saw considerable inflationary pressures, volatility, and real challenges for companies in Europe in terms of managing risk and exposures.

Some industries were severely affected - industrial demand in Germany, for example, hasn't fully recovered. One key takeaway from this period was that as fossil fuel prices increased, governments around the world reaffirmed their commitments to renewables as a strategy to reduce exposure to both high and volatile fossil-fuel prices. Beyond Europe, also in India, China, and Pakistan - markets that rely heavily on imported gas or oil - you saw a more aggressive pivot to renewables and electrification. For instance, China is on track for around 50% EV penetration this year, which is 10 years ahead of its target. That has taken a noticeable bite out of oil demand growth. This sort of dynamic means that when geopolitical tensions flare up, the direct impact on oil and gas prices can be more muted than it would have been a decade ago. Renewables, EVs, and in some cases reduced demand in industries have all contributed to a more tempered market.

Meanwhile, on the supply side, there's a lot being built: more LNG export capacity, more offshore oil in Latin America, steady production in the US, and efforts from OPEC. So overall, the environment could become somewhat deflationary for fossil fuels in the longer term. We still see volatility, but the energy system's response, bringing on more supply and investing in alternative technologies, helps mitigate some of that.

Now, how has this volatility impacted infrastructure investors? One big challenge for renewables is that if you lock in a price in an auction or in a PPA with a private counterparty at the start of your development phase, and your project takes four or five years to build, such as in the case of wind, a period of high inflation can erode margins. Labor costs rise, financing costs rise, but your locked-in price doesn't. That pressure can lead to cancelled or delayed projects. We did experience a challenging period, but things have been improving since last year since prices have adjusted. PPA prices, especially in the US and also in Europe, have adjusted upward to better reflect project costs. Some contracts have even been renegotiated to avoid outright cancellation. Manufacturers are also factoring in these new cost realities. Inflationary pressures on equipment are also easing: Chinese PV panel prices are coming down again; battery prices

are declining; turbine costs have stabilized; financing rates in Europe have started to come down. Overall, it seems the worst of that inflationary period is behind us, and there's still a lot of demand for clean electricity, which should help sustain investment.

GR: You mentioned the adjustments in PPAs and other long-term instruments. Looking forward, is there room for more flexibility within these instruments or is it more about adding complexity in other parts of the market design?

Dario Traum: You raise a good point. In many markets with growing renewable penetration (Europe is nearing 50% renewables, for example), we need market reforms. Awarding fixed returns in auctions to renewables is a popular and effective way to procure clean electricity, but we're also seeing periods of very low or even negative wholesale electricity prices, and there's a recognized need for capacity markets to ensure dispatchable generation is built. No one has found the perfect recipe for this yet. We have to incentivize zero-carbon electricity generation as it helps us meeting decarbonization goals, ensure sufficient dispatchable capacity for reliability and energy security, and still allow wholesale markets to function for price discovery and to encourage flexibility. Multiple mechanisms- like rethinking CFDs, using carbon pricing more effectively, or shifting from generation incentives to investment incentives - are being explored.

IH: We've talked about energy security and how it's driving renewables in places that rely on imported oil and gas. But in certain areas, like green hydrogen, there's still difficulty securing offtakers because of higher costs. Margins are narrow, infrastructure is expensive, and buyers are hesitant. You also mentioned carbon markets - could that help?

Dario Traum: Green hydrogen is still in its infancy and has been through a hype cycle that is now rationalizing. If we wanted to draw some parallels, maybe ESG investment also went through a similar cycle. But going back to first principles, the bulk of emissions can be tackled by electrification with significant increases in clean power.

And if you think about our business at Macquarie, our renewables development platforms are investing in and developing clean-energy projects around the world. Electricity is really central to what we do and where we have scale, coverage, and a strong base. On the offtaker side, there's a compelling supply-demand story: major tech companies are investing in data centers; transportation is moving toward EVs; and many economies want to electrify to reduce exposure to volatile fossil-fuel prices.

That said, what you raise about hydrogen specifically still applies: it's a technology largely aimed at hard-to-abate sectors. Unfortunately, the notion that all decarbonization will happen at a discount to the status quo is misguided, particularly in very price-sensitive industries like steel, which must also compete with Chinese overcapacity. Expecting these offtakers to pay a hefty green premium without additional support is extremely difficult. That's why policy support is essential. A simple carbon price might not be enough, because it risks driving heavy industry out of certain regions if the cost premium is too high. Mechanisms like contracts for difference for industrial applications, similar to renewables CFDs, could bridge that gap. Governments are constrained by budgets, so they're selective about where to grant subsidies, but focusing on high-impact sectors (like sustainable aviation fuels, shipping fuels, or fertilizers) can make sense. Those are areas with fewer alternatives and where distributing a moderate green premium across a broad user base is more feasible.

Question 2

IH: The Russia-Ukraine conflict has profoundly disrupted global energy markets, heightening the emphasis on energy security. Meanwhile, the European Union, guided by the recommendations of the Draghi Report, is working to enhance the competitiveness of its industries, particularly but not limited to the cleantech space. Local content requirements (LCRs), which mandate a specified percentage of domestically produced components in key sectors, are being pursued as part of this effort.

How have these trends reshaped private-sector financing for cleantech, especially in Europe? Would this crowd-out cleantech investment in under-developed and developing countries of Africa and Asia?

Dario Traum: Let's break that down. There has never been more investment in clean-technology supply chains globally, and importantly, for the first time, over the next two or three years, the U.S. and Europe, plus other non-Chinese regions, will capture a significant share of new investment in manufacturing.

Until now, China has been the success story for scaling PV and batteries. They have overcapacity in several areas and are, to some extent, exporting that capacity overseas. Europe and the U.S. want local supply chains for energy security and to create industrial employment. However, competing directly with China in commodity-like products (e.g., standard PV panels) can be very expensive because China's supply chains are already massive and highly efficient. Countries like Australia have taken a more pragmatic approach,

asking, “Does it really make sense for us to start a PV manufacturing industry from scratch when we can import panels far more cheaply?” On the other hand, for something like batteries to power an auto industry, the stakes are different. For example, we have invested in Verkor, the developer of France's first gigafactory in Dunkirk, supported by the French government and the European Investment Bank, to ensure battery supply for European EV manufacturing. I think it's the kind of well-designed projects with broad stakeholder support that are important to the industrial tissue of large economies.

Regarding crowding out investment in emerging markets, we’re actually seeing increased investment flows to countries like Brazil, Mexico, and parts of Southeast Asia from Chinese manufacturers who want to diversify geographically and also serve local demand. So, in many cases, emerging and developing markets are benefiting from the shift. Some of this new manufacturing will serve local needs - emerging markets are electrifying transport faster than many expected - and some of it is designed to circumvent geopolitical trade barriers by producing in a neutral location.

GR: It could also be an opportunity for technology transfer, but some might worry that having Chinese companies build factories abroad still creates dependency, which could be used as a weaponisation tool. Is there scope for Western lenders or investors to partner with Chinese companies on battery manufacturing or other cleantech without creating unwanted risks?

Dario Traum: Yes, absolutely. I’d be less concerned about immediate geopolitical risk because if a Chinese manufacturer builds a factory inside the EU for instance, it’s quite difficult for it to be “removed” later. It becomes an EU-based asset. If that plant generates value and creates local jobs, it’s in everyone’s interest to keep it operational. Europe, for example, is open to Chinese companies building battery factories in the EU, as long as there’s technology transfer, local job creation, and so on. If a Chinese company wants to invest, they can typically access European financing. So it can actually reduce the impact of geopolitical friction on clean technology supply chains, not heighten it.

IH: What about ventures like Northvolt, which struggled financially and entered bankruptcy? Some might wonder if partnering with Chinese firms is a safer bet than trying to develop, say, a “Northvolt 2.0” from scratch. Any thoughts?

Dario Traum: Every project has its own story; it’s hard to generalize. It’s true that completely avoiding anything from China in your supply chain is extremely difficult, whether we’re talking raw materials or technology. But that doesn’t

mean you need partnerships that fully rely on Chinese equipment and technology partners. It's about diversification and focusing on where you can innovate. Northvolt's situation is quite specific- location choices, partners, how they sourced talent, and so forth. I wouldn't say it defines the outlook for every non-Chinese battery project. We're certainly seeing successful plants emerging in the US and Europe with different partnership models.

Question 3

GR: The recent US elections and the country's withdrawal from the Paris agreement have been interpreted by many observers as prompting shifts in the financial sector's positioning on climate goals. For instance, several financial institutions have withdrawn from the Net-Zero Banking Alliance in recent months while maintaining that their commitment to net-zero remains unchanged. As private capital is the cornerstone of energy financing, these moves have sparked concerns about the stability of climate-focused investment strategies.

Do the fundamentals of the energy transition remain intact, or are they increasingly susceptible to shifts in political climates and institutional strategies?

Dario Traum: If we step back, the energy transition is now a trillion-dollar-plus annual investment movement. A significant portion of that is in the US, and what's interesting is it's been relatively insulated from political cycles. During the previous Trump administration, despite rhetoric and the withdrawal from Paris, US clean energy deployment and investment actually rose. So, what we want to really convey as the first key message is the energy transition has many aspects that are not political. They are driven by demand side factors, improved economics of certain technologies, corporate demand for clean power, and stable regulation in key states and power markets. Brazil is another example: at times, you might have expected shifts in government policy to slow momentum, but investment in renewables has remained robust. Factors such as attractive resources, established supply chains, and strong local players have helped Brazil keep moving forward regardless of political oscillations.

On top of that, the current policy environment (including the Inflation Reduction Act) is stimulating a major wave of manufacturing and clean power development. Even if you shift to a less climate-friendly administration, removing something like the production tax credit is not straightforward, nor is ignoring the fundamental demand for more electricity in data centers, EVs, etc. The business case for clean energy often stands on its own.

GR: Michael Liebreich has described a growing divergence between the US (deemed a "petrostate") and China (an "electrostate"), as China has built a huge advantage in EVs, batteries, solar, etc. Meanwhile, the US has strong and growing fossil-fuel production. Could China's slowdown or the US's cleantech momentum change these energy-transition fundamentals?

> **Dario Traum:** The US is indeed a "petrostate" in one sense. But it also has huge technological momentum that relies on electricity, not petroleum. If you need to power data centers, you're not going to burn crude oil; you'll need gas, renewables, or nuclear.
>
> You can try to increase oil and gas output, but if market prices don't justify large expansions, private investors won't fund them. So even with political support, you can't just snap your fingers and double oil production at will; the economics have to line up. Meanwhile, the demand for electricity, especially clean electricity, continues to grow rapidly. That underpins the transition no matter who is in office. I don't see that structural trend reversing.
>
> China has been a major growth engine for decades, lifting hundreds of millions of people out of poverty by building massive infrastructure and industrial capacity. Slowing down from, say, 8% growth to 4% growth can feel dramatic inside China because of the large relative shift. But there's still plenty of room for continued improvement in living standards and infrastructure. The county's pivot to new-energy industries (EVs, solar, batteries) is a bright spot in its economy. Even if its overall growth is moderating, the energy-transition sector remains central to generating jobs, domestic demand, and exports. So I'd expect them to keep pushing aggressively to maintain leadership.
>
> When you compare that to the US, yes, the US still produces a lot of fossil fuels, but it also has a drive to compete with China in the clean technology space, supported by strong private-sector demand for renewables, data-center expansion, and EVs. That persistent demand for electricity drives a major chunk of the US energy transition. So even though there's a "petrostate" element, the technology and economic forces pushing decarbonization remain powerful.

Question 4

IH: AI is increasingly being used to automate decision making by most industries including energy finance. For instance, it is being deployed to increase access to finance to formerly underserved sections of society. AI has the potential to transform how energy transition projects are financed, from predictive modelling of market trends to optimising energy infrastructure deployment.

How can the energy infrastructure sector leverage AI to enhance precision in forecasting project performance?

Dario Traum:
From our perspective, AI has a significant impact on both the demand and the supply side of the energy transition. On the demand side, technology companies using AI in data centers are some of the largest corporate buyers of renewables. Their need for large amounts of power, ideally clean and reliable, drives investment in new projects. At the same time, our own digital infrastructure investments benefit from AI's rapid adoption because more data centers need to be built.

On the supply side, energy infrastructure is fundamentally an optimization problem. AI can process massive datasets quickly, allowing us to refine forecasts for everything from wind and solar production to load profiles and grid constraints. For example, where the International Energy Agency publishes three main scenarios for the future of energy today, we could run dozens or hundreds with a fraction of the resources, making project modelling far more sophisticated. At a project level, this could mean better risk management for investors, more stable returns for projects, and potentially smoother integration of renewables into the grid. There are also potential gains for emerging markets. If one skilled engineer paired with an AI assistant can handle tasks that used to require entire teams, it lowers barriers to high-quality project planning. It can also facilitate financing. Investors often want reliable data and sound designs before committing capital. AI-powered analytics could streamline feasibility studies, reduce uncertainty, and make the case for investments in countries that haven't yet attracted large-scale private capital.

Of course, there is concern about energy consumption: AI operations are power-intensive. Tech companies have a track record of signing power-purchase agreements for renewables. It's also worth noting that whenever capacity constraints appear, you tend to see major innovation in efficiency. Data centers and chip manufacturers have historically boosted efficiency in leaps and bounds whenever the cost or availability of power becomes a concern. So on balance, AI is likely to be a net positive. It creates new demand, which supports renewable deployment, and it offers better planning and forecasting, which can accelerate the energy transition globally. We'll need policy support to ensure grids can handle the extra load and that robust permitting processes make large-scale projects feasible. But the opportunities for optimization and better decision-making are very real, and they hold particular promise for accelerating energy investment where it's most needed.

Section 2
DEBATES

First Debate - Financing Fossil Fuels: Abrupt Stop or Strategic Exit?

Should financial institutions cease providing loans and underwriting for fossil fuel projects, rather than implement a slow transition period that balances environmental goals with the economic and energy needs of the present?

For: Stringent policy is necessary to effectuate the energy transition.

Hugo Kapteijn
Master's in International Energy Transition, Sciences Po

Coming from the Netherlands, Hugo Kapteijn is currently pursuing a master's degree in International Energy Transitions at Sciences Po. Hugo holds bachelor's degrees in Dutch law and Politics, Philosophy, Law, and Economics from the University of Amsterdam.

The recent wildfires in Los Angeles have served as frightening manifestations of increasingly severe climate catastrophes. Natural disasters of this kind are becoming more and more prevalent, intrinsically linked to an increased concentration of greenhouse gases in the atmosphere.[12] They showcase the devastating damage that climate change can and will bring about if significant changes are not made. Limiting the damage caused by these and other effects of climate change requires a drastic approach that sharply reduces the use of fossil fuels and related emissions.

In the International Energy Agency (IEA) 2024 World Energy Outlook (WEO), developments compatible with 2050 net-zero targets require a reduction in oil use to 58 million barrels per day by 2035, and 23 million barrels by 2050 (International Energy Agency, p. 138).[13] The continued financing of new fossil fuel projects is incompatible

[12] Van Aalst, M. K. 2006. "The Impacts of Climate Change on the Risk of Natural Disasters." *Disasters* 30 (1): 5-18.
[13] International Energy Agency. 2024. *World Energy Outlook 2024.* Paris: IEA.

with the respective 44 and 77% decreases necessary to achieve such figures. As such, it can be argued that financial institutions should cease to provide funding for fossil fuel-related projects, with the caveat of continued finance to projects aiming to reduce the emissions of existing fossil fuel infrastructure. This paper argues that such a cessation will save lives, and produce better fiscal outcomes, while downsides are limited. The trade-off involved here acknowledges growing energy demand and the SDG-7 which aims to increase access to energy worldwide.

The benefits of ceasing fossil fuel financing are difficult to ignore

Ceasing lending and financial support for fossil fuel projects will produce various beneficial outcomes. Firstly, it encourages oil and gas companies to explore investments in green technologies such as wind, solar, and energy storage, areas that have long seen a reluctance in investments. The current investment gap for renewables amounts to 400 billion dollars per annum between 2024 and 2030.[14] A cessation of fossil-lending could, for example, have discouraged BP from divesting its wind projects and refocusing its business strategy towards the fossil sector.[15] The culmination of these incentives will result in a more efficient allocation of capital that respects the true environmental costs of fossil fuels. This will in turn be a valuable contribution to achieving climate targets set in the 2015 Paris accords, and reinforced by the IEA's NZE scenario.[16]

While the achievability of the NZE scenario is debated, there is broad support in academia about the disastrous consequences of unmitigated climate change. Researchers argue that any additional warming of the planet will contribute to tens of thousands – perhaps millions – of additional deaths.[17] The link between increased climate migration and the destabilization of societies, as well as the potential for the extinction of a sixth of all species in a business-as-usual scenario has been extensively explored. [18] [19] As such, we are faced with both a strong practical, as well as a moral obligation to limit warming to the best of our abilities. The cessation of fossil fuel financing by financial institutions goes towards fulfilling that obligation.

There are also fiscal arguments to cease fossil fuel financing. Cessation would act to prevent path-dependence and lock-in effects caused by current investments in fossil fuels. As fossil fuel projects often have long lifespans and payback periods, there is a palpable risk of stranded assets, where evolving regulations and shifting consumer

[14]Alam, Shafiqul, Vibhuti Garg, and Labanya Prakash Jena. 2024. "Bridging the Financing Gap to Triple Renewable Energy Capacity." *Institute for Energy Economics and Financial Analysis*, November 8.
[15] Li, M., G. Trencher, and J. Asuka. 2022. "The Clean Energy Claims of BP, Chevron, ExxonMobil, and Shell: A Mismatch between Discourse, Actions, and Investments." *PLOS ONE* 17 (2): e0263596.
[16] International Energy Agency. 2024. *World Energy Outlook 2024.* Paris: IEA.
[17] Ritchie, H. 2024. "How Many People Die from Extreme Temperatures, and How This Could Change in the Future: Part Two." *OurWorldInData.org.*
[18] Adger, W. Neil, Nigel W. Arnell, Richard Black, Stefan Dercon, Andrew Geddes, and David S. G. Thomas. 2015. "Focus on Environmental Risks and Migration: Causes and Consequences." *Environmental Research Letters* 10 (6): 060201.
[19] Lambers, Janneke Hille Ris. 2015. "Extinction Risks from Climate Change." *Science* 348 (6234): 501-502.

attitudes kill returns and leave investors with negative profits.[20] This is worsened in a situation where financial institutions finance projects with consumer deposits. There is reason to believe that a sudden market re-evaluation of fossil assets can significantly diminish the value of investment portfolios held by various financial institutions.[21] This would be reflected in the returns guaranteed by pension funds, and ripple through the broader economy. Not only would this situation hurt welfare, it would also worsen prospects for additional green investments which require a strong economic foundation.

Downsides are moderate and can be mediated

It may be countered that fossil fuel projects can help save and improve lives. One example is the Songo Songo Gas Project in Tanzania, which helped swathes of the country gain access to cleaner and more reliable electricity.[22] However, a relatively sharp cessation of financing from financial institutions holds the potential for nuance and does not necessitate a blanket ban. Rather, such a cessation can redirect money and effort towards any projects that make a real contribution to social and economic well-being, such as the Songo Songo Gas Project mentioned before. Meanwhile, a cessation will decrease funds flowing to projects which aim purely to make a profit while disregarding externalities. This includes deep-sea drilling initiatives in the Gulf of Mexico that, in addition to locking in the extraction and burning of millions of additional barrels of oil, present risks of returning environmental catastrophe mirroring the 2010 Deepwater Horizon oil spill.[23]

Funding options can thereby remain for beneficial projects. Energy companies that wish to consider investing in fossil fuels can do so using their own retained earnings/corporate cash flows, restricting fossil investment to that which is absolutely necessary for the continued existence of their enterprises. For example, BP had a free cash flow of 2,2 billion dollars in Q3 of 2024, but returned 2 billion dollars to shareholders.[24] With a change in distribution policies and additional equity financing, enough money can be made available to make essential investments. Where projects are necessary for social or economic development, government funding would be the first recourse. Alternatives include foreign direct investments orchestrated by states, or funding from multilateral development banks (MDBs). If none of these options are viable, exemptions can of course be arranged so as not to jeopardize economic development and access to energy.

---

[20] Hansen, T. A. 2022. "Stranded Assets and Reduced Profits: Analyzing the Economic Underpinnings of the Fossil Fuel Industry's Resistance to Climate Stabilization." *Renewable and Sustainable Energy Reviews* 158: 112144.
[21] Boermans, M. A., and R. Galema. 2019. "Are Pension Funds Actively Decarbonizing Their Portfolios?" *Ecological Economics* 161: 50-60.
[22] Bishoge, Obadia Kyetuza, Lingling Zhang, Witness Gerald Mushi, Shaldon Leparan Suntu, and Grace Gregory. 2018. "An Overview of the Natural Gas Sector in Tanzania-Achievements and Challenges." *Journal of Applied and Advanced Research* 3 (4): 108-118.
[23] McCormick, Myles, and Jamie Smyth. 2024. "Offshore Oil Is Back. At What Cost?" *Financial Times*, November 18.
[24] BP. 2024. "Third Quarter 2024 Results." *Press Release*, October 31.

Conclusion

Right now, the world is at a crossroads. We must move decisively to readjust our energy development to meet current climate targets. To limit catastrophe, ruin, and loss of human lives, it is essential to keep global warming to an absolute minimum. This requires drastic policy decisions, including the cessation of institutional financing for fossil fuel projects. This will reallocate money to green technologies, while shielding the economy from a fossil fuel investment bubble. Alternative cash streams remain available for fossil fuel projects that meet SDG-7 objectives.

Against: All-or-nothing and nothing-for-all: Criticizing the absolute mindset towards energy transition.

David Difrancescomarino
Senior Consultant

David Difrancescomarino has over three years of experience in energy transition consulting, focusing largely on the development of the hydrogen and clean gases economy in North America and Europe. David is a graduate of the University of Ottawa.

There is little room to debate the negative consequences of incremental global average temperature increase towards and beyond 1.5ºC above pre-industrial levels, including but not limited to exacerbated extreme weather events, disrupted agricultural systems, and forced human displacement.[25] According to the UN Net-Zero Coalition, limiting warming to 1.5ºC would require a net reduction in global anthropogenic greenhouse gas (GHG) emissions of 42% by 2030 compared to 2024 levels, and 100% (Net-Zero) by 2050.[26] By most estimates, fossil fuels are responsible for over 70% of global GHG emissions, leading many to believe that it is in humanity's best interest to avoid any new fossil fuel lending and invest massively in cleaner energy alternatives.[27] It can be debated, however, that the cessation of lending for new fossil fuel projects is neither the most sustainable nor the most socioeconomically optimal path forward. Additionally, it is argued that a balanced approach to energy transition is needed, one which maintains persistent total fossil fuel reductions as a major societal priority, but

[25] World Health Organization. 2023. "Climate Change." October 12.
[26] United Nations Environmental Program. 2024. *Emissions Gap Report 2024.* October 12.
[27] Cambridge Institute for Sustainability Leadership. 2024. "Phasing Out Fossil Fuels."

recognizes that strategic investment into certain new fossil fuel projects can play a role in meeting urgent needs.

Halting new fossil fuel project lending could mean neglecting near-term human development needs, and missing opportunities to decarbonize efficiently.

The many benefits of energy transition should not be undervalued, including improved pollution-related health outcomes, millions of new jobs, and new markets for clean technologies.[28] However, there are numerous trade-offs to consider, especially as the pace of transition towards a fossil fuel-free world is accelerated. Access to electricity alone remains a first-order concern for over 730 million people worldwide, a means that correlates positively with socioeconomic indicators like the Human Development Index (HDI), and GDP per capita.[29] Concurrently, around 1.2 and 3.5 billion live in energy poverty and without reliable power respectively.[30] [31] Certainly, the cost of energy is a key factor in providing energy access to some of the world's poorest populations, opening the debate on which sources are cheapest.

Solar PV, often touted as the cheapest electricity generator, is not always the lowest-cost option even in some of the world's sunniest places. One reason is that grids with high shares of intermittent power require energy storage to ensure consistent supply, adding significant cost compared to fossil fuel-powered electricity generators. As an example, the levelized cost of new solar generation in Africa is expected to fall between $18-$49/MWh by 2030, compared to new gas-fired power generation of between $30-110/MWh.[32] However, the levelized storage cost needed to balance solar energy supply is likely to add anywhere from $100/MWh to upwards of $150/MWh for various storage technologies including lithium-ion batteries.[33] Moreover, although moderate intermittent power penetration typically reduces electricity prices in a balanced energy mix due to nil fuel costs, it has been established that very high penetrations can greatly increase price volatility and reduce system reliability. As a result, even though total solar and wind power generation is expected to steadily increase, certain regions will likely continue developing fossil fuel projects to build balanced energy mixes amenable to reliable power and economic growth where other baseload power sources like hydroelectric or nuclear are unrealistic. Of course, sustainable intermittent power will become better tolerated with technological improvements and investment instruments like carbon markets, but the pace of transition is further limited by certain hard constraints such as critical mineral demand.

[28] International Energy Agency. 2021. *Net Zero by 2050.* May.

[29] energypedia. 2018. "Socio-Economic Impact of Access to Energy." September 19.

[30] Energy Hub for Growth. 2020. "3.5 Billion People Lack Reliable Power." September 8.

[31] World Bank Blogs. 2024. "Beyond Access: 1.18 Billion in Energy Poverty Despite Rising Electricity Access." June 12.

[32] International Energy Agency 2022. Africa Energy Outlook 2022. May.

[33] Guidehouse. 2024. "Long-Duration Energy Storage."

To meet the demand for new energy technologies in line with Net-Zero, the IEA predicts critical mineral demand in 2050 will increase by a factor of around five compared to 2020.[34] Importantly, the development of the necessary mining value chains falls far below the required trajectory, with geopolitical instability, humanitarian concerns, and additional environmental damage further worrying investors. Ultimately, as these bottlenecks persist, it is unlikely that lead markets for these materials can be developed as fast as our highest expectations.[35] [36]

Moreover, using fossil fuels as a bridge for energy transition can provide energy security and economic benefits, while kick-starting decarbonization. In regions such as the Middle East, Africa, India, and Southeast Asia, national policy and continued investment are driving the replacement of coal with natural gas-fired power, which emits half as much CO_2 per unit of energy produced. Notably, this transition has already contributed to double-digit percentage reductions in total GHG emissions in countries like Canada, the US, and the UK.[37] [38] [39] However, upstream emissions associated with the extraction and processing of natural gas must be mitigated to the extent possible for overall emissions reductions to be realised. In addition, the continued development of liquefied natural gas infrastructure in net energy-deficient regions like Southeast Asia, China, and Europe, as well as net energy-surplus regions like North America and the Middle East, is improving energy security and providing economies with the capital required to invest in cleaner energy solutions and climate mitigation solutions.[40] Accordingly, it can be argued that continued investment into certain fossil fuel project types such as natural gas is not only an effective socioeconomic lever, but can also be a driver for decarbonization.

Financial institutions have a major role to play in determining the optimal energy transition pathway.

Although it is argued that new fossil fuel investment can be beneficial, there is no denying the need to gradually transition away from fossil fuels to a cleaner energy economy. To determine the best way forward, it is imperative to understand where investment in fossil fuel projects comes from. Currently, global fossil fuel subsidies likely exceed $7 trillion, and if reformed, could reduce global GHG emissions in line with the UN target of 42% below baseline levels in 2030.[41] Yet, another important linchpin for continued fossil fuel investment is project syndication debt, which enables

[34] International Energy Agency. 2022. The Role of Critical Minerals in Clean Energy Transitions. March.
[35] Center on Global Energy Policy at Columbia | SIPA. 2023. "Critical Mineral Supply Constraints and Their Impact on Energy System Models."
[36] Laurent, A., et al. 2024. "Assessing the Social and Environmental Impacts of Critical Mineral Supply Chains for the Energy Transition in Europe." *Global Environmental Change* 85 (May).
[37] Canadian Gas Association. 2023. "CGA By the Numbers: Coal Switching in Canada and the LNG Potential Abroad."
[38] U.S. Energy Information Administration. 2021. "Electric Power Sector CO_2 Emissions Drop as Generation Mix Shifts from Coal to Natural Gas." June 9.
[39] Carbon Brief. 2024. "Analysis: UK Emissions in 2023 Fell to Lowest Level since 1879." March 11.
[40] Asia Natural Gas and Energy Association. n.d. "LNG to Asia."
[41] International Monetary Fund. 2023. "IMF Fossil Fuel Subsidies Data: 2023 Update." August 24.

deals that are too large for any individual bank's balance sheet by spreading risk among syndicate participants. In total, syndicated loans for fossil fuels accounted for 66% of global fossil fuel finance in 2018, and are often synergistically combined with subsidization.[42] Research shows that networks of syndicated banks are resilient to uncoordinated divestment, since financing can easily be substituted by banks with less exposure to climate policy. Accordingly, this is readily done through lending relationships conducive to the sharing of information and experience.[43] To properly address debt syndication, a systematic approach in which the phase-out of financing by key institutions in certain regions prevents substitution and leads towards a tipping point that greatly increases the efficiency of phase-out. Banks in the US, Canada, China, and Japan are key targets for early phase-out as they tend to substitute finance in the EU and elsewhere, while EU banks decreasingly substitute fossil fuel financing in other geographies.[44] Ultimately, policy targeting specific project types and banking networks could likely have an outsized benefit on the degree and efficiency of decarbonization. However, effectively incentivizing financial institutions to invest in new clean energy projects will also require improving the relative attractiveness of financial returns over new fossil fuel projects, through additional technology improvements, shifting subsidization, and holistic work addressing community needs adjacent to energy access to make sure vital needs are met.

Conclusion

The subject of this debate is a popular moral dilemma, in which possible detrimental outcomes are weighed against ongoing suffering. If the goal is to optimize human flourishing now and into the future, it is clear that a balanced approach toward energy transition is needed. This approach must realize persistent reductions in total fossil fuel investment to mitigate climate change while prioritizing affordability and energy access through pragmatic investment in certain fossil fuel projects moving forward.

[42] Falkenberg, M., Rickman, J., S. Kothari, et al. 2024. "The Challenge of Phasing-Out Fossil Fuel Finance in the Banking Sector." *Nature Communications* 15: 51662.
[43] Ibid.
[44] Ibid.

Second Debate - Green Bonds & Carbon Markets: Solution or Shortfall?

Are innovative financial instruments, such as carbon markets and green bonds, effective in bridging the financing gap for the energy transition globally?

For: carbon markets and other innovative financial instruments should be strengthened and regulated, not abandoned

Andrea Bonzanni
International Emissions Trading Association

Andrea Bonzanni is the international policy director of the International Emissions Trading Association (IETA). He has previously worked at EDF Trading, Equinor, and the UN Economic Commission for Europe (UNECE). From 2012 to 2021, he has been a visiting professor at Sciences Po.

As we are entering into the second half of what the IPCC defined as the "critical decade" for the fight against climate change, two events that took place last November are likely to shape the energy transition for the years, if not decades, to come. The first event is the re-election of Donald Trump as 47th President of the United States, whose consequences for energy and climate policies are not yet fully clear, but directionally obvious. The second is the outcome of the COP29 summit that took place in Baku, Azerbaijan. While the summit is unlikely to be remembered as a historic one, the decisions that emerged after two weeks of tense negotiations are consequential.

In Baku, a new collective quantified goal (NCQG) on climate finance was agreed and resulted in a commitment of $ 300 billion per year by 2035 from developed country governments. This figure might seem big to the general public, but it is a far cry from the investment needed in the energy and land use sector to keep global temperatures at check. According to the McKinsey Global Institute, capital spending would need to

amount to $ 9.2 trillion per year.[45] UNCTAD estimates that the cost of the energy transition for several developing countries would amount to 19% of their GDP.[46]

While such an underwhelming outcome was harshly criticised by many NGOs and developing country governments, the bottom line is clear - governments in rich countries will not directly provide the resources necessary to finance the energy transition globally. The impact of a second Trump presidency further strengthens this conclusion. The corollary is also clear – if public investment is insufficient, finance must be mobilised through any other means. The NCQG decision quantifies the need for international climate finance at $ 1.3 trillion of "public and private resources" which ought to be mobilised by "all actors".[47] A reference to carbon markets, green bonds and debt-for-climate swaps was included in a draft version of the text but removed from the final iteration.[48] Even short of an explicit mention, it is clear that any approach to climate finance that does not include innovative instruments is destined to fail and disappoint.

The theory behind carbon markets is simple. By measuring and pricing carbon emissions across the economy, they establish a mechanism whereby emitters compensate for those emissions they cannot or do not want to reduce by purchasing certificates (called *carbon credits*) that finance projects that reduce or remove emissions elsewhere. If done well, carbon markets mobilise financial resources where it is cheaper and faster to reduce emissions, enabling us to reach our climate targets faster and at a lower cost, or to abate more emissions for the same cost. In the international political economy of climate change, the actors with abundant finance and technology but higher abatement costs are usually in the global North, while those with lower abatement costs but no finance and technology to untap them are usually in the global South. International carbon markets thus provide the policy and financial infrastructure to drive North-to-South private finance. When modelled, the potential impact of international carbon markets and estimated the cost of meeting global 2030 targets would be reduced by $ 300 billion per year. If reinvested, such resources could more than double the amount of GHG abated over the same timeframe.[49]

While carbon markets are so good in theory, they are quite controversial in the real world. First, there has been widespread mistrust of corporate action and market mechanisms in climate policy. The fact that several large corporations supported the establishment of carbon markets and sometimes chose to participate in them

[45] McKinsey & Company. *The Net-Zero Transition: What It Would Cost, What It Could Bring.* January 2022.
[46] United Nations Conference on Trade and Development. "The Costs of Achieving the SDGs: Energy Transition." Accessed February 10, 2025.
[47] United Nations Framework Convention on Climate Change. *New Collective Quantified Goal on Climate Finance – Submissions from Parties and Observers.* Accessed February 10, 2025.
[48] United Nations Framework Convention on Climate Change. Streamlined compilation of proposals serving as transition to Presidency draft decision text on CMA 6 agenda item 11(a) New collective quantified goal on climate finance. Accessed February 10, 2025.
[49] Edmonds, James, Geoffrey J. Blanford, Leon Clarke, Joseph E. Aldy, Allen A. Fawcett, Nathan Hultman, and William McJeon. *How Much Could Article 6 Enhance Nationally Determined Contribution Ambition Toward Paris Agreement Goals?* 2021.

voluntarily is seen with suspicion. According to some, companies offsetting emissions using carbon markets are misleading the public and the funds they use to purchase carbon credits should instead be used to reduce their own emissions. While the accuracy of such claims is subject to heavy debate, Greenpeace ran a global campaign in 2021-2022 that plainly maintained that "carbon offsets are a scam".[50] Studies such as those conducted by Sylvera and MSCI (based on data from 100 and 4,000 companies respectively) have since challenged the assumption of a negative correlation between lack of internal decarbonisation and use of carbon credits. On the contrary, companies active in voluntary carbon markets are also reducing their emissions at a faster rate.[51] [52] However, public perception remains largely negative.

Second, some actors in the global South have been reluctant to openly endorse private financial instruments while negotiating the size of government-to-government financial transfers within the UNFCCC and other multilateral forums. In this context, any reference to carbon markets or green bonds would be seen as an attempt by wealthier governments to deflect their responsibilities. Some of the proponents of this view are driven by idealistic or ideological motives, but for others the positioning was merely tactical. Considering that the NCQG was agreed upon at COP29, supporting and incentivising finance flows to carbon markets should no longer be seen as an alternative to public finance – both are desperately needed and must work alongside each other.

Third, since their initial establishment in the late 1990s, carbon markets have had a mixed track record. In numerous cases, the volumes claimed by carbon credits did not amount to the actual volumes of GHG reduced or removed. The reasons behind such setbacks were diverse. Some of the methodologies used to quantify carbon credits under the Clean Development Mechanism (the UNFCCC carbon crediting mechanism under the Kyoto Protocol) proved inadequate as they were based on unrealistic assumptions and measurements were sometimes unreliable. The fact that developing countries where these projects took place had no climate targets of their own incited moral hazard. Fraudulent activities also occurred, further undermining the reputation of these instruments. Private independent programmes were created to correct some of these shortcomings, but they have been subject to similar issues.[53]

However, the Paris Agreement has laid better foundations for carbon markets with the introduction of Nationally Determined Contributions (NDCs) to be made by all countries. Further UNFCCC guidance put in place a robust accounting and reporting framework to track and oversee carbon transactions. Since 2022, the UNFCCC has been working on a new carbon crediting mechanism called Paris Agreement Crediting

[50] Greenpeace International. "Carbon Offsets Are a Scam: Why Net Zero Pledges Are Greenwashing." Last modified February 8, 2023.
[51] Sylvera. "Carbon Credits and Decarbonization: How They Work Together." 2023.
[52] MSCI. *Corporate Emission Performance: Navigating the Transition to a Low-Carbon Economy.* June 1, 2023.
[53] Oxford Institute for Energy Studies. *Carbon Management and Hydrogen: Complementary or Competing Climate Solutions?* November 2023.

Mechanism (PACM). This frustratingly slow and bureaucratic (but inclusive) process is expected to lead to the supply of the first new UN-issued credits in 2025, which may be traded and used to meet a government or a corporate climate target.

Carbon credits will never be perfect. There will be more incidents and frauds. However, no one suggested putting an end to share and bond markets because we went through the Global Financial Crisis and the Madoff scandal. As such, carbon markets and other innovative financial instruments should be strengthened and regulated, not abandoned. If we are serious about financing the energy transition, the role carbon markets need to play must be greater, not smaller.

Against: Carbon markets must first address their own deficiencies before they can functionally complement, not substitute, the urgent need to mobilize resources

Trishant Dev
Programme Officer, Climate Change Programme

Trishant is a Programme Officer in the Climate Change Programme at the Centre for Science and Environment, New Delhi. His work currently focuses on global climate policy, carbon markets, Article 6 of the Paris Agreement, and climate-related trade policy issues.

The severe consequences of the climate crisis are weighing heavily on the ability of developing countries to fight climate change. With developed nations unwilling to fund urgent climate needs of developing countries, a host of influential actors have advocated for the mobilisation of the private sector to fill the financing gap.[54] [55] To this end, efforts have been made to position global voluntary carbon credit markets as a source of mobilising private finance for climate action.

As such, optimism regarding voluntary carbon markets (VCMs) needs critical evaluation, especially to avoid a narrative that positions markets as a silver bullet to fill the financing gap. This article considers the insufficient scale of investments compared to global needs, the opaque flow of money, the issue of additionality, and the exploitative nature of the market, where intermediaries often reap the benefits while

[54] CNBC. "John Kerry Says Private Sector Can Win Climate Change Battle." *CNBC*, December 1, 2021.
[55] Bernards, Nick. "The Finance Gap." *Phenomenal World*, September 20, 2022.

communities and projects remain underfunded, to highlight the severe limitations presented by VCMs in bridging the global finance gap for the energy transition.

Far from enough

According to Ecosystem Marketplace, a non-profit organisation that collates information on carbon markets, at its peak in 2021, the total value of carbon credits transacted in the voluntary carbon market (VCM) was $2 billion and between 2020 and 2023, the cumulative value of transactions totalled $5.3 billion.[56] According to MSCI, $14.1 billion was raised or committed for carbon credit projects in the VCM worldwide in 2023.[57] Assuming an optimistic estimate of all "committed" investments being realised, this would amount to less than 0.8% of the $1.9 trillion estimated yearly clean energy investment needs for emerging and developing economies, excluding China.[58] Ironically this is also about one percent of what developing countries paid as foreign debt in 2023.[59] If the expectation is for the market to mobilise a trillion dollars, it would need to grow nearly 72-fold to reach that mark.

Where does the money go?

Even if huge amounts of money are expected to be pumped into carbon markets, it is important to understand how much of the money is actually used to realise the emission-reducing activity.

The foremost challenge in answering these questions stems from the fact that the VCM has been notoriously opaque regarding disclosures.[60] This issue is particularly vexing in the case of carbon credit transactions.[61] For a significant volume of credits, the source may not be traceable nor is clear as to what percentage of the money paid by the end-buyers actually goes to the project and what percentage is cornered by the unknown number of hands that exchanged the credits. Carbon Market Watch, a Belgium-based watchdog, found that 90% of intermediaries transacting in the VCM did not disclose the fees or profit margins they earned from these transactions.[62] Ecosystem Marketplace relies on its network of respondents to self-report transaction-related data.[63] Furthermore, in the absence of any legal requirements, companies are often reluctant to disclose such data.

[56]Forest Trends' Ecosystem Marketplace. *State of the Voluntary Carbon Market 2024.* Washington, DC: Forest Trends Association, 2024.
[57] MSCI. *Investment Trends and Outcomes.* New York: MSCI, 2024.
[58] Sieber, A., et al.. "Quantifying International Public Finance Provision Needs for the New UN Climate Finance Goal." *Nature*, 2024.
[59] World Bank. "Developing Countries Paid Record $1.4 Trillion on Foreign Debt in 2023." *World Bank*, December 3, 2024.
[60] Delacote, Philippe et al. "Strong Transparency Required for Carbon Credit Mechanisms." *LSE Research Online*, 2023.
[61] Barratt, L., et al. "How Middlemen Carbon Brokers Take a Cut from Money Meant to Help Offset Emissions." *Unearthed* (Greenpeace), May 2, 2022.
[62] Carbon Market Watch. *Secret Intermediaries: Are Carbon Markets Really Financing Climate Action?* Brussels: Carbon Market Watch, 2023.
[63] Forest Trends' Ecosystem Marketplace. *State of the Voluntary Carbon Market 2024.* Washington, DC: Forest Trends Association, 2024.

Voluntary carbon credits have also been found to not cover the actual costs of emission reduction activities. This issue is closely tied to the frequently highlighted concern of additionality. An investigation conducted in India by Down To Earth and the Centre for Science and Environment revealed that carbon credits accounted for just a fraction of the project costs for renewable energy projects—only 3 to 4% over a 10-year crediting period.[64] An investigation into a carbon credit project involving household-based biogas plants for cooking by DTE-CSE found that the project was financed partly by the rural households themselves and partly through State government subsidies - the carbon credit money remained untraceable. The investigation concluded that the market was benefiting developers, auditors, registries, and a host of other intermediaries, but neither the project nor the community associated with it accrued any monetary benefits from the market in its current form—a conclusion echoed by several other studies.[65]

Filling the gap or fuelling the problem?

Private investments channelled through VCM must not be conflated with the critical funding needed to ensure urgent global emission reductions.[66] Companies buying carbon credits may use them to continue or even increase their emissions, effectively putting more greenhouse gases into the atmosphere. Consider Chevron - In 2023, Corporate Accountability reported that 90% of the carbon offsets Chevron used through the VCM were likely worthless, even as the company increased its emission-heavy production.[67] This highlights the need to distinguish investments through carbon markets from those sources of climate finance, which directly fund projects to reduce emissions rather than allowing companies to write off emissions from their inventory.

What implications would it have for developing countries' climate goals?

By design, VCM operates on the principle of companies seeking cheaper mitigation solutions elsewhere to offset their emissions (Trencher et al., 2024).[68] This focus on 'low-hanging fruit', often projects in developing countries, means that these host countries may need to resort to higher-cost mitigation efforts to achieve their own climate targets. Even with private investments flowing through carbon markets, developing countries would still require additional finance to meet their targets—now potentially at a higher cost—since the emission reductions financed through carbon

[64] Dev, T., et al. *The Voluntary Carbon Market in India: Do People and Climate Benefit?* New Delhi: Centre for Science and Environment, 2023.
[65] "The Guardian." "Money from Carbon Credits Fuels Zimbabwe Conservation Efforts." *The Guardian*, March 15, 2024.
[66] Ock, H.,. "The Promise of Voluntary Carbon Markets: Unlocking Finance for the Global South May Be a Myth." *NewClimate Institute*, October 30, 2024.
[67] Corporate Accountability. *Chevron's Climate Racket: How Big Oil Distorts Climate Policy and Governance to Maintain Its Power*. Boston, MA: Corporate Accountability, 2023. Accessed February 12, 2025.
[68] Trencher., G. et al. "Demand for Low-Quality Offsets by Major Companies Undermines Climate Integrity of the Voluntary Carbon Market." *Nature Communications*, 2024.

markets are credited to the investors' climate goals, not the host countries' (Narain, 2023).[69] [70]

The revelation of a series of integrity issues in the VCM, in recent years demands that we view the unregulated VCM with a heavy dose of caution, particularly when we wish to rely on its ability to meet the scale of such a crucial challenge (Trexler, 2024).[71] The market must first attend to its own deficiencies before we can place faith in its ability to constructively compliment - rather than substitute - the urgent need to mobilise meaningful resources.

[69] NewClimate Institute. 2024. "The Promise of Voluntary Carbon Markets: Unlocking Finance for the Global South May Be a Myth." October 30, 2024.
[70] Narain, S., "Dark Underbelly of Carbon Trade." *Down to Earth*, October 16, 2023.
[71] For a brief discussion of aggregated news on the VCM, see Trexler., M. "Offset Critiques in the News," *LinkedIn*, 2024.

Section 3
CRITICAL ESSAYS

Funding the Energy Transition: Public-Private Partnerships as a Lever to Increase Private Climate Finance

Kian Akhavan
Consultant, Wood Mackenzie

Kian is a consultant at Wood Mackenzie, where he advises both public and private sector clients on how to navigate challenges associated with the energy transition. He specialises in new fuels and commodities. He holds a Master's in Public Policy from Sciences Po and a Bachelor of Arts in political science and history from McGill University.

The world is in the midst of an urgent and important energy transition. The consequences of climate change are well known; global temperatures continue to reach record highs and extreme weather events have grown in both frequency and intensity, making many parts of the world increasingly uninhabitable.

Urgent action is required to limit global warming to 1.5ºC above pre-industrial averages by 2050. According to the International Energy Agency's Net Zero Roadmap, annual global investments in clean energy must surpass US$4.5 trillion by the early 2030s to reach this target.[72] At the same time, any successful transition must address the trilemma of secure, affordable and sustainable access to energy.

Refined oil product markets and hard-to-abate sectors – industries that rely on the combustion of fossil fuels but lack large-scale low or no-emissions alternatives – face a significant challenge in the transition. Economically vital industries including aviation, maritime shipping and heavy industry are structurally reliant on hydrocarbons to function. Replacing conventional fossil fuels with more sustainable alternatives like biofuels, hydrogen-based fuels or recycled carbon can be prohibitively expensive and often incompatible with existing technology and infrastructure. In other industries, including cement or chemical production, substitutes for hydrocarbons, both as fuels and as feedstocks, are even rarer and often do not exist. As a result, most countries still

[72] International Energy Agency. 2024. *Net Zero Roadmap: A Global Pathway to Keep the 1.5ºC Goal in Reach.* Revised November.

rely on fossil fuels to power their economies.

How, then, can we execute the energy transition if basic economic functions are inextricably interconnected with the use of hydrocarbons? Of course, there is no panacea to the transition; no single set of technologies or policies can solve the trilemma. While there is much debate about how best to approach the energy transition, most informed observers agree that the public and private sectors must collaborate to achieve climate goals.

The wholesale reinvention of how the world functions is a complex and intricate process. Meaningful progress demands immense capital expenditure, technical innovation and robust policy and regulatory support, with both the public and private sectors leveraging their respective strengths to deliver meaningful progress. Mobilising sufficient funding is perhaps the biggest challenge facing a project of this scale. While the Climate Policy Initiative estimates that climate finance has increased significantly over the last several years, annual investments must increase by more than double to reach net zero by 2050.[73, 74]

The majority of the funding required to bridge gaps in climate finance must inevitably come from the private sector; public budgets are cumulatively smaller than those of private actors and constrained by sensitivities to debt, fiscal pressures and competing political priorities. While meaningful progress has been made in recent years to increase the volume of private finance directed toward climate-conscious investments, further progress must be supported and encouraged by governments and public institutions. Most notably, public actors can design policies that de-risk major investments that serve climate goals, for example in new technology or infrastructure. Public-Private Partnerships (PPPs) are a key lever in this effort.

Mobilising private finance through collaborative public policy

PPPs can offer a rare win-win-win for businesses, governments and strategic energy objectives. This is a project structure in which governments and private companies collaborate to deliver goods that are traditionally provided by the public sector, including building energy infrastructure to power grids.[75] The public sector typically offers policy and regulatory support while the private sector is responsible for financing, building and operating a project. As discussed below, PPPs aim to make infrastructure projects profitable for private investors while simultaneously strengthening energy security and making meaningful progress towards achieving climate goals – potentially addressing every point of the trilemma at once.

[73] Buchner, B., et al.. 2024. *Global Landscape of Climate Finance 2024: Insights for COP29.* Climate Policy Initiative, October.

[74] Wood Mackenzie. 2024. *Energy Transition Outlook: 2024-25 Update.* Published October.

[75] Gerrard, M. B. 2001. "Public-Private Partnerships." *Finance and Development* 38 (3): 48-51.

Identifying a PPP can be tricky. Governments often offer financial and policy support for projects that are deemed to be in the public interest, including encouraging investment in new or strategically significant infrastructure and technologies. Likewise, governments can outsource projects or tasks to private companies to save costs or supplement technical expertise. In contrast to traditional, directly managed infrastructure projects, PPPs emphasise reaching desired outcomes rather than engaging directly in the development process. This framework focuses on long-term contracts and typically encompasses a broad scope, including the project's design, construction and operation, while also defining the strategic role of public actors within it.

The onus for financing a PPP usually falls on the private sector, though that can be supplemented by public funding. In exchange, PPPs often include complex provisions for long-term financial agreements that mitigate commercial risks and offer a predictable return on investment, including through offtake agreements, power purchase agreements (PPAs) or contracts for difference (CfDs). PPAs, for example, can be appealing to both buyers and sellers by ensuring long-term price stability through agreements to purchase a specific amount of power at an agreed-upon price.[76]

Likewise, CfDs are designed to guarantee a degree of revenue stability on high-risk projects. The producer (a private company) and a purchaser (often a public entity like a grid operator) negotiate a fixed price at which the producer will sell a given product. If the market price falls below the agreed-upon price, the seller receives the difference; if it rises above, the seller pays the buyer the excess, providing stability for both parties.[77]

CfD auctions have become an important part of the UK's decarbonisation policy, and they have been found to increase uptake of affordable renewable energy, improve overall market efficiency and reduce investor uncertainty about energy supply.[78] While these contract structures are most commonly used to purchase electricity, similar arrangements can (and are) used for renewable fuels like green hydrogen or biomass.[79]

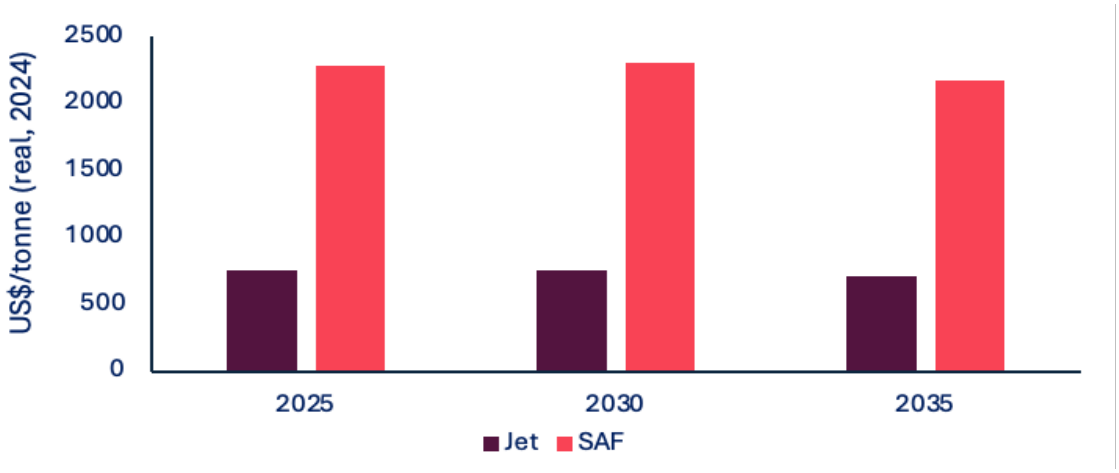
Both PPAs and CfDs ensure predictable revenue streams for a producer, guaranteeing a minimum return on investment and significantly reducing the risk of investing in a new project. These pricing mechanisms serve the dual purpose of de-risking investments in new, expensive

[76] Ghiassi-Farrokhfal, Y., et al.. 2021. "Making Green Power Purchase Agreements More Predictable and Reliable for Companies." *Decision Support Systems* 144: 1-16.
[77] Khodadadi, A. et al., 2024. "Contracts for Difference – CfDs – in the Energy Transition: Balancing Market Efficiency and Risk Mitigation." *Oxford Institute of Energy Studies.*
[78] Welisch, M., et al. 2020. "Auctions for Allocation of Offshore Wind Contracts for Difference in the UK." *Renewable Energy* 147: 1266-1274.
[79] Khodadadi, A., et al. 2024. "Contracts for Difference – CfDs – in the Energy Transition: Balancing Market Efficiency and Risk Mitigation." *Oxford Institute of Energy Studies.*

technologies while also encouraging the uptake of more environmentally friendly alternatives to fossil-based fuels. In particular, liquid renewable fuels and biofuels cannot currently compete with fossil fuel-based equivalents, in part because they are significantly more expensive.

Beyond providing financial incentives, a government's primary role in a PPP is to provide policy support to alleviate regulatory risks for a project. This can take the shape of expediting permitting processes, guaranteeing land access and facilitating compliance with legal frameworks, allowing projects to develop and launch more quickly. Notably, Germany's first LNG import terminal at Wilhelmshaven was brought online in only nine months, largely due to the federal government providing the operator and developers with generous regulatory exemptions. The facility was the first of its kind in Germany and represented a significant milestone in German energy security and access to natural gas.

Average forecast price difference between conventional jet fuel and sustainable aviation fuel (SAF), global[80]



The EU is a world leader in harnessing PPPs for the energy transition. Notably, its system of Projects of Common Interest (PCIs) identifies projects of significant strategic importance to the Bloc that connect the energy systems of member states and contribute to climate goals outlined in EU policy. These initiatives – which include projects as diverse as CO_2 transport pipelines, ammonia import terminals and electricity interconnectors – are eligible to receive funding from the EU's Connecting Europe Facility, which has a budget of €5.8 billion to support the energy sector between 2021 and 2027.

[80] *Wood Mackenzie Liquid Renewable Fuels Service; Product Markets Service*

PCIs receive extensive political and regulatory support, as well as occasional financial support, with governments waiving some regulations altogether to facilitate the construction of critical energy infrastructure across the continent.[81]

The PCI programme is unique in its structure and benefits to privately owned and operated projects. Other governments are developing similar programmes as they recognise the importance of formal and sustained collaboration with the private sector to reach climate goals. For example, the government of Japan co-founded the Asia Zero Emission Community in partnership with 10 governments across the Asia Pacific region. The programme uses PPPs as a key tool to foster regional cooperation to bolster decarbonisation. 350 projects have received support so far, with an emphasis on liquid renewable fuels like ammonia, hydrogen and biofuels.[82]

PPPs and the energy transition

The world is far behind in its commitments to reach its climate targets. Global emissions must fall immediately and dramatically to mitigate the catastrophic effects of climate change. At the same time, countries need to ensure that their economies can function and remain resilient in the face of increasing geopolitical instability.

The transition must be executed quickly, thoughtfully and pragmatically. National-level climate pledges need to be ambitious but realistic, governments need to remain focused on making consistent and meaningful progress and companies need to commit to reducing the environmental impact of their operations. These commitments must go hand-in-hand with shrewd energy security strategies that efficiently neutralise current and future geopolitical risks.

Public-private partnerships offer a rare win-win-win setup in which governments, private investors and the energy trilemma benefit directly from major development projects. Policy support accelerates the development of new, crucial energy infrastructure while pricing agreements guarantee a minimum return on investment on otherwise high-risk, potentially low-return projects. Together, these support structures derisk investment into new technologies and infrastructure, attracting more private funding for energy transition projects.

While they are not a cure-all for the climate crisis, PPPs are a powerful tool that can leverage the strengths of both public and private actors to ensure energy security, prevent the worst effects of climate change and ensure a smooth, just and successful energy transition.

[81] European Commission, *Funding for PCIs and PMIs*. 2024

[82] Government of Japan. 2024. "AZEC: Asia's Various Pathways to Net Zero Co-Created by Japan."

The Role & Potential of Sovereign Wealth Funds in Advancing the Energy Transition: *A Case Study of the Republic of Qazaqstan*

Nargiz Shantayeva
Master in International Energy Transitions, Sciences Po

Nargiz is a Master's student in International Energy Transitions at Sciences Po, with a focus in the evolving energy landscape in oil-producing states. She previously completed an internship at KazMunayGas, where she gained hands-on experience in the energy sector of Qazaqstan. Nargiz is particularly passionate about decarbonisation strategies in oil-producing economies and the transformation of electricity systems for supporting a sustainable future.

Alibek Sembayev
ESG Consultant at Ernst & Young, Climate Change and Sustainability Services Department

Alibek is an ESG consultant at EY, where he engages with clients on matters of ESG strategy and sustainability reporting. He graduated from the University of Manchester with a BSc (Hons) degree in Chemistry. His final-year research paper focused on Polymers of Intrinsic Microporosity (PIM-1), which help prevent dye pollution in oceans and rivers. His paper was inspired by contributions to the UN SDGs, specifically Goal 6: Clean Water and Sanitation. Alibek is interested in oil and gas decarbonisation (CCS) and sustainable mining and metallurgy technologies.

Introduction

Scaling up finance for the global energy transition has now become one of the most critical issues that policymakers, scientists, and citizens across the world face. One of the key findings of the World Energy Outlook 2024 of the International Energy Agency (IEA) was the significant gap between existing financial commitments and the funding required for sustainable energy transition in line with the Net Zero Emissions (NZE) scenario. This scenario, developed by the IEA, is one of three projected scenarios for the world energy transition away from fossil fuels. It envisions ambitious emission reductions with an end goal of keeping global warming to 1.5°C. To reach this goal, total investments in the transition would need to be at least USD 3 trillion annually between 2023 and 2050. By comparison, the funding in 2023 only

amounted to USD 1.8 trillion.[83] Given that out of this sum, only around USD 150 billion are directed towards emerging and developing economies outside of China, the urgency to bridge the world's investment gap is clear.[84]

The situation is especially complicated for oil producing developing countries, such as the Republic of Qazaqstan. For this and other states (e.g. Azerbaijan and Nigeria), the so-called 'oil needle'[85] is getting increasingly unreliable in the long run, due to falling commodity prices, ambitious NDCs, and the imminent entering into force of CBAM.[86] Qazaqstan must thus take swift action towards shifting the domestic economy away from oil and attracting finance in the direction of decarbonisation.[87] For this purpose, the country has developed a Carbon Neutrality by 2060 Strategy, and submitted its NDCs as a Paris Agreement signatory. In particular, Qazaqstan aims to unconditionally reduce its emissions in 2030 by 25% from 1990 levels, and achieve carbon neutrality by 2060.[88] Critically, it must also do so without compromising the current economy, of which oil & gas constitute 17% of GDP and 67% of total exports, and in which thousands of workers depend on this industry in regions like Janaozen and Atyrau.[89] Qazaqstan is also constrained by an immature business environment, underpinned by technological, institutional, and socioeconomic factors, which affects the scalability of green finance.[90] Although the country has made extensive efforts to 'green' its economy, namely by introducing a national ETS, green bonds, and a notable number of renewable energy generation projects, none have had overwhelming success. Green obligations, in the small amount that they were issued, lack certification standards; ETS implementation continues to be challenged by persistent oil subsidies; and, generally speaking, the profit margin for renewable energy systems remains insufficient to attract investors[91].

It is in this context that the potential of Sovereign Wealth Funds can be understood most effectively. When the private sector is hesitant, and large fossil fuel revenues are collected by the state, it can be effective to reconsider the utilisation of Sovereign Wealth Funds in the green transition of such states. Sovereign Wealth Funds (SWFs) are defined as "directly or indirectly government-owned and controlled investment funds established out of receipts from the extractive and trading operations of finite natural resources, trade surpluses, or pension

[83] International Energy Agency (IEA), World Energy Outlook 2024 (Paris: IEA, 2024).
[84] Idem.
[85] Aliya Shalabekova, interview by Nargiz Shantayeva, Astana, December 27, 2024.
[86] Giacomo Luciani, "Lecture on Oil & Gas," Sciences Po, Paris, September 25, 2024.
[87] Republic of Kazakhstan, "Decree of the President No. 121: On Approval of the Strategy for Achieving Carbon Neutrality of the Republic of Kazakhstan Until 2060," February 2, 2023. U2300000121.
[88] Idem.
[89] Idem.
[90] Stefanos Xenarios, Sembayeva Aliya, Tsani Stella, Orazgaliyev Serik, and Ansaganova Zhanat, "Clean Energy Challenges and Innovation Opportunities in Kazakhstan," Environmental Research Communications 6, no. 11 (2024), https://doi.org/10.1088/2515-7620/ad87b5.
[91] Idem

contributions."[92] These have sharply grown in number between 2000-2019, accumulating over USD 116 trillion in assets managed worldwide.[93] A range of oil-producing countries, such as Saudi Arabia, UAE, or Norway, have already developed a strong climate focus, deploying significant amounts of finance towards the transition away from oil. Nevertheless, according to Gioia (2024), SWF involvement in funding low carbon initiatives in oil-producing countries is still too low.[94] According to PwC, global clean energy investments by SWFs only amounted to USD 9 billion,[95] which is miniscule in relation to the total investment by SWFs. Out of the USD 9 billion, Qazaq SWFs' investment is a mere USD 35 million.

In fact, Qazaqstan has several SWFs that partake in raising green investment. The Samruk Kazyna JSC SWF, is a state-owned holding company managing the assets of several large companies, e.g. JSC NC KazMunayGas[96] or JSC NC KazAtomProm.[97] It is directly controlled by the government and invests its subsidiaries' assets mainly in domestic sectors. Another significant SWF is the National Investment Corporation of the National Bank of Kazakhstan (NIC NBK). This entity also participates in raising green investment, but focuses more on Qazaqstan's foreign reserves and is more indirectly controlled by the government. The two work independently from one another and are important for examining the Qazaq green investment scene, which is overall suboptimal in terms of performance. For example, Samruk Kazyna still reports high levels of cross subsidisation - through which the fund's earnings flow towards the subsidisation of its high-emitting subsidiaries, such as KazMunayGas. Thus, the Fund's involvement in the green transition remains somewhat limited, and money tends to flow to high-emitting sectors despite efforts to spend more on the transition[98]. This is also the case in oil-producing Azerbaijan and Nigeria, which struggle to raise sufficient investment from SOFAZ[99] and NSIA[100] due to a variety of similar reasons. The conclusions of the present article can thus be expanded to these economies, as SWFs hold significant potential in such contexts.

In sum, the article argues that in order to reach the global investment levels necessary for attaining the NZE scenario, there are three main action mechanisms that SWFs in oil-producing developing countries like Qazaqstan can take. These are green bonds,

[92] Stella Tsani and Indra Overland, "Sovereign Wealth Funds and Public Financing for Climate Action," *Climate Action*, Springer Nature Switzerland AG, 2020, https://doi.org/10.1007/978-3-319-71063-1_130-1.
[93] Idem.
[94] Gioia, Pietro. "From Black Gold to Green: The Role of Petrostates and Oil Money in Driving the Global Energy Transition." Sciences Po Energy Review, Vol. 1 (2024): 63-68.
[95] Rollinshaw, Richard, Clara Cutajar, Danny Touma, Dariush Yazdani, and Tarek Shoukri. *Rethinking the Role of Long-Term Investors in the Energy Transition*. PwC, 2024. https://www.pwc.com/gx/en/issues/esg/the-energy-transition/sovereign-wealth-pension-fund-investors.html#.
[96] A state-owned petroleum company.
[97] National nuclear company and world's largest uranium producer.
[98] PwC. *Rethinking the Role of Long-Term Investors in the Energy Transition*. London: PwC, 2023.
[99] State Oil Fund of the Republic of Azerbaijan.
[100] Nigeria Sovereign Investment Authority.

public-private partnerships and alternative investment methods (mezzanine financing). While acknowledging the constraining factors for such SWFs - namely the overreliance of government budgets on them[101] , the lack of private investment, and regulatory uncertainty, among others, these tools can prove highly useful in raising public and private finance in developing oil-producing states.

Literature Review

Existing literature and conducted interviews all converge on the fact that SWFs are currently taking a limited, sub-optimal role in clean energy and decarbonisation investment in developing countries. Rollishaw et al. (2024) argue that SWFs' high potential for green investments is justified by their strategic long-term investment horizon and ability to de-risk projects in emerging markets throughout an asset's life cycle. Gioia (2024) highlights that SWFs' connection to governmental bodies would signal public sector support, which then contributes to reducing private sector risk.[102] Tsani and Overland (2020) specify that for oil and gas producers, investments in clean energy production through SWFs can also potentially help reaping first-mover advantages. More specifically for Qazaqstan, Shalabekova emphasises that Samruk Kazyna's green investment involvements represent a large chunk of the country's overall green investment advances.[103] Though this only seems to identify that Qazaqstan has highly constrained investment resources as a whole, this contextualisation underpins the present article and its thesis. It is therefore that the following three mechanisms, along with relevant challenges and recommendations are suggested for consideration.

Mechanism 1: Green Bonds

The first potential mechanism is issuing more standardised green bonds, directed at specific transition projects, following the example of more mature SWFs. KEGOC (Kazakhstan Electricity Grid Operating Company), 85% owned by Samruk-Kazyna SWF, has in fact already issued green bonds in two periods: KZT 35 billion (approx. USD 66.8 million) in November 2022, and KZT 16.9 billion (approx. USD 30.5 million) in March 2023 in collaboration with EBRD.[104,105] These bonds, issued on KASE (Kazakhstan Stock Exchange, owned by the NIC NBK

[101] Shalabekova Aliya, Interview by Shantayeva Nargiz. Astana, December 27, 2024 ; Aiman Nakispekova, "Experts Raise Concerns Over Transfers from Kazakhstan's National Fund," The Astana Times*, October 15, 2024

[102] Gioia, Pietro. "From Black Gold to Green: The Role of Petrostates and Oil Money in Driving the Global Energy Transition." Sciences Po Energy Review, Vol. 1 (2024): 63-68.

[103] Aliya Shalabekova, interview by Nargiz Shantayeva, Astana, December 27, 2024.

[104] KEGOC. KEGOC Issued Its First Green Bonds. Press release, September 13, 2022. https://www.kegoc.kz/en/press-center/press-releases/158710/.

[105] KEGOC. *KEGOC Places Green Bonds Totalling KZT 16.9 Billion*. Press release, March 31, 2023. https://www.kegoc.kz/en/press-center/press-releases/161021/

SWF), were notably in line with ICMA green bond principles.[106]

However, these green bonds were criticised for a number of reasons. In particular, these included the lack of standardisation, high issuance costs, insufficient certification standards, and low profit margins[107]. Indeed, the green bond market remains underdeveloped in the country despite increasing demand, which contextualises the above mentioned shortcomings. Additionally, all financial instruments driving the green energy transition are also still heavily concentrated in the government's hands, as both Samruk-Kazyna and KASE are government-owned. In this manner, green bonds remain an imperfect tool for raising green capital.

To counter this, learning from examples of Saudi Arabia's Public Investment Fund, Norway's Government Pension Fund Global, or Abu Dhabi Investment Authority, it is advisable to issue bonds aimed at specific projects, e.g. solid domestic waste utilisation or modernisation of heat and power networks in Qazaqstan. These initiatives should also be developed with more robust certification standards and increased issuance to attract environmentally conscious investors and institutional funds focused on ESG criteria. In doing so, the SWF would increase investor confidence and positively affect the demand for green bonds on the market. The government should also consider demonopolizing its assets and promoting privatisation through IPOs and SPOs, following existing reforms. This can provide a dedicated financial instrument to support Qazaqstan's sustainable development initiatives, offering distinct investment projections. Thereby, green bonds as a tool would be better positioned to raise significant private capital and lower borrowing costs for oil-producing states similar, but not exclusive to, Qazaqstan.

Mechanism 2: Public-Private Partnerships

The second mechanism involves securing more and larger-scale Public-Private Partnerships (PPPs), specifically with international actors. Samruk-Kazyna has already demonstrated commitment through several significant collaborations in 2023, including partnerships with Saudi Arabia's ACWA Power for a 1 GW wind power plant in the Zhetysu region and China Power International Holding for a 1 GW wind farm with energy storage in the Zhambyl region. Additionally, collaborations with UAE's Masdar Energy Company and the Kazakhstan Investment Development Fund aim to construct another 1 GW wind farm.

Still, current PPPs are relatively small-scale, with most plants being 1 GW, suggesting possible low investor confidence. This can be explained by

[106] Kazakhstan Stock Exchange. Shareholders and Capital Structure. https://kase.kz/en/shareholders/.
[107] Bertaeva, Kulyash, Onaltaev Darhan, Bakhyt Yerik, Kozhakhmetova Maral, and Mukhametzhanova Zhadyra. "Green Bond Market in Kazakhstan: Problems and Prospects." BIO Web of Conferences, Vol. 130 (2024). https://doi.org/10.1051/bioconf/202413008026

the political risks perceived by investors in the Republic of Qazaqstan. The unpredictable authoritarian structure of governance is exacerbated by the country's simultaneous high dependence on commodities, export concentration risk, and high inflation. These risks reflect a less developed macroeconomic policy framework and weak governance indicators, despite the country's BBB rating from Fitch and strong sovereign net foreign asset position.[108] As a result, most existing PPPs with private foreign actors on renewable energy projects do not exceed 1 GW in capacity and are more rarely achieved as compared to generic Memoranda of Understanding.

Increasing the scale of current PPPs appears thus to be necessary to boost investment in countries like Qazaqstan. In order to address the above-mentioned political risks, the government would be recommended to demonopolise its assets, propagate privatisation of its companies, starting from partial sale of its shares via an Initial and Secondary Public Offerings (IPOs and SPOs). There are notably already set into motion due to the reforms by the 2nd President of the Republic of Kazakhstan, Qassym-Jomart Toqayev.[109] Decentralisation and diversification can, in this way, help mitigate high risks and lead to transparent and higher returns on investment, as well as a generally more stable fiscal and monetary environment.

Mechanism 3: Mezzanine Financing

The third mechanism is mezzanine financing, one of the alternative investment methods practiced in international finance. This type of investment offers a balanced approach to achieving higher returns, all while managing risk. According to financial reports by NIC NBK SWF[110], this method is already used by this SWF, and is widely recognised in private finance, however it is generally not as common among SWFs. In particular, mezzanine financing provides money via a hybrid approach that combines debt and equity aspects. By doing this, SWFs can bridge funding shortages and provide more flexible financing options for large-scale green and sustainable energy projects. Because a mezzanine loan is not backed by the company's assets and has a lower priority for repayment than secured debt, it is sometimes referred to as subordinated finance.[111] Notably, this approach improves the investor's debt-to-equity ratio and, consequently, their leverage position by treating the loan on the balance sheet as an equity.[112] In line with long-term investment objectives, mezzanine financing enables NIC NBK SWF and possibly

[108] Fitch Ratings, Fitch Affirms Kazakhstan at 'BBB' Outlook Stable, 2024, https://www.fitchratings.com/research/sovereigns/fitch-affirms-kazakhstan-at-bbb-outlook-stable-15-11-2024.
[109] Qazaqstan's 1st President served for 28 years since 1991, the 2nd began his term in 2019.
[110] National Investment Corporation of National Bank of Kazakhstan Sovereign Wealth Fund.
[111] Business Development Bank of Canada (BDC), Mezzanine Financing, n.d., https://www.bdc.ca/en/articles-tools/entrepreneur-toolkit/templates-business-guides/glossary/mezzanine-financing.
[112] Idem.

other SWFs to achieve equity-like upside potential without experiencing an instant dilution of ownership.

Yet, the extent of mezzanine financing application remains undisclosed and likely limited, especially among SWFs. Despite NIC NBK SWF joining the One Planet Sovereign Wealth Funds Initiative in 2020 and committing to ESG frameworks (TCFD[113], GRI[114] and ISSB[115] standards), these commitments of Qazaqstan also face significant skepticism. In fact, ensuring transparency and accountability of green investment, as well as avoiding greenwashing practices[116] in Qazaqstan has thus become more of a buzzword for raising investment, rather than a concrete set of actionable principles. Coinciding with this is the high reliance of government budgets on such SWFs, in order to cover budget deficits and gaps resulting from corruption. Consequently, mezzanine financing is also not sufficiently considered and faces many of Qazaqstan's larger economic challenges.

It is therefore that further exploration of mezzanine financing methods alongside classic investment mechanisms is advised, as it could potentially attract larger investment, offering higher returns and aligning with many SWFs' desired risk-return profiles. Nevertheless, in a context like Qazaqstan, unless stricter protocols for ensuring correct reporting standards and ESG frameworks are established and government reliance is reduced, the aforementioned green initiatives by SWFs, despite their high ambitions and good intentions, may be rendered entirely ineffective.

Conclusion

There is a general consensus that SWFs are not reaching their potential in harnessing finance for the global energy transition. In developing oil-producing countries like Qazaqstan, there are specific challenges, such as regulatory uncertainty, low investor confidence, greenwashing risk, overreliance of government budgets on SWFs, and currency volatility, that prevent increased SWF involvement in terms of investment. However, in light of these issues, it is nonetheless recommended that SWFs issue more green bonds, acquire PPPs with international actors with de-risking mechanisms, and attempt alternative investment methods such as mezzanine financing, in order to raise more capital for the green transition.

Specifically for Qazaqstan, this implies developing green bond certification standards, issuing bonds for the renewability of power and heat

[113] Task-Force for Climate-Related Financial Disclosures, a financial framework for companies to disclose climate-related risks and opportunities.
[114] Global Reporting Initiative, a sustainability reporting standard that helps organisations report their environmental, social, and governance (ESG) impacts.
[115] International Sustainability Standards Board, an initiative developing unified sustainability disclosure standards to ensure consistent, comparable, and reliable ESG reporting
[116] One Planet Sovereign Wealth Funds, OPSWF Companion Document (2020), https://oneplanetswfs.org/download/23/online-publication/1008/1_20201120-opswf-companion-document-2020.pdf.

systems, and increasing the scale and number of PPPs with international private companies. For mitigating the effects of political and economic challenges, strengthening the private sector and reducing the budget strain on SWFs are among the recommendations, as well as ensuring transparency and accountability of green investment on behalf of both Samruk Kazyna and NIC NBK. These suggestions can also be applicable to the SWFs of Azerbaijan and Nigeria. If taken into account, these recommendations can potentially help harness the assets of SWFs for the green transition of such developing oil-producing countries, scaling up total investment and making the NZE scenario more attainable.

Renewable Energy as a Strategic Tool: What Motivates the UAE's Push for Sustainable Energy

Marína Kováčová
Master in International Relations, Central European University

Marína is a master's student in International Relations at Central European University, specializing in International Political Economy. During her undergraduate studies, she spent a semester at Sciences Po, where she developed a strong interest in energy security and energy diplomacy. She now writes for Security Outlines, a Czechoslovak security portal, focusing on renewable energy security, and tracks global energy developments at Energy-HUB.

Recent years have seen an enormous, yet insufficient, rise in public debates over climate change and, consequently, increased investments in sustainable development worldwide. Middle Eastern fossil fuel giants are now setting their own goals to mitigate climate change and are heavily investing in renewable resource enterprises. What motivates this relative change of heart and how much of a change it really is? Will Middle Eastern societies go green, or as the Arabic proverb "Deil Al Kalb Umruhu ma Ya'tadil" says: Would the dog's tail never straighten? A closer look at the sustainable energy reality of the United Arab Emirates (UAE), the leading sustainable innovator in the Middle East, shall provide a decent answer. This essay seeks to examine the dual nature of Emirati energy investments and trace their strategic significance in shaping the UAE's international positioning and trajectory.

Ever since the first commercial oil discovery in 1958, the Emirati economy has been heavily reliant on fossil fuels. To this day, the energy supply market remains dominated by natural gas (63%) and oil (almost 30%).[117] Furthermore, crude oil makes up to 80% of the energy production market, representing almost 16% of the UAE's GDP, one of the highest overall GDPs per capita in the world, making the UAE the seventh largest liquid fuel producer in the world.[118] Over time, due to fossil fuels' exhaustible nature, particularly evident in Fateh and Southwest Fateh oil fields in Dubai, the country's economy, although diversified to multiple sectors, remains heavily reliant

[117] International Energy Agency. United Arab Emirates – Countries & Regions. Accessed January 23, 2025.

[118] U.S. Energy Information Administration. "United Arab Emirates Invests to Meet 2027 Crude Oil Production Capacity Goal." Today in Energy. Last modified 2024.

on the fossils coming predominantly from Abu Dhabi.

Bearing this fossil-dominated reality in mind, it did not, however, come as a shock that one of the richest emirates, Dubai, hosted the 28th United Nations Climate Change Conference (COP28) in November 2023. The UAE was the first Middle Eastern nation to become a party to the Paris Agreement.[119] The Agreement classifies participating countries into groups, primarily those historically responsible for greenhouse gas emissions (Annex I) and those without such a history (non-Annex I). Among the oil-rich middle eastern countries, the UAE is not the only one to have initiated sustainable energy goals on a large scale. Notably, Saudi Arabia has introduced an ambitious domestic imitative Vision 2030 to diversify its economy from the oil-dependance by raising the share of non-oil exports to 50% of the total GDP by 2030.[120] Similarly, the Kuwaiti government has also crafted long-term clean energy goals under the New Kuwait Vision 2035, through which it aims to generate 15% of its electricity from renewables by 2030.[121] Furthermore, Kuwait has been actively participating in international negotiations and closing clean energy deals with partners reaching from China to France.[122] The UAE's example, however, is unique in its scale and complexity.

Emirates Go Green

Following the path set by the European Union, the UAE has embarked on reaching Net Zero (emissions) by 2050.[123] This strategy includes reducing carbon emissions to a minimal level that can be naturally absorbed and permanently stored, or removed through carbon dioxide removal methods, resulting in no remaining emissions in the atmosphere. While the UAE's Net Zero 2050 strategy integrates Carbon Capture, Utilization, and Storage (CCUS)—notably through projects like Al Reyadah and the latest ADNOC CCUS initiative—the emphasis overwhelmingly lies on emissions avoidance, which remains the predominant focus, particularly through substantial investments in renewable energy and sustainable technologies.[124] Its concrete targets aligning with the Paris Agreement include limiting the rise in global temperature to 1.5°C above pre-industrial levels and reducing greenhouse gas emissions. Additionally, the strategy entails bolstering sustainable investments in renewable energy - both domestically and globally. To meet its Net Zero 2050

[119] Ministry of Foreign Affairs - UAE. "The UAE and Climate Change." Ministry of Foreign Affairs - UAE. Accessed January 23, 2025.
[120] Kingdom of Saudi Arabia. "Vision 2030." Vision 2030 Official Website. Accessed January 23, 2025.
[121] State of Kuwait. "Kuwait Vision 2035." Ministry of Foreign Affairs - Kuwait. Accessed January 23, 2025.
[122] Enerdata. "Kuwait Shortlists Six Companies to Develop 1.1 GW Solar Power Project." Enerdata.
[123] The Official Portal of the UAE Government. "The UAE's Net Zero 2050 Strategy."
[124] For the ADNOC Initative see "Abu Dhabi Future Energy Company PJSC – Masdar Celebrates Milestone Year of Delivering Clean Energy and Climate Action." Financial Times, January 14, 2025. For the UAE's CCUS strategy see "UAE: New Federal Decree-Law Underscores the Potential of CCUS in Contributing to the Country's Climate Ambition," Global CCS Institute, November 6, 2023, accessed January 26, 2025.

target, the UAE has claimed to undertake more than 25 programs across six major polluting sectors: industry, buildings, transport, power, waste, and agriculture.[125]

Furthermore, the UAE has invested heavily in sustainable cities and energy-related R&D in cooperation with MIT, predominantly through its flagship project Masdar. Masdar, Arabic for 'source', established in 2006 and re-structured in 2014 encompassed five initiatives – the Masdar Institute of Science and Technology, Masdar Capital, Masdar Clean Energy, Masdar Special Projects and finally, Masdar City, a vast sustainable community project located in Abu Dhabi. All Masdar projects aimed to make Abu Dhabi a "preeminent source of renewable energy knowledge, development and implementation" and become a competitor to California's Silicon Valley. [126]

Masdar's overall ownership lies in the hands of the state-owned Mubadala Investment Company (MIC, an Abu Dhabi-owned sovereign wealth fund managing up to $300 billion in assets.) MIC's portfolio ranges from real estate and infrastructure companies in China, to pharmaceuticals in France, a raw materials digital trading platform in Switzerland, a crypto trading platform, and Abu Dhabi National Oil Company (ADNOC). It is, therefore, fair to say that Mubadala Investment Company is a fervent for-profit investor, not a fervent sustainable development activist.[127] Besides being home to the International Renewable Energy Agency (IRENA), Masdar City aimed to be a tangible step toward Net Zero. However, its sustainability, along with its younger sister, the Sustainable City in Dubai, is questionable. The delay in construction and relative isolation from other major cities raise questions about their purpose. Furthermore, out of five former initiatives, only two survived – Masdar City (now named Sustainable Real Estate) and Masdar Clean Energy, although they have shifted their vision from the original zero-carbon to low-carbon". The rest has been either integrated into other institutions or quietly ceased to exist completely.[128]

Domestically, the UAE is investing in nuclear, solar, and hydrogen sectors. The Emirates Nuclear Energy Company (ENEC), established in 2009, launched its first nuclear unit in Barakah in 2021 which accounted for 7% of the whole electricity generation mix in 2021.[129] With its geographic location providing abundant sunshine, the UAE's entry into the solar energy market was a natural and inevitable progression. Ever since the inauguration of the first solar plant in 2006 the Emirates has profitably

[125] Ram, A. "UAE's 2050 Net-Zero Target Pegged on Lower Emissions, Mainly from Industry." S&P Global, November 17, 2023.
[126] Shahan, Zachary. "Masdar — Manufactured Silicon Valley of Cleantech?" CleanTechnica, February 13, 2013.
[127] Mubadala Official Website. Our Portfolio. Accessed January 23, 2025.
[128] Griffiths, Steven, and Benjamin K. Sovacool. "Rethinking the Future Low-Carbon City: Carbon Neutrality, Green Design, and Sustainability Tensions in the Making of Masdar City." Energy Research & Social Science 62 (April 2020): 101368. https://doi.org/10.1016/j.erss.2019.101368.
[129] World Nuclear Association. "Nuclear Power in the United Arab Emirates." Last modified 2024.

installed numerous domestic solar power plants, including the world's largest single-site solar power plant – Al Dhafra Solar PV, with capacity of 2 GWp.[130] In contrast to abundant sunshine, the Emirati topography does not offer fertile soil for wind energy. Despite the low winds, Masdar launched a domestic Wind Program in 2023,[131] supposedly providing enough energy to power approximately 23,000 homes, making up approximately 10% of the total number of households.[132] As Jules Verne predicted many years ago, "water will one day be employed as fuel, that hydrogen and oxygen which constitute it, used singly or together, will furnish an inexhaustible source of heat and light, of an intensity of which coal is not capable."[133] Two hundred years later, the world's sustainable movement also emphasizes the significance of low-carbon, or zero-carbon, hydrogen. The UAE's National Hydrogen Strategy of 2023 sets off to develop and implement low-carbon hydrogen alike whilst playing "a leading role in the global hydrogen economy."[134]

Sustainable partnerships

Internationally, the UAE has showcased its interest in transnational cooperation through sustainable investments and joint ventures. According to a Financial Times analysis, the UAE is expected to invest around $160 billion in renewable energy worldwide over the next three decades.[135] Arguably, their energy-related partnerships represent a security web and entail their growing sphere of influence worldwide.

An estimated two-thirds of the UAE's foreign renewable investments are directed towards developed countries. Turkey is slated to be its largest recipient, with an estimated $30 billions of Emirati capital. Such strategic capital allocation could be explained by the Emirati's desire for a stable partnership with a regional military power at the crossroads between the East and the West. Surrounded by potential adversaries that could pose a potential threat to the UAE's sovereignty, such as Saudi Arabia, establishing such a secure partnership would serve as a strategic advantage. Furthermore, significant investments have been pledged in the United States as well as in partnership with the United States (US) under the Biden administration. Together, under the Partnership for Accelerating Clean Energy (PACE), the UAE and the US are launching an initiative to fund $100bn into renewable energy and deploy 100 GW of clean energy by 2035.[136] Additionally, Masdar finalized acquisition of 50% in a US-based independent power plant Terra-Gen (the project currently includes 3.8GW of

[130] List Solar. "Largest Solar Power Stations in UAE." Last modified 2024.
[131] Masdar Official Website. "UAE Wind Program." Last modified 2023.
[132] Patel, Sonal. "UAE Launches 104-MW Wind Project Despite Low Winds." Power Mag, November 2023.
[133] Verne, Jules. The Mysterious Island. Open Road Integrated Media, 1988.
[134] The Official Portal of the UAE Government. "National Hydrogen Strategy." Last modified 2023.
[135] Mooney, Attracta, and Andrew Williams. "The Cheque Book COP: UAE's $200bn Bid for Climate Influence." Financial Times, November 2023.
[136]Embassy of the United Arab Emirates. "UAE-US Partnership: Accelerating Clean Energy." UAE Embassy in Washington, DC.

wind, solar and battery storage projects, along with 5.1GWh of energy storage facilities), broadening the UAE's existing energy portfolio in the US.[137] Newly-elected Trump administration seems to be keen on pursuing the US-UAE partnership too, already introducing vast UAE-funded projects in the field of artificial intelligence.[138] The tactical partnership the UAE formed with the US showcased in the UAE's foreign direct investments in the US and the airport pre-clearance. By securing these US and Turkish partnerships, the UAE establishes itself as a global and regional geopolitical power.

Emirati renewable investments have not been avoiding the Old Continent either. Following the Memorandum of Understanding with the major French government-owned electric utility company, EDF, on research and development in nuclear and hydrogen energy, the Emirates Nuclear Energy Corporation (ENEC) has been eyeing investments in European nuclear energy assets.[139] An Emirati investor has reportedly approached the Sizewell C nuclear power plant to invest in Suffolk after the UK removed China General Nuclear Power Group due to security concerns.[140],[141] Furthermore, the UAE has closed green hydrogen deals with partners in Germany and Japan,[142] solar energy contracts with Indonesia, and many others.[143] Thus, Emirati investments in Europe reflect the UAE's intention to be included in the energy mix of developed nations and, in some instances, to replace traditional superpowers with a long-established history of international development.

The African continent is also one of the destinations of Emirati renewable capital. In cooperation with the US-established initiative Power Africa, the UAE-based Averi Finance plans on allocating $5bn into renewable energy generation, and connecting 500,000 homes in Sub-Saharan Africa to advance the sustainable efforts.[144] Furthermore, the UAE has pledged over $5 bn to the Africa50 initiative, run by African Development Bank and African governments, as a form of aid for developing countries towards a sustainable transition. Recently, the UAE has become the source of largest investments for Africa, pledging billions for mining industries and development programs.[145],[146] Arguably, such initiatives extend the web of Emirati influence and transform their geopolitically vulnerable position into a

[137] Associated Press. "United Arab Emirates Announces Major Renewable Energy Initiative in Abu Dhabi." AP News.
[138] Le Monde and AFP. "Trump Announces $20 Bn Emirati Investment in US Data Centers." Le Monde. Last modified January 7, 2025.
[139] Sadaqat, Rooh. "ENEC and EDF to Sign MOU on Research and Development." Khaleej Times, 2021.
[140] Lawson, Alex. "UAE Approached to Invest in Sizewell C Nuclear Power Plant." The Guardian, November 27, 2023.
[141] Grylls, George, and Alex Ralph. "Sizewell C Stake Seized from China May Go to UAE." The Times, November 27, 2023.
[142] Welle, Deutsche. "Germany Receives First Hydrogen Shipment from UAE." DW.com, October 21, 2022.
[143] Arab News. "UAE's Masdar Launches Its First Foreign Investment-Based Solar Plant in Azerbaijan." 2022.
[144] Embassy of the United Arab Emirates. "UAE and US Officials Highlight New Projects to Expand Clean Energy, Reaffirm Bilateral Climate Goals." UAE Embassy in Washington, DC.
[145] Rachel Savage. "UAE Becomes Africa's Biggest Investor amid Rights Concerns." The Guardian. Last modified December 24, 2024.
[146] Africa News. "DRC: UAE Signs $1.9 Billion Deal with State-Owned Mining Company." Africa News. Last modified July 18, 2023.

source of influence.[147] Additionally, they also raise concerns over the state of human and labor rights in the regions prone to mistreatment.

Yet fossils still prevail…

The Emirati domestic and foreign investments undeniably show a great interest in playing an active role in the post-fossil world. However, the Emirates also understand and reinforce the fossil-fuelled nature of the present times. Because of the large global oil and gas demand and the UAE's enormous fossil reserves, the country continues to pump out as much as it can. This fact alone would not come across as a surprise – fossil fuels are exhaustible, and demand is growing; thus, any country would continue to export while actively trying to switch to green energy. In the case of the UAE, it is not that simple. Months before hosting the COP28, the government-owned major oil company ADNOC introduced an ambitious $150 billion plan to "accelerate growth and strategy" for oil and gas production.[148] ADNOC's commitment to expansion is reflected in the acquisition of a 30% stake in Azerbaijan's condensate gas field, a 50% ownership gas deal with Israel worth $2 billion[149], and a planned 10% stake in a gas project in Mozambique. [150],[151], [152] Additionally, $17 billion have been allocated to exploiting the Hail and Ghasha offshore gas fields, located in the Persian Gulf, west of Abu Dhabi.[153] Once constructed, the Ghasha concession will produce over 1.5 billion cubic feet of gas per day by 2030. ADNOC claims that the project has the potential to become a flagship for carbon capture and low-carbon production.

Whilst such marketing rhetoric helps the UAE build an image of a sustainable partner, it has failed, however, to reflect on the fact that such production remains a significant emitter, even with low-carbon technology.[154] ADNOC further argued that the project would create jobs and "responsibly unlock its gas resources to enable gas self-sufficiency for the UAE, grow export capacity and support global energy security."[155] While this may be true, questions arise regarding the effectiveness and real motivation behind these green energy projects. In a world of accelerated climate warming, two major ongoing regional wars, and exposed energy security, are fossil fuels really the most responsible bet? As a result of these ambivalent energy objectives, the independent scientific project, Climate

[147] The Euro-Mediterranean Economists Association (EMEA). "COP28 Build-Up: $200 Billion from the UAE for Global Clean Energy Investments." EMEA, 2023.
[148] Tani, Shotaro. "UAE Energy Group ADNOC to Lift Spending on Decarbonisation Projects." Financial Times, 2024.
[149] *N.B The deal was postponed due to the ongoing war in Gaza.*
[150] El Dahan, Maha, Ron Bousso, and Alexander Hernandez. "Abu Dhabi's ADNOC to Acquire 30% Stake in Absheron Gas Field." Reuters, August 4, 2023.
[151] Ziady, Hannah. "BP and UAE Suspend $2 Billion Gas Deal in Israel as Gaza War Drags On." CNN Business, March 13, 2024.
[152] El Dahan, Maha, Yasmin Saba, and Ron Bousso. "Abu Dhabi's Oil Champion ADNOC Bets on Global Expansion." Reuters, October 9, 2023.
[153] N.B *Two major contracts were terminated by ADNOC. As a result, the project will be further delayed.*
[154] World Oil. "ADNOC Awards $17 Billion in Contracts to Develop Offshore Natural Gas Fields with Zero CO2 Emissions." October 5, 2023.
[155] Reuters. "UAE's ADNOC Awards $17 Billion of Contracts for Gas Project." October 5, 2023.

Action Tracker (CAT) estimates that the UAE will not achieve the set goals due to its heavy fossil fuel dependence and ongoing investments in hydrocarbons.[156]

When faced with questions about the contrasting national energy interests, COP28's chair Sultan Al Jaber responded that there was no scientific evidence of fossil fuels' impact on climate. When confronted by Mary Robinson, former UN special envoy for climate change, Al Jaber blamed her for 'trusting biased' media. Al Jaber's dual professional role best reflects the UAE's energy position. While he holds office as president of Masdar, the UAE Special Envoy for Climate Change, and chaired COP28, he is also the Minister of Industry and Advanced Technology and the CEO of ADNOC. He talks about the need for joint action against climate change yet denies fossil fuels' role in the climate crisis.[157],[158]

What motivates the sustainable course then?

An MIT Technology Review analysis shows that less than 4% of the Emirati domestic supply market consists of renewable sources, yet the Emirati foreign and domestic investments display an intention to take part in the global energy transition.[159] This commitment remains undermined by expanding fossil-related investments.

On the one hand, the UAE has invested both financial capital and its international reputation in sustainable progress at home and abroad. Over the past years, it has made significant financial contributions to developing sustainable energy solutions. Such actions, indisputably, make the UAE a recognized partner in the developed world and an ally to developing countries. This way, it secures a seat at the changing global energy table.

On the other hand, despite these ongoing sustainability efforts in domestic and foreign policy, the UAE keeps pouring capital into its hydrocarbon assets. While such actions are expected of an oil-rich country in a fossil-dominated world, they significantly undermine the UAE's position as a forerunner in fighting the climate crisis and raise questions about its true intentions.

Because of this reality, it is fair to conclude that the Emirati renewable energy interests lie not in ideology but in political and economic pragmatism. With its international role as a fossil superpower threatened by renewable transition, it has decided to become a part of the change to secure not only the flow of future capital but also a place at the international table. This way, the UAE secures its position as a traditional fossil fuel leader and a clean energy pioneer. While other middle eastern oil-

[156] Climate Action Tracker. "UAE." Last modified 2024. https://climateactiontracker.org/countries/uae/. European Commission. "Press Corner."
[157]European Comission. 2023. https://ec.europa.eu/commission/presscorner/detail/en/statement_23_5722.
[158] Stockton, Ben. "COP28 President Secretly Used Climate Summit Role to Push Oil Trade with Foreign Government Officials." Centre for Climate Reporting, 2024.
[159] MIT Technology Review. "The Green Future Index 2023." Last modified 2023.

rich countries have introduced renewable energy goals and related initiatives, such as Kuwait, the UAE provides a unique case of active pursuit of international strategy anchored in sustainable energy. Despite the possible power-driven motivation, Emirati financial contributions help accelerate the infrastructure for renewable transition by large. However, while the UAE does invest in clean energy projects in developing countries, such as those in Africa, most of its capital flows disproportionately toward developed countries, such as Turkey, which already possess substantial financial resources and established mechanisms to facilitate their energy transitions. This imbalance exacerbates the climate investment gap, as critical funding is diverted away from the developing nations most in need of financial support to address energy poverty and build sustainable transition infrastructure. By prioritizing developed countries, these actions undermine global efforts to achieve equitable climate resilience and a fairer distribution of resources for energy transition.

Thanks to its active participation in the clean transition and efforts to engage in global energy diversification, we may expect to encounter the UAE more and more in our lives, whether in the fossil-based scenario or, contrastingly, in the post-fossil world.

This constitutes an edited version of the article 'Security Dressed in Green: What Motivates the UAE's Push for Sustainable Energy', first published in Security Outlines.

Bridging the Gap: Enhancing Climate Finance Mobilisation for the Green Transition in Emerging Market and Developing Economies

Linus Mehl
Master in International Development, Sciences Po

Linus Mehl studies International Development at Sciences Po, Paris and earned his bachelor's degree in International Relations at the Technical University of Dresden. Linus focuses on climate mitigation pathways for low- and middle-income countries. In collaboration with the Climate & Development Group at the Potsdam Institute for Climate Impact Research, he wrote his master's thesis on clean cooking fuel adoption in Ghana and works with the Sciences Po European Chair for Sustainable Development and Climate Transition on the evaluation of EU climate policies.

Large-scale mobilisation of climate finance is vital for aiding emerging markets and developing economies' (EMDEs) in their transition to low-carbon, climate-resilient economies.[160] Despite pledges by developed countries to provide financial resources to support EMDEs with mitigation and adaptation efforts, challenges persist in mobilising and fairly distributing climate-related funding.[161] Current financial support falls short of meeting the needs outlined in Nationally Determined Contributions (NDCs), hindering the ability of EMDEs to achieve their climate targets. For instance, the African continent alone requires USD 277 billion per year to implement its NDCs and meet the 2030 climate targets, yet current annual climate funding to Africa is only USD 30 billion.[162] This essay proposes avenues to effectively mobilise and distribute climate finance mechanisms in EMDEs to address this issue.

Sources of climate finance for EMDEs

Public funds represent a significant source of climate finance, typically provided by governments, multilateral development banks (MDBs), and international financial institutions (IFIs). These funds are often allocated through bilateral or multilateral channels, including official development assistance (ODA) and specialized

[160] Panda, A. (2023). "Transformative finance for climate-resilient development." *Current opinion in Environmental Sustainability* 64.
[161] UNFCCC (2015). *The Paris Agreement*. Bonn, Germany: United Nations Framework on Climate Change (UNFCCC); Banga, J. (2019). "The green bond market: a potential source of climate finance for developing countries." *Journal of Sustainable Finance & Investment* 9(1).
[162] Qi, J. and Qian, H. (2023). "Climate finance at a crossroads: it is high time to use the global solution for global problems." *Carbon Neutrality* 2(31).

climate funds such as the Green Climate Fund (GCF) and the Global Environment Facility (GEF).[163] Moreover, domestic budgets earmarked for climate-related projects and programmes play a vital role in financing climate change mitigation and adaptation activities, spanning renewable energy projects, ecosystem restoration, and disaster risk reduction initiatives.[164] In 2022, international climate finance to EMDEs (excl. China) amounted to USD 205 billion, while domestic climate finance in these countries reached USD 93 billion.[165]

Additionally, private investment is a crucial source of climate finance in EMDEs. The engagement of the private sector encompasses a wide range of activities, including investments in renewable energy, energy efficiency, clean technology, and sustainable infrastructure projects.[166] Institutional investors, commercial banks, venture capital firms, and impact investors contribute through various financing mechanisms, such as green bonds, climate funds, and public-private partnerships (PPPs). These private investments not only provide financial resources but also bring in expertise, innovation, and market-driven solutions to address climate-related challenges.[167]

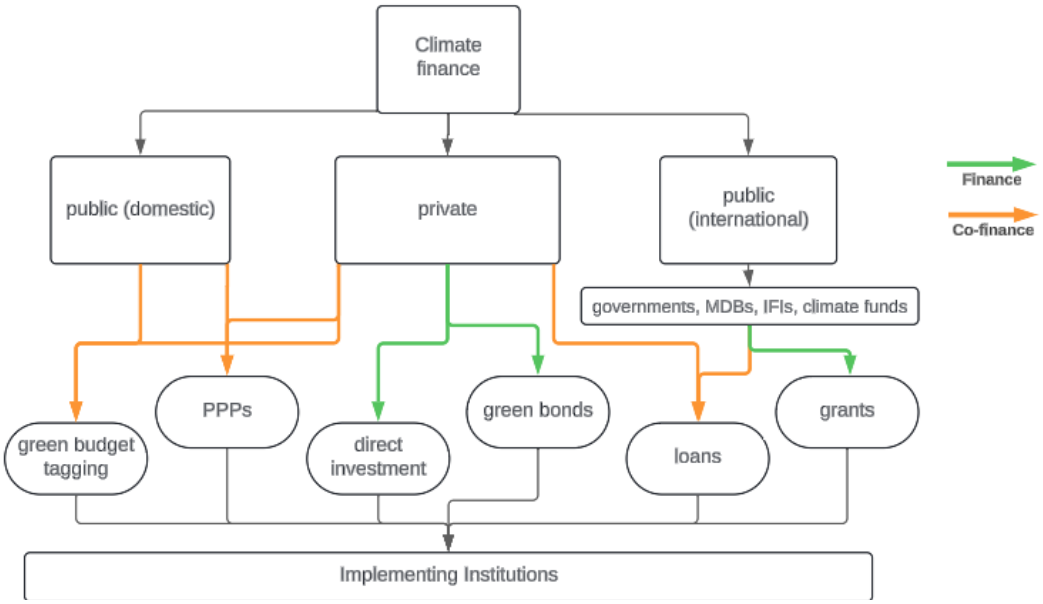


Figure 1: Sources of climate finance. Own illustration.

[163] Ishiwatari, M. (2022). "Disaster risk reduction." In: *Handbook of Climate Change Mitigation and Adaptation* (pp. 3019-3045). Cham: Springer International Publishing.
[164] Ibid.
[165] Climate Policy Initiative. 2025. "Global Landscape of Climate Finance 2024 - CPI." CPI. January 16, 2025.
[166] Digitemie, W. N. and Ekemezie, I. O. (2024). "Assessing the role of climate finance in supporting developing nations: a comprehensive review." *Finance and Accounting Research Journal* 6(3).
[167] Glemarec, Y. (2022). "How to ensure that investment in new climate solutions is sufficient to avert catastrophic climate change." In *Handbook of international climate finance* (pp. 445-474). Edward Elgar Publishing.

While private finance has been steadily increasing to around 47% of total climate finance in EMDEs, this is heavily driven towards emerging market economies such as China, Indonesia, South Africa and Brazil. In Sub-Saharan African countries, private climate finance accounts for less than 10% creating a lack of sufficient finance for climate-related projects.[168] Together, public and private finance form the cornerstone of climate funding for EMDEs, with each source playing a unique role in addressing climate challenges (see Figure 1). However, significant gaps remain in the scale and efficiency of climate finance mobilisation, underscoring the need for enhanced mechanisms and strategies to meet the growing demands of the green transition.

Overcoming institutional barriers in EMDEs

To date, institutional capacity constraints, limited technical expertise, and complex procedural requirements are the main barriers impeding access to climate finance.[169] These constraints manifest in various forms, including difficulties in accessing, managing, and implementing climate finance effectively, as well as challenges in project design, implementation, and monitoring & evaluation.[170] Moreover, the uncertainty in funding flows, driven by changing donor priorities, political dynamics, and economic conditions exacerbates challenges in long-term planning and implementation efforts.[171]

Another barrier to more effective climate finance is its fragmented international landscape, characterized by disparate institutions and varying standards and practices, despite commitments from developed countries to contribute to international finance mechanisms that are directly accessible.[172] A prime example is the Green Climate Fund (GCF), which enables direct access for entities from EMDEs, but imposes stringent accreditation requirements, resulting in delays in funding approval for climate projects. Moreover, protracted processes for proposal development and approval exacerbate the challenge of inadequate public financing for combating climate change, hindering timely disbursement to on-the-ground projects.[173]

To scale up climate finance, more effective governance and institutional frameworks are pivotal for mobilising, allocating and utilizing climate finance resources.[174] For example, the establishment of National Climate

[168] Climate Policy Initiative. 2025. "Global Landscape of Climate Finance 2024 - CPI." CPI. January 16, 2025.
[169] Digitemie, W. N. and Ekemezie, I. O. (2024). "Assessing the role of climate finance in supporting developing nations: a comprehensive review." *Finance and Accounting Research Journal* 6(3).
[170] Islam, M. (2022). "Distributive justice in global climate finance – Recipients' climate vulnerability and the allocation of climate funds." *Global Environmental Change* 73.
[171] Ibid.
[172] Chaudhury, A. (2020). "Role of Intermediaries in Shaping Climate Finance in Developing Countries – Lessons from the Green Climate Fund." *Sustainability* 12.
[173] Ibid.
[174] Cash, C. and Swatuk, L. A. (2022). "Climate Finance: Lessons from Development Finance." In *The Political Economy of Climate Finance: Lessons from International Development* (1-19). Cham: Springer International Publishing.

Finance Institutions (NCFIs) is a key strategy for enhancing climate finance activities.[175] NCFIs serve to align and harmonize international policies and resources to achieve national climate change objectives, thereby strengthening bureaucratic and financial systems to promote sustainable development.[176] The Bangladesh Climate Change Resilience Fund (BCCRF) or the National Fund for Environment (FONERWA) in Rwanda are examples of NCFIs that have effectively mobilised climate finance to support projects in renewable energy, conservation and climate resilience. Additionally, initiatives such as green budget tagging offer an effective tool for developing countries to improve resource mobilization by clearly defining and isolating climate-related project expenditure within national budgets. Indonesia, Nepal, the Philippines and Morocco, for instance, have been successful in facilitating the inflow of climate finance and supporting climate action through such systems.[177]

Mobilizing International Climate Finance Mechanisms

Simplifying and harmonizing funding mechanisms could enhance accessibility and efficiency in climate finance governance, allowing accelerated access for national entities.[178] Intermediaries, so-called "Accredited Entities" (AEs) to the GCF, play a decisive role by acting as brokers between distributed policy actors and bridging key constituents and stakeholders.[179] AEs facilitate the diffusion of knowledge and information, offer structural connections among disparate actors, and play a pivotal role in building the capacities of EMDEs to achieve climate finance readiness. The GCF deliberately introduces national AEs to promote country ownership[180], reduce transaction costs, ensure a balanced distribution of funding, and enhance accountability and transparency in local implementation capabilities.[181] However, to date, many EMDEs have not accredited their AEs at the GCF, impeding direct access of these countries to funds for climate projects. Integral involvement of recipient countries thus needs to be empowered to ensure their involvement in the projects by simplifying and

[175] Sheriffdeen, Muhammad, Nurrochmat, Dodik Ridho, Perdinan, Di Gregorio, Monica (2020). "Indicators to Evaluate the Institutional Effectiveness of National Climate financing Mechanisms." *Forest and Society* 4(2).
[176] Watson, C. and Shalatek, L. (2019). *The Global Climate Finance Architecture*. *Climate Finance Fundamentals 2*. Overseas Development Institute. London: ODI.
[177] Pindiriri, C. and Kwaramba, M. (2024). "Climate finance in developing countries: green budget tagging and resource mobilization." *Climate Policy*.
[178] Omukuti, J. (2020). "Country ownership of adaptation: Stakeholder influence or government control?" *Geoforum* 113.
[179] Chaudhury, A. (2020). "Role of Intermediaries in Shaping Climate Finance in Developing Countries – Lessons from the Green Climate Fund." *Sustainability* 12.
[180] Country ownership aims to ensure that any form of development cooperation is aligned with the development priorities of recipients, while using country systems for implementation.
[181] De Silva, M., Howells, J., Meyer, M. (2018). "Innovation intermediaries and collaboration: Knowledge-based practices and internal value creation." *Resources Policy* 47.

supporting accreditation processes for national AEs.[182]

Moreover, there remains limited interest from private investors in co-financing public climate funds' projects despite the efforts by climate funds to attract them.[183] Stricter regulations on CO2 emissions and the potential sale of carbon credits generated through GCF projects could foster incentives for the private sector to do so.[184] By imposing higher costs on emissions, stricter regulations create a financial imperative for businesses to invest in low-carbon technologies and projects, making climate finance opportunities more attractive. Another barrier to co-financing is the preference of EMDEs for grants over loans. Grants alleviate the burden of debt accumulation and enable governments to address pressing development needs.[185] However, to attract private capital through co-financing, and to maximise the impact from limited public funding sources, non-grant instruments are favoured for facilitating reinvestment in new projects.[186] While loans provide a more impactful tool for co-financing, addressing sovereign debt issues is crucial to increasing the creditworthiness and fiscal abilities of EMDEs, which are central to scaling up climate finance. Climate-for-debt swaps offer a solution to restructure sovereign debt, freeing financial resources for climate mitigation or adaptation measures that countries commit to in exchange for debt relief. The Seychelles and Belize have, for example, successfully implemented such swaps. In the short-term, this provides capital to invest in climate projects, whereas in the long term, it enhances the country's attractiveness for private investments.[187]

Mobilising Private Investment

Mobilising private investment is crucial for bridging the climate finance gap and shifting towards a low-carbon, climate-resilient economy.[188] However, numerous barriers impede the flow of private finance into climate-related projects in EMDEs. These comprise political and regulatory risks, market risks and underdeveloped financial markets.[189] To mobilise private climate finance effectively, there is a growing recognition of the need to shift financial flows in alignment with Article 2.1(c) of the Paris Agreement.[190] This implies leveraging public climate finance to incentivise and mobilise private sector investments in climate-resilient projects. Achieving this goal requires an

[182] Chaudhury, A. (2020). "Role of Intermediaries in Shaping Climate Finance in Developing Countries – Lessons from the Green Climate Fund." *Sustainability* 12.
[183] Kalinowski, T. (2024). The Green Climate Fund and private sector climate finance in the Global South. *Climate Policy*, *24*(3).
[184] Ibid.
[185] Pauw, W. P., Moslener, U., Zamarioli, et al. (2022). "Post-2025 climate finance target: how much more and how much better?" *Climate Policy* 22(9): 1241-1251
[186] Ibid.
[187] Chamon, M., Klok, E., Thakoor, V. *et al.* (2023). "An Economic Analysis of Debt-for-Climate Swaps." *IMF Economic Review*.
[188] Panda, A. (2023). "Transformative finance for climate-resilient development." *Current opinion in Environmental Sustainability* 64.
[189] Banga, J. (2019). "The green bond market: a potential source of climate finance for developing countries." *Journal of Sustainable Finance & Investment* 9(1): 17-32.
[190] Pauw, W. P., Moslener, U., Zamarioli, L. H., et al. (2022) "Post-2025 climate finance target: how much more and how much better?" *Climate Policy* 22(9): 1241-1251

improved policy and regulatory environment that fosters regional, cross-border, and multi-country cooperation to address policy barriers and create conducive investment conditions.[191]

Governments should therefore develop guidelines and fiscal frameworks that align private sector investments with long-term societal benefits while ensuring economic profitability.[192] By enhancing the policy and regulatory environment, EMDEs can attract private sector investments and unlock new opportunities for sustainable development while ensuring that private investments align with climate goals.[193] Country ownership is therefore paramount as it means that private climate projects align with national development plans and contribute to institutional building. However, many EMDEs lack a strong "developmental state" capable of guiding private investments.[194] In such cases, private investment should be channelled through the GCF that ensures that projects are country-driven and evaluated based on their contribution to national development and institution building.[195]

Mobilising the Use of Green Bonds

Green bonds can help both public and private investments to attract co-financing for climate mitigation and adaptation projects by earmarking the proceeds for financing eligible green projects.[196] However, the use of green bonds within developing countries still encounters notable barriers. These stem from both institutional and market-related factors. Institutionally, EMDEs often lack the technical expertise required for monitoring and assessing the utilisation of green bond proceeds throughout project lifecycles.[197] Market barriers, including minimum size requirements, transaction costs, and currency of issuance, further impede the widespread adoption of green bonds in developing countries.[198] In fact, green bond underwriters typically require a minimum bond size of USD 200 million, which is rarely met by climate finance projects in EMDEs. Bond sizes in EMDEs usually range between USD 10 million and USD 100 million.[199]

To overcome institutional barriers, improvements in global definitions and disclosure standards are essential to facilitate investment in EMDEs, where green bond markets are less

[191] Mungai, E. M., Ndiritu, S. W., & Da Silva, I. (2022). Unlocking climate finance potential and policy barriers—A case of renewable energy and energy efficiency in Sub-Saharan Africa. *Resources, Environment and Sustainability*, *7*.
[192] Ibid.
[193] Pauw, W. P., Moslener, U., Zamarioli, L. H., et al. (2022) "Post-2025 climate finance target: how much more and how much better?" *Climate Policy* 22(9): 1241-1251
[194] Kalinowski, T. (2024). The Green Climate Fund and private sector climate finance in the Global South. *Climate Policy*, *24*(3), 281–296.
[195] Ibid.
[196] Banga, J. (2019). "The green bond market: a potential source of climate finance for developing countries." *Journal of Sustainable Finance & Investment* 9(1): 17-32.
[197] Ibid.
[198] Franklin, A. (2016). "Is Green Striping the Future of Green Bonds?" *International Financial Law Review*.
[199] Banga, J. (2019). "The green bond market: a potential source of climate finance for developing countries." *Journal of Sustainable Finance & Investment* 9(1): 17-32.

established.[200] Common global definitions and norms would provide clarity and assurance to issuers and investors alike, while high standards of disclosure and reporting would decrease transaction costs and facilitate the differentiation between brown and green assets.[201] Additionally, the constructive use of guarantees and de-risking measures can help expand the green bond market in emerging economies, as demonstrated by initiatives such as the Amundi Planet Emerging Green One (EGO) fund.[202]

To overcome the market size barrier a "green striping system" has been proposed where bonds are aimed at financing both green and non-green projects to increase bond size. As such, only a fraction of proceeds is allocated to green initiatives increasing the bond size.[203] However, under this approach, the lines between greenwashing and climate financing are thin, and might undermine investors' confidence in "green" bonds. Additionally, conventional green bonds are only suitable for investors who are familiar with the market and for countries with a high creditworthiness, which is rare in highly indebted developing economies.[204] Therefore, local governments can promote local green bond markets with the help of MDBs acting as intermediaries for green bond issuance. MDBs can leverage their favourable credit ratings to secure funds at efficient costs and allow access to international capital markets that local governments often lack.[205] To reach a sufficient size, instead of a "green striping system", MDBs could also pool green projects on a regional level ensuring investments in purely green projects distributed over several countries.[206]

Conclusion

The mobilisation and equitable distribution of climate finance in EMDEs represents a pivotal juncture in fostering the green transition. Addressing the outlined challenges necessitates a multifaceted strategy encompassing institutional, financial, and regulatory dimensions. Enhancing institutional capacity through the establishment of National Climate Finance Institutions (NCFIs) stands as a cornerstone for efficient resource mobilisation, allocation, and utilisation. Moreover, streamlining international finance mechanisms, exemplified by initiatives

[200] Deschriyver, P. and de Mariz, F. (2020). "What Future for the Green Bond Market? How Can Policymakers, Companies, and Investors Unlock the Potential of the Green Bond Market?" *Journal of Risk and Financial Management* 13(61): 1-26.
[201] Banga, J. (2019). "The green bond market: a potential source of climate finance for developing countries." *Journal of Sustainable Finance & Investment* 9(1): 17-32.
[202] Deschriyver, P. and de Mariz, F. (2020). "What Future for the Green Bond Market? How Can Policymakers, Companies, and Investors Unlock the Potential of the Green Bond Market?" *Journal of Risk and Financial Management* 13(61): 1-26.
[203] Franklin, A. (2016). "Is Green Striping the Future of Green Bonds?" *International Financial Law Review.*
[204] Banga, J. (2019). "The green bond market: a potential source of climate finance for developing countries." *Journal of Sustainable Finance & Investment* 9(1): 17-32.
[205] Campiglio, E. (2016). "Beyond Carbon Pricing: The Role of Banking and Monetary Policy in Financing the Transition to a Low-carbon Economy." *Ecological Economics* 121: 220-230.
[206] Banga, J. (2019). "The green bond market: a potential source of climate finance for developing countries." *Journal of Sustainable Finance & Investment* 9(1): 17-32.

like the Green Climate Fund (GCF), can enhance accessibility and effectiveness in governance. Encouraging private sector engagement constitutes another important avenue, underpinned by the creation of conducive policy frameworks aligning private investments with societal benefits while ensuring economic viability. Leveraging public climate finance to incentivise private sector involvement holds promise in bridging existing funding gaps and driving transformative change.

It Takes a Village: Embracing the Opportunity for Oil and Gas Industry Expertise to Lead Next-Generation Geothermal Development

Arina Khotimsky
Master in International Energy Transition, Sciences Po

Arina Khotimsky is a second-year master's student at Sciences Po in International Energy Transitions. Prior to this, she completed her bachelor's degree at the Massachusetts Institute of Technology in Materials Science and Engineering with a minor in Energy Studies. Arina most recently interned at the Energy Transition Institute at Kearney in Paris in 2024, where she contributed to a FactBook on geothermal energy and several client projects. Previously, Arina co-led the MIT Energy and Climate Club (2022-2023).

Introduction

The site of solar panels or wind turbines has become synonymous with the progress of energy transition. But another energy source that is much trickier to emblazon on a poster is *geothermal energy*.

Geothermal energy comes from the heat of the Earth itself. It is mostly concentrated deep underground and spread unevenly throughout the world due to the complex nature of plate tectonics.[207,208] Humans have engineered geothermal energy systems to collect this energy and put it to use. Today, geothermal energy comprises 0.8% of global energy demand, harnessed for heating (79% of this total) and electricity (21%).[209]

In the last few years, investment in geothermal technologies has increased from less than USD 50 million in 2017 and 2018 combined, to over USD 400 million in 2023. Nearly 3/4 of this funding went to innovative, next-generation geothermal power.[210,211] However, although the IEA predicts a market potential of over 800 gigawatts (GW) for next-generation geothermal power by 2050, the feasibility of these systems will come down to their cost. They will not be competitive with other renewables at their current cost, as high as over USD 230 per megawatt-

[207] IEA, "The Future of Geothermal Energy" (Paris: IEA, December 2024), https://www.iea.org/reports/the-future-of-geothermal-energy.
[208] Romain Debarre et al., "Geothermal Energy: Turning up the Heat" (Kearney Energy Transition Institute, January 2025), https://www.energy-transition-institute.com/factbooks/geothermal-energy-turning-up-the-heat.
[209] IEA, "The Future of Geothermal Energy."
[210] *Note that in this context, "electricity" and "power" are used interchangeably.*
[211] IEA, "The Future of Geothermal Energy."

hour (MWh).[212] In recent years, the United States Department of Energy-sponsored Frontier Observatory for Research in Geothermal Energy (FORGE) facility has led cost reductions in next-generation geothermal power alongside Fervo Energy, a geothermal startup. Fervo's leverage of US oil and gas industry knowledge has contributed to a halving of drilling costs among its projects' wells thus far.[213] Engaging with the oil and gas industry will be crucial to continue lowering costs, as it has the resources, manpower, and know-how that overlap with next-generation geothermal technologies.

This essay begins with a description of the strengths and weaknesses of conventional and next-generation geothermal systems. It then discusses the cost of geothermal power in comparison to other renewable energy sources and reflects on the key steps needed to reduce costs and increase the development of next-generation geothermal power. It ends with a discussion of the US geothermal market, where investment in next-generation technology is concentrated, and where geothermal very well may be the silver lining to the Trump administration's agenda of "drill, baby drill."[214]

Strengths and weaknesses of geothermal energy

A key strength of geothermal energy is that it is both renewable and non-intermittent ("clean, firm power").[215,216] Indeed, the capacity factor of geothermal power exceeds all other renewable energy sources.[217,218] This makes geothermal energy suitable to power baseload electricity demands, such as in Kenya, where Microsoft and G42 are investing in a 100 MW geothermal-powered data centre, or local electricity utility mandates, such as in California, where Southern California Edison signed a power purchase agreement (PPA) with Fervo Energy in 2024 for "non-weather-dependent, non-battery, zero-emission energy to increase the reliability of the state's electric grid."[219,220] Other

[212] Because so little capacity of next-generation geothermal power has been installed, cost estimates vary widely. The IEA "The Future of Geothermal Energy" reports costs of first-of-a-kind projects at over USD 230/MWh. A contrasting value is the National Renewable Energy Labs Annual Technology Baseline (2024), which estimates next-generation technologies to cost around USD 100/MWh.
[213] Doug Blankenship et al., "Pathways to Commercial Liftoff: Next-Generation Geothermal Power" (US Department of Energy, March 2024), https://liftoff.energy.gov/wp-content/uploads/2024/03/LIFTOFF_DOE_NextGen_Geothermal_v14.pdf.
[214] "Trump: 'We Will Drill Baby, Drill'" (YouTube, January 20, 2025), https://www.youtube.com/watch?v=xSfg0qTBCHQ.
[215] IEA, "The Future of Geothermal Energy."
[216] Katrina McLaughlin et al., "Next-Generation Geothermal: Considerations and Opportunities for Responsible Development" (Washington, D.C.: World Resources Institute, November 2024), https://www.wri.org/research/next-generation-geothermal-considerations-and-opportunities-responsible-development.
[217] Capacity factor measures how much a power plant is active. It is calculated by dividing the total energy produced by a plant in a certain period of time by the theoretical maximum production over that period.
[218] IEA, "The Future of Geothermal Energy."
[219] Matthew Gooding, "Microsoft and G42 to Build Geothermal-Powered Data Center in Kenya," Data Centre Dynamics, May 22, 2024, https://www.datacenterdynamics.com/en/news/microsoft-and-g42-to-build-geothermal-powered-data-center-in-kenya/.
[220] Fervo Energy, "Fervo Energy Announces 320 MW Power Purchase Agreements with Southern California

advantages include the ability to provide ancillary grid services, having a small land footprint compared to other renewable energy sources, low water use, and lower critical mineral reliance than solar PV and wind.[221,222,223]

With such clear benefits, what has prevented previous investment in geothermal power?

A major difference between geothermal energy and other renewable energy sources is **resource risk**: It is much easier to measure the solar irradiation or wind patterns of a given site than to quantify its underground geothermal resource. Conventional geothermal

systems, those that have been mostly developed to date, utilize **hydrothermal reservoirs**: geothermal resources characterized by sufficient 1) heat, 2) fluid, and 3) permeability.[224] Once a well is drilled to the reservoir, heated vapor or fluid (called brine) is extracted for heating or electricity generation. However, if there is less fluid or permeability than expected, it becomes difficult to harvest the geothermal energy. The well may result in less power output than expected, driving up the levelized cost of electricity (LCOE). Between 2010-2023, geothermal LCOE ranged from USD 40/MWh to USD 240/MWh; on the low end, on par with other dispatchable renewables, but on the high end, far from it.[225]

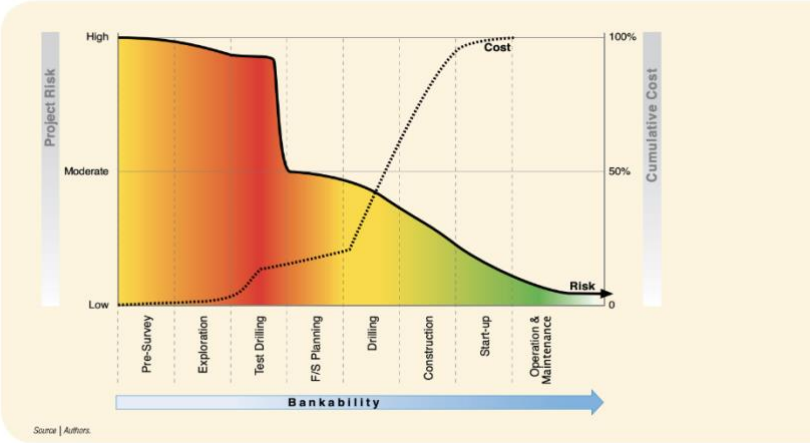


Figure 1: ESMAP 2012: Risk profile of geothermal power development.

Edison - Fervo Energy," Fervo Energy, June 25, 2024, https://fervoenergy.com/fervo-energy-announces-320-mw-power-purchase-agreements-with-southern-california-edison/.

[221] Geothermal energy can also serve as a significant source of sustainable heat, energy storage, and even lithium extraction (from geothermal brines). While there are many examples of innovation in these areas, this article focuses on next-generation geothermal power.

[222] Jody Robins et al., "2021 U.S. Geothermal Power Production and District Heating Market Report" (NREL, July 2021), https://doi.org/10.2172/1808679.

[223] McLaughlin et al., "Next-Generation Geothermal."

[224] Debarre et al., "Geothermal Energy: Turning up the Heat."

[225] IEA, "The Future of Geothermal Energy."

Fully understanding if a geothermal resource is suitable for power generation requires site exploration and confirmation drilling. This can take around 10-15% of the total project cost[226] – a significant investment before the resource is even confirmed. Investors are often unwilling to take these initial steps without intervention to reduce the risk (Figure 1).

Successful geothermal power development has featured a variety of mechanisms that alleviate resource risk. Government-sponsored resource exploration and data sharing can remove some of the early costs for project developers. Governments can lead development, or provide grants, favourable debt, or fiscal incentives to developers that improve project economics.[227,228,229] Companies like Zanskar Geothermal are developing models to better predict geothermal resources, also decreasing risk.[230] Once resource risks are better understood, they can be incorporated into financial models of investors and developers, boosting investment.

Another challenge that affects geothermal resource development more than many other renewable energy sources is **permitting.** Geothermal permitting often requires multiple steps. For example, in the US, geothermal development can require up to six environmental reviews under the National Environmental Policy Act (NEPA). As a result, project development on federal land has taken 7-10 years on average; unexpected litigation can introduce further delays.[231,232] Permitting uncertainty thus introduces significant risks for project developers.

The IEA recommends several examples of how permitting processes can be improved, from creating new legal frameworks tailored to geothermal resources to streamlining procedures and incorporating deadlines into the process.[233] But permitting reform takes time, and it progresses only as far as it is made a priority by the government agencies responsible.

Additional policy areas do not directly address geothermal resource risk reduction or permitting, but they nonetheless facilitate project implementation. These include: building social awareness, developing technical standards for geothermal equipment, creating revenue mechanisms, supporting research, and developing geothermal industry job

[226] Ibid.
[227] IEA, "The Future of Geothermal Energy."
[228] Subir K. Sanyal et al., "Comparative Analysis of Approaches to Geothermal Resource Risk Mitigation: A Global Survey" (Washington, D.C.: World Bank Group, March 2016), https://doi.org/10.1596/24277.
[229] Padraig Oliver and Martin Stadelmann, "Public Finance and Private Exploration in Geothermal: Gümüşköy Case Study, Turkey" (Climate Policy Initiative, March 2015), https://www.cif.org/sites/cif_enc/files/knowledge-documents/sgg_report_public_finance_and_private_exploration_in_geothermal_gumuskoy_turkey_0.pdf.
[230] Zanskar, "Zanskar Announces $12M Series A Funding for Geothermal Discovery Tech," Zanskar Geothermal & Minerals, August 26, 2024, https://www.zanskar.com/blog/zanskar-seriesa.
[231] Blankenship et al., "Pathways to Commercial Liftoff: Next-Generation Geothermal Power."
[232] McLaughlin et al., "Next-Generation Geothermal."
[233] IEA, "The Future of Geothermal Energy."

skills.[234] These policies can further increase investor confidence, thus improving the chances of obtaining funding.

The potential and the challenges of next-generation technologies

Due to the strict requirements of having sufficient fluids and permeability, the amount of conventional hydrothermal reservoirs is limited. This is where **next-generation geothermal systems** can step in – making previously unsuitable geologies (those that lack sufficient fluid or permeability) available for geothermal power generation.[235,236]

Next-generation technologies make use of resources that are not suitable for conventional geothermal systems. **Enhanced Geothermal Systems (EGS)** inject fluids through a well into deep, hot areas, creating microfractures, and extract the now-heated fluids through a second well. **Advanced Geothermal Systems (AGS)** or **closed-loop systems** circulate fluids, avoiding direct contact with the ground, but absorbing heat from the Earth (Figure 2). Both technologies serve the same purpose: extracting geothermal heat from hot, dry, non-permeable geologies.[237] While next-generation drilling technologies are not free from risks of environmental impacts, most notably water use/contamination, seismicity, and land-use footprint, these risks are lower

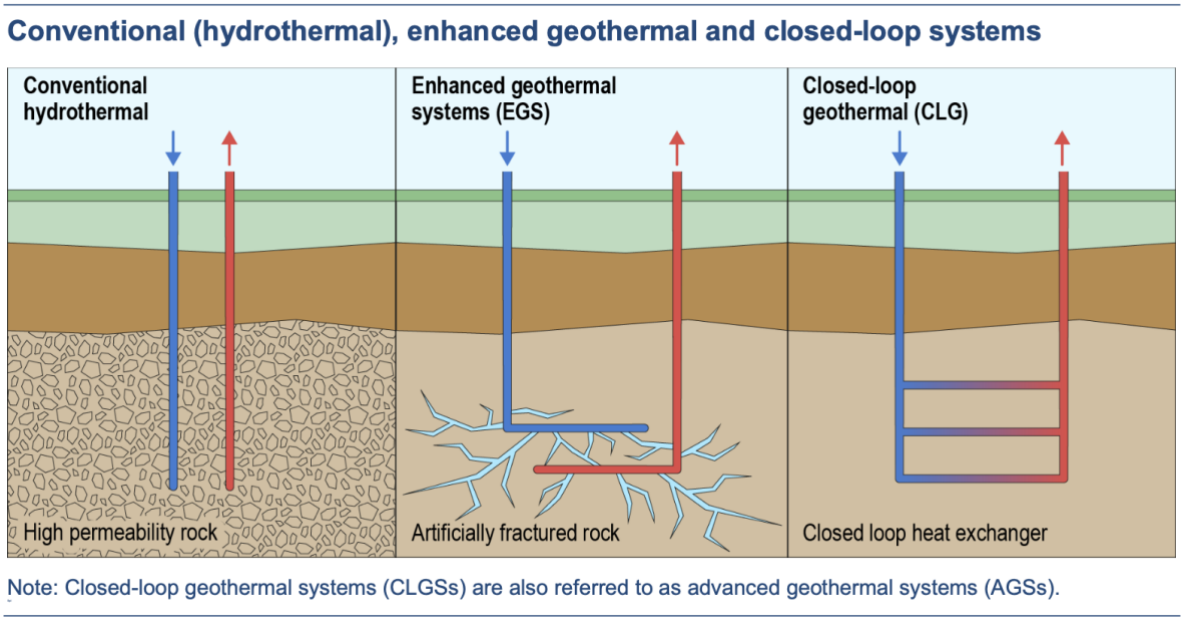


Figure 2: The differences between conventional geothermal systems, enhanced geothermal systems, and closed loop geothermal systems (IEA 2024).

[234] Ibid.
[235] Blankenship et al., "Pathways to Commercial Liftoff: Next-Generation Geothermal Power."
[236] McLaughlin et al., "Next-Generation Geothermal."
[237] AGS requires longer wells for sufficient heat exchange, which does currently increase drilling costs relative to EGS.

than for typical oil and gas drilling projects.[238,239,240]

However, there is an enormous gap between the 15 GW of geothermal power capacity that is online today (nearly all conventional), the 60-80 GW of conventional geothermal power that could be online by 2050,[241] and the *800 GW* of next-generation geothermal market potential by 2050 predicted by the IEA.[242]

This scale of growth is not unheard of for renewable energy. There were approximately 40 GW of solar photovoltaic (PV) capacity installed in 2010; capacity exceeded 800 GW in 2021.[243]

Onshore wind power capacity totalled around 17 GW in 2000; it, too, exceeded 800 GW by 2021.[244] However, both of these impressive developments were accompanied by a decrease in cost. Solar PV weighted average levelized cost of electricity (LCOE) decreased rapidly from USD 460/MWh in 2010 to around USD 40/MWh in 2023. Onshore wind prices decreased quickly too, from USD 170/MWh in 2000 to USD 33/MWh in 2023.[245] Meanwhile, geothermal power costs have remained fairly constant. Since 2016, weighted average costs have hovered around USD 71-77/MWh.[246] This is around the current weighted average cost of offshore wind power, USD 75/MWh (Figure 3).

[238] Companies leading in the next-generation geothermal sector include Fervo Energy, Sage Geosystems, XGS Energy, GreenFire Energy, and Eavor Technologies.
[239] Blankenship et al., "Pathways to Commercial Liftoff: Next-Generation Geothermal Power."
[240] McLaughlin et al., "Next-Generation Geothermal."
[241] The 2024 IEA Stated Policies Scenario (STEPS) and Advanced Pledges Scenario (APS) found that there could be 60 GW and 80 GW of geothermal power capacity by 2050, respectively.
[242] IEA, "The Future of Geothermal Energy."
[243] IRENA - processed by Our World in Data, "Installed Solar Energy Capacity," Our World in Data, 2024, https://ourworldindata.org/grapher/installed-solar-pv-capacity.
[244] IRENA - processed by Our World in Data, "Installed Wind Energy Capacity," Our World in Data, 2024, https://ourworldindata.org/grapher/cumulative-installed-wind-energy-capacity-gigawatts?country=~OWID_WRL.
[245] IRENA - processed by Our World in Data, "Levelized cost of energy by technology, World," Our World in Data, 2024, https://ourworldindata.org/grapher/levelized-cost-of-energy.
[246] IRENA, "Renewable Power Generation Costs in 2023" (Abu Dhabi: International Renewable Energy Agency, 2024), https://www.irena.org//media/Files/IRENA/Agency/Publication/2024/Sep/IRENA_Renewable_power_generation_costs_in_2023.pdf.

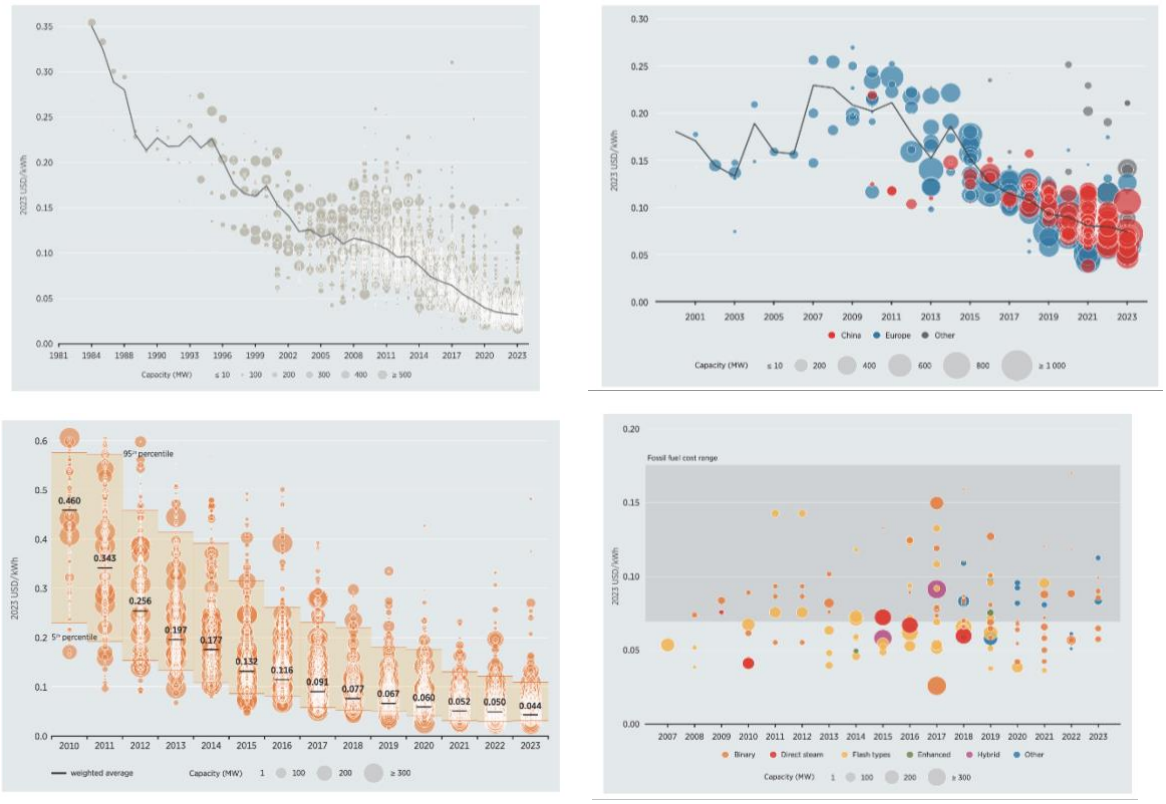


Figure 3: The levelized cost of electricity (LCOE) of global utility-scale solar PV (top left), onshore wind (top right), offshore wind (bottom left), and geothermal power (bottom right). Graphs are reproduced from IRENA, "Renewable Power Generation Costs in 2023 (IRENA).

Resource risk and permitting challenges aside, next-generation geothermal technologies face a particular challenge of reaching cost-competitiveness with other energy technologies. While conventional geothermal power costs average near the bottom or below the fossil fuel cost range, next-generation geothermal costs are currently over USD 230/MWh for first-of-a-kind projects according to the IEA; or ranging between USD 65-141/MWh for next-generation projects in the US.[247, 248] The 800 GW market potential for next-generation geothermal power development depends on this cost coming down.

More involvement from the oil and gas industry is needed for next-generation geothermal prices to fall

The hope for energy transition with next-generation geothermal lies in an unlikely place: the oil and gas industry. Well stimulation and drilling techniques developed within the shale gas and tight oil industries in the US are used for

[247] IEA, "The Future of Geothermal Energy."
[248] US Department of Energy, "Pathways to Commercial Liftoff: Next-Generation Geothermal Power" Fact Sheet Version, October 2024, https://liftoff.energy.gov/wp-content/uploads/2025/01/Fact-Sheet-_-Next-Generation-Geothermal-Power_Updated-2.5.25.pdf

EGS.[249] In addition, skills like surface facility planning and construction, operations, and production monitoring, which are necessary for geothermal plants, have also been developed. The IEA foresees that most of the cost reduction of next-generation geothermal can come from learning in the oil and gas industry. Assuming a high level of knowledge transfer, next-generation geothermal power costs could decrease by 80% by 2035. This would result in a LCOE as low as USD 50/MWh by 2035 and USD 30/MWh by 2050 (on par with the solar PV and onshore wind prices above), though a more realistic medium-cost scenario would reduce costs only to USD 120/MWh in 2035 and USD 70/MWh in 2050.[250] Meanwhile, the US Department of Energy also acknowledges that next-generation geothermal national average costs could reach USD 60-70/MWh by 2030 – driven by "reasonable advances expected in drilling, reservoir engineering, and resource exploration largely informed by the existing unconventional oil & gas industry."[251]

Although oil and gas companies have begun engaging with next-generation geothermal power, it is not yet enough. Insights from the 2024 New York Climate Week by Morgan Stanley concluded that "the sector has yet to see meaningful engagement from the energy majors, large scale infrastructure investors, project financiers and lenders, oil field services players or insurance companies" – the ecosystem that provides the capital and resources to traditional energy development.[252] Some energy players, like Devon Energy, have announced investments in next-generation technologies, but most, like ExxonMobil, are for now just watching the market.[253,254] More engagement is needed if the projected cost reductions in next-generation technologies are to be reached by 2050.

Next-generation geothermal market potential in the United States

Given the requirements outlined above for the development of next-generation geothermal power – cost reductions and oil and gas industry involvement – the United States can lead next-generation geothermal power development.

Next-generation (specifically EGS) geothermal research and development

[249] Reader's are referred to Employ America's and the Institute for Progress's four-part series *Hot Rocks: Commercializing Next-Generation Geothermal Energy* to learn more about the history of shale oil and gas development in the United States and similarities with the development of next-generation geothermal: https://ifp.org/hot-rocks-commercializing-next-generation-geothermal-energy/
[250] IEA, "The Future of Geothermal Energy."
[251] Blankenship et al., "Pathways to Commercial Liftoff: Next-Generation Geothermal Power."
[252] Adam Ross, "Financing the Geothermal Transition," Morgan Stanley Investment Management, November 13, 2024, https://www.morganstanley.com/im/en-us/capital-seeker/about-us/news-and-insights/articles/financing-the-geothermal-transition.html.
[253] Fervo Energy, "Fervo Energy Announces Investment From US Oil And Gas Leader Devon Energy - Fervo Energy," Fervo Energy, April 18, 2023, https://fervoenergy.com/fervo-energy-announces-investment-from-us-oil-and-gas-leader-devon-energy/.
[254] Ben Geman, "ExxonMobil's CEO on Geo-Power, Guyanese Oil," Axios, March 19, 2024, https://www.axios.com/2024/03/19/exxon-mobil-woods-geothermal.

in the United States has demonstrated successful cost reductions. The Department of Energy-sponsored Frontier Observatory for Research in Geothermal Energy (FORGE) in Utah has improved well drilling rates by 500% since 2017. Fervo Energy, building on FORGE's progress, nearly halved drilling costs from USD 9.5 million to 4.8 million per well drilled.[255]

Building on oil and gas industry skills has been a reason for this success: On Fervo's largest project to date, 400 MW Cape Station, over 90% of onsite labour-hours were by fossil fuel workers.[256] And further collaboration between the geothermal and fossil fuel industries is imminent. The Department of Energy has funded the GEODE Consortium, bringing together the two industries. If successful, by 2030, the consortium hopes to have contributed to the launch of multiple geothermal demonstration projects and have "positioned geothermal energy as a significant, reliable, and cost-competitive clean energy source for the future."[257]

Another reason why geothermal could play a significant role in the US in coming years is that, unlike solar and wind, it is a renewable energy source that is politically conceivable. In a list of energy sources in President Trump's recently announced National Energy Emergency, solar and wind energy were conspicuously absent; "geothermal heat" made the cut.[258] Geothermal systems do not require the same volume of critical minerals as solar PV and wind energy technologies, meaning there is less risk from exposure to those materials in the supply chain.[259] Developing the United States' geothermal resources thus fits into the narrative of US energy independence and national security. Finally, as outlined previously, one of geothermal power's needs (both conventional and next-generation) is improved permitting processes. Given the administration's focus on increasing US energy production, pushing for permitting reform is likely to be a priority in the coming months.[260] Congressional action, led by Republican-controlled houses in Congress, could also make progress in 2025.[261]

Ultimately, it is not yet clear exactly how much funding and support geothermal will receive under the current

[255] Blankenship et al., "Pathways to Commercial Liftoff: Next-Generation Geothermal Power."
[256] Fervo Energy, "Fervo Energy's Record-Breaking Production Results Showcase Rapid Scale Up Of Enhanced Geothermal - Fervo Energy," Fervo Energy, September 10, 2024, https://fervoenergy.com/fervo-energys-record-breaking-production-results-showcase-rapid-scale-up-of-enhanced-geothermal/.
[257] U.S. Department of Energy GEODE, "About | GEODE," GEODE, 2025, https://www.geode.energy/about.
[258] The White House, "Declaring a National Energy Emergency," The White House, January 20, 2025, https://www.whitehouse.gov/presidential-actions/2025/01/declaring-a-national-energy-emergency/.
[259] McLaughlin et al., "Next-Generation Geothermal."
[260] Reed Blakemore et al., "Seven Questions (and Expert Answers) about Trump's First Actions to Transform US Energy," Atlantic Council, January 22, 2025, https://www.atlanticcouncil.org/blogs/new-atlanticist/experts-react/seven-questions-and-expert-answers-about-trumps-first-actions-to-transform-us-energy/.
[261] Maya Weber, "Permitting Reform Left off US Funding Bill, Leaving Action for Republican-Controlled Congress," S&P Global Commodity Insights, December 17, 2024, https://www.spglobal.com/commodity-insights/en/news-research/latest-news/natural-gas/121724-permitting-reform-left-off-us-funding-bill-leaving-action-for-republican-controlled-congress.

administration. But given that geothermal energy can very well be part of President Trump's goals of energy independence, national security, and the production of energy from federal lands, it is likely that it will not be neglected.

Conclusion

Geothermal energy is a promising renewable energy source with significant potential to support the energy transition. While challenges such as resource risk and permitting remain, these obstacles can be mitigated through targeted policy actions. Next-generation geothermal technologies further address the limitations of conventional systems, unlocking greater geothermal potential worldwide. Although other renewable energy technologies are currently more cost-competitive, geothermal energy offers unique political feasibility, particularly among governments prioritizing energy security, such as in the United States.

Geothermal is an industry to watch, but it will take a village to reach the 800 GW market potential that the IEA projects by 2050. Keep an eye out for:

- **Drilling cost reductions and technology breakthroughs** by R&D programs, startups, and industry leaders
- **Policy reforms and initiatives** that de-risk geothermal resources and accelerate permitting
- **Demonstration of successful projects** by leading startups and new developers entering the market
- **Oil and gas sector involvement** to transfer knowledge and push for even greater cost reductions
- **Power purchase agreements** and offtake contracts that signal increasing market demand

Let's "drill, baby, drill" geothermal wells.

The Risk of Financing Conflict: Why the energy transition and peacebuilding efforts must align

Lindley Saffeir
Master in International Energy Transitions, Sciences Po

Lindley Saffeir is a master's student in International Energy Transitions at Sciences Po, Paris, and a Rotary Global Grant scholar. She holds an undergraduate degree in Environmental Studies and International Relations with a concentration in Peace and Conflict. Her bachelor's thesis on environmental peacebuilding has been published, and her research on U.S. and EU offshore wind collaboration was recognized with a finalist Fulbright grant. Lindley has held multiple research positions with international think tanks and NGOs, focusing on global climate and energy policy.

Introduction

The nexus of renewable energy financing and conflict presents a central and underexplored dilemma of the international energy transition. Research on the intersection of climate change and conflict has led to the development of the largely divergent fields of climate security and environmental peacebuilding. While these areas are relatively well-established and mainstreamed,[262] the literature exploring the relationship between the responses to climate change, particularly renewable energy investment, and conflict, remains in its early stages.[263] In a geopolitical landscape that is increasingly marked by conflict, understanding these interactions is central to a thoughtfully planned and just energy transition. This article begins by examining the historical relationship between conflict and traditional energy sources before exploring the intersection of conflict and energy transition financing, including the limited energy investments flowing to fragile and conflict-affected states (FCAS). In examining the interplay between these variables, it becomes clear that a risk of the energy transition is the potential escalation of conflict as a negative externality of renewable energy financing and development. This analysis emphasizes pathways to align renewable energy financing with conflict sensitivity and peacebuilding initiatives, specifically through implementing conflict-sensitive

[262] Florian Krampe et al., "Climate Change and Peacebuilding: Sub-Themes of an Emerging Research Agenda," International Affairs 100, no. 3 (May 2024), https://doi.org/10.1093/ia/iiae057.

[263] Andrew Gilmour, "Risks of Violent Conflict Will Rise as the Green Transition Picks up Speed," *Financial Times*, July 15, 2024.

financing mechanisms and by improving the integration of common goals between renewable energy development and peacebuilding fields. This article is grounded in the premise that renewable energy need not be regarded as a driver or amplifier of conflict but rather as a strategic resource capable of promoting peace.

Fossil Fuels and Conflict

Historically, fossil fuels have been the central connection between energy and conflict. Ownership, control, and transportation of oil and gas have fueled political unrest, territorial wars, and interventions by powerful states that are seeking to safeguard their supply chains.[264] The likelihood of conflict often depends on institutional strength and the presence of violence exacerbating factors which can include complex interactions between social, economic, political, cultural, or environmental variables. The term "conflict" is not inherently negative. Approached constructively, non-violent conflict is a necessary part of human relations and can serve as a catalyst to fuel peace and positive change. Conflict poorly managed, however, can become destructive and erode social relations, inhibit communication between actors, and further tensions to the point of violence.[265] Fragile regions, characterized by high-risk exposure and inadequate capacities to manage or mitigate risks are the most vulnerable, resulting in institutional breakdown, displacement, and other crises.[266] Factors within energy systems that

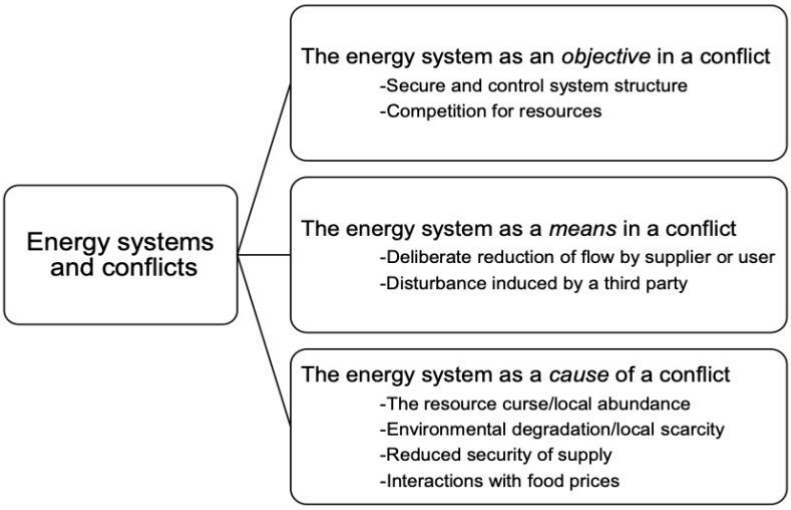


Figure 1: Typology of links between energy systems sourced (André Månsson, 2014)

[264] Jeff Colgan, "Fueling the Fire: Pathways from Oil to War," *International Security* 38, no. 2 (2013): 147–80, http://www.jstor.org/stable/24480933.
[265] Isobel Edwards, *The Role of Decentralized Renewable Energy in Peacebuilding* (Geneva: Quaker United Nations Office, 2018), https://unfccc.int/sites/default/files/resource/Inputs%20from%20Quaker%20United%20nations%20office_Role.pdf.
[266] Ibid.

heighten conflict risks include the geographic concentration of resources, the diversity of exporters in the global energy market, infrastructure susceptibility to attacks, and vulnerabilities of users to supply disruptions.[267] Research has commonly focused on individual drivers, whether they be geopolitical, environmental, or economic. It has also been common to focus on one specific resource in isolation, particularly oil.[268] Consensus does not exist on the definition of "energy conflict" nor on the nexus of traditional energy sources and conflict as a whole; however, scholars often classify energy's role in conflict as one of three types: objective, means, or cause. [269]

Månsson's typology (Fig. 1) offers organisational insight into the dynamics between traditional energy systems and conflict, although it is not fully comprehensive in all cases. When energy is the objective, actors seek security or legitimacy through control over energy resources or systems, such as when states violate sovereignty to secure access. When energy serves as the means, it becomes a tool to achieve non-energy objectives, as seen in cases where exporters limit supply to exert political pressure on importers. Finally, when energy is the cause of conflict, the destabilization of a region due to energy-related factors, such as disputes over resource distribution, triggers or intensifies violence.[270] While this typology can in large part be applied to renewables and their interactions with conflict, as the energy transition accelerates, these interactions will evolve in complexity. The increased penetration of renewable energy sources and the declining reliance on fossil fuels are changing conflict dynamics. Identifying these changes is a central effort in mitigating the risk of the energy transition financing conflict.

Financing the Energy Transition and Conflict

Building on the fossil fuels-conflict nexus, the intersection of energy transition financing and conflict is multidimensional. The presence of ongoing conflict in an area limits investments in renewable energy development, and the emergence of new conflicts disrupts existing initiatives and impedes future progress.[271] The development of renewable energy requires a relatively stable social environment. When conflict disrupts renewable energy financing, investors typically adjust their positions, triggering market reactions. Conflicts create uncertainty, raising the risk of energy projects and leading to shifts in financial commitments. The uncertainty that characterizes conflict also weakens economic development, destroys infrastructure, reduces human

[267] André Månsson, "Energy, Conflict and War: Towards a Conceptual Framework," *Energy Research & Social Science* 4 (2014): 106–16, https://doi.org/10.1016/j.erss.2014.10.004.
[268] Ibid.
[269] Ibid.
[270] Ibid.
[271] Qi-Cheng Yang et al., "The Shocks of Armed Conflicts to Renewable Energy Finance: Empirical Evidence from Cross-Country Data," *Energy Economics* 112 (2022): 106109, https://doi.org/10.1016/j.eneco.2022.106109.

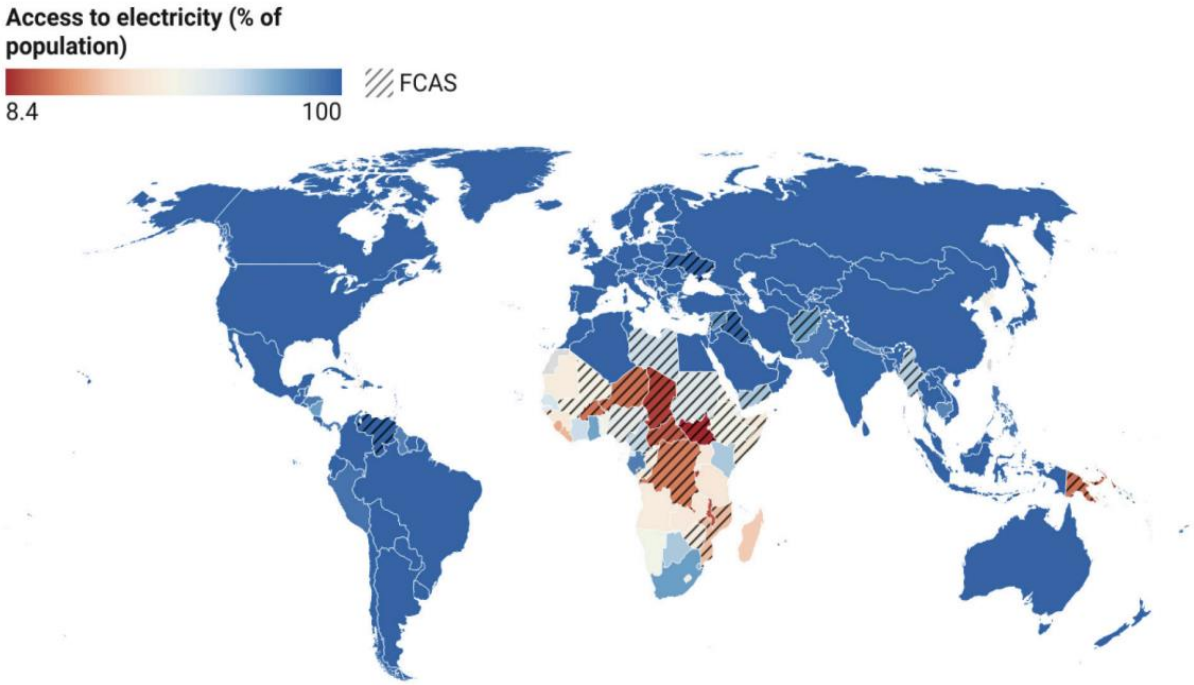


Figure 2: Energy access rates in fragile and conflict-affected states (Clingendael Institute, 2024)

resources, and distorts energy prices, ultimately influencing the possible uses of renewable energy.[272] The impact of conflicts on energy finance leads to varied outcomes across countries and regions, depending on the market's ability to absorb or mitigate these risks; however, conflict generally results in a decline in investments, particularly in areas where risk management mechanisms are weaker.[273] This is most acute for fragile and conflict-affected states.

As shown in Figure 2, energy access is particularly limited in fragile and conflict-affected states (FCAS), where many of the least electrified countries are also among the most impacted by conflict.[274] The amount of renewable energy investments in these states is substantially lower than necessary to ensure reliable electricity access for their populations. Clean energy financing prioritizes projects in stable countries that offer the highest economic returns and environmental benefits, while FCAS are often overlooked due to their lower levels of "financial readiness" and present greater operational challenges for investors.[275] Additionally, humanitarian assistance and state-building in FCAS are prioritized over renewable energy investment, despite evidence of the

[272] Ibid.
[273] Ibid.
[274] Hannah Lentschig et al., *Why Renewable Energy Matters in the Context of Peace and Stability*, Policy Brief (The Hague: Clingendael Institute, 2024).
[275] "Powering Peace," *Energy Peace Partners*, accessed December 28, 2024, https://www.energypeacepartners.com/powering-peace.

positive feedback loop between access to clean energy, state-building and peace.[276]. The interaction between investments and conflict is a two-way process. On one side, conflict often disrupts energy financing and investment flows, as illustrated in FCAS. On the other, renewable energy projects and their financing can fuel conflict.

Oil Rents, Sovereign Wealth Funds, and the Geopolitics of Energy Conflict

The shift away from fossil fuels and increased investment in renewable energy risks catalysing new and existing conflicts. Parallel to lines of global inequality, the conflicts surrounding the energy transition in Western Europe or North America are minor compared to the challenges faced by countries most affected by climate change and conflict, particularly those with high fossil fuel revenues.[277] This is especially true for nations including Iraq, Libya, and Nigeria which are classified as both FCASs and petrostates, and where fossil fuels account for over 89% of exports, dominating their economies.[278] Declining demand for their primary exports increases risks of revenue shortfalls and economic instability, which may break social contracts, trigger resistance or violence, and in some cases, increase recruitment into extremist groups. Particularly in petrostates, oil rents and sovereign wealth funds (SWFs) can finance conflict by enabling rent-seeking behaviour and corruption.[279] While SWFs can have stabilizing effects on fragile economies by promoting long-term investment strategies, they also risk financing conflict. Particularly in times of low oil prices, mismanagement of SWFs risks increased economic disparities and fiscal stress that creates conflict-prone environments.[280] As the international energy transition accelerates and reliance on oil diminishes, these risks are likely to intensify.[281]

Foreign Direct Investment and Large-Scale Infrastructure Risks

The energy transition poses risks of catalysing land-use disputes, particularly in areas where large-scale renewable energy projects require extensive land use. Conflict with local communities and Indigenous people over land rights and resource allocation is not uncommon, as seen in the development of large-scale wind energy projects in Oaxaca, Mexico, which have elicited conflict with indigenous communities over land dispossession and environmental

[276] Camilla Sacchetto, Nicholas Stern, and Charlotte Taylor, "The Case for Scaling Renewable Energy Investments in Fragile and Conflict-Affected Situations," *International Growth Centre*, November 4, 2020.
[277] Vane Aminga, "Renewable Energy as an Opportunity for Peace?" *Stockholm International Peace Research Institute*, April 2, 2020, https://www.sipri.org/commentary/blog/2020/renewable-energy-opportunity-peace.
[278] Andrew Gilmour. "Risks of Violent Conflict Will Rise as the Green Transition Picks up Speed." *Financial Times*, July 15, 2024.
[279] Robert Lamb, Kathryn Mixon, and Sadika Hameed, *Sovereign Wealth Funds in Commodity-Rich Fragile States* (Washington, DC: Center for Strategic and International Studies, May 13, 2013), https://www.csis.org/analysis/sovereign-wealth-funds-commodity-rich-fragile-states
[280] Ibid.
[281] Rabah Arezki, Adnan Mazarei, and Prasad Ananthakrishnan, "Sovereign Wealth Funds in the New Era of Oil," IMF Blog, October 26, 2015, https://www.imf.org/en/Blogs/Articles/2015/10/26/sovereign-wealth-funds-in-the-new-era-of-oil

impact.[282] The transition also risks fuelling poor interstate cooperation that can turn to violence. The lack of interstate cooperation regarding projects such as hydropower dams that span borders can catalyse tensions that are especially acute surrounding shared water resources. Literature often focuses on the Grand Ethiopian Renaissance Dam that has created significant tension between Ethiopia, Sudan, and Egypt to highlight this form of conflict.[283] In emerging markets especially, foreign direct investment (FDI) provides critical and substantial capital for renewable energy development, which ought not be understated; however, and as is the case with most financing mechanisms to varying degrees, FDI risks exacerbating conflict, particularly via land disputes.[284] In cases in Southern Sudan and Myanmar, FDI in energy projects has led to violent land grabs, Indigenous population displacement and an intensification of ethnic and political conflict.[285] Additionally, risks extend to financiers themselves, as they can face reputational and financial risks if investments become controversial or fuel conflict. Financiers of projects like the Narmada dams in India, the Ilisu dam in Turkey, and the Three Gorges dam in China have been targeted by activists and NGOs, who urge withdrawal due to social and environmental harm.[286] Across these cases, regions with existing social or economic tensions are particularly vulnerable to renewable energy projects leading to conflict.

Critical Minerals and Conflict Financing

While the scope of this paper cannot comprehensively address the intersection of critical minerals and renewable energy financing, it would be remiss not to acknowledge the potential for the critical mineral supply chain to generate conflict. Access to critical minerals is central to the energy transition, and substantial reserves of critical minerals are geographically consolidated in countries already affected by conflict. In FCAS', where mining sector governance is weak or easily exploited, mineral extraction is linked to violence, conflict, and human rights abuses.[287] When robust governance and economic frameworks

[282]Carlos Tornel, Mariana Gutiérrez, and Jorge Villarreal, *Energy Transition in Mexico: The Social Dimension of Energy and the Politics of Climate Change*, Climate Transparency/Iniciativa Climática de México Policy Paper (Berlin: 2019), https://www.climate-transparency.org/wp-content/uploads/2019/06/Energy-Transition-in-Mexico-%E2%80%93-Social-dimension-of-energy-and-the-politics-of-climate-change.pdf.

[283] John Mbaku, "The Controversy over the Grand Ethiopian Renaissance Dam," *Brookings Institution*, 2020, https://www.brookings.edu/articles/the-controversy-over-the-grand-ethiopian-renaissance-dam/.

[284] Florence Jaumotte et al., *Policies to Foster Green FDI: Best Practices for Emerging Market and Developing Economies*, IMF Staff Climate Note 2024/004 (Washington, DC: International Monetary Fund, 2024), https://www.imf.org/en/Publications/staff-climate-notes/Issues/2024/10/08/Policies-to-Foster-Green-FDI-Best-Practices-for-Emerging-Market-and-Developing-Economies-555062.

[285] Jérémie Gilbert, *Land Grabbing, Investments & Indigenous Peoples' Rights* (International Work Group for Indigenous Affairs, 2017), https://iwgia.org/images/publications/new-publications/land-grabbing-indigenous-peoples-rights.compressed.pdf.

[286] Jessie Banfield and Salil Tripathi, *Conflict-sensitive Project Finance: Better Lending Practice in Conflict-Prone States* (International Alert, September 2006), https://www.international-alert.org/publications/conflict-sensitive-project-finance-better-lending-practice-conflict-prone-states.

[287] Clare Church and Alec Crawford, *Green Conflict Minerals: The Fuels of Conflict in the Transition to a Low-Carbon Economy* (August 2018) https://www.iisd.org/publications/green-conflict-minerals.

are lacking, regions involved in mining and exporting the minerals that are critical to renewable technologies are likely to encounter a similar resource curse or "paradox of plenty" known to many oil-rich states, where reliance on natural resource extraction and subsequent economic mismanagement leads to higher levels of corruption, income inequality, and violent conflict. The Democratic Republic of Congo, for instance, accounts for more than 60% of the world's cobalt production, which is critical to lithium-ion batteries for storage and electric vehicles.[288] In the DRC, mining wealth has perpetuated widespread violent conflict, mass displacement and human rights violations, and has fuelled the creation of at least seventy armed groups.[289] As demand grows, conflict is likely to increase. In addition, concentrated supply chains intensify geopolitical tensions as well as resource nationalism. Global competition between larger powers has led to trade restrictions, export bans, and heightened strategic rivalries, deepening the conflict-renewables nexus.[290] The following section will focus on overarching measures to bridge energy transition financing and conflict; however, specifically concerning critical minerals, paths forward that promote transparent and sustainable mining practices, along with increased investment in secondary markets such as recycled critical materials are likely to ease demand pressures on high-conflict regions, stabilize prices, and diversify supply chains.[291]

Paths Forward

Financing the energy transition must not inadvertently heighten the risk of violent conflict, yet this remains a likely trajectory without the integration of conflict-sensitive approaches. This article explores two approaches to avoid these effects: 1) implementing conflict-sensitive financing and 2) improving the alignment of shared objectives between renewable energy development and peacebuilding efforts. The following recommendations draw on the collaborative work between Ecorys, the PeaceNexus Foundation, and the International Growth Centre.[292]

Conflict-Sensitive Financing

Investors must understand their two-way relationship with conflict. While significant priority is generally given to minimizing the impact of conflict on a renewable project's operations, comparatively little attention is placed on minimizing the ways projects can be the catalyst of such conflict. Integrating conflict sensitivity throughout renewable energy project lifecycles is essential to

[288] Ibid.
[289] Madison Freeman and Morgan Bazilian, "How Renewable Energy Could Fuel Future Conflicts," *Georgetown Journal of International Affairs*, October 8, 2018
[290] Ibid.
[291] International Renewable Energy Agency, *Geopolitics of the Energy Transition: Critical Materials*, accessed January 1, 2025, https://www.irena.org/Digital-Report/Geopolitics-of-the-Energy-Transition-Critical-Materials.

[292] Sharon Beijer et al., Towards a Peaceful Energy Transition (Ecorys, PeaceNexus Foundation, and International Growth Centre, 2023) https://www.theigc.org/sites/default/files/2023-09/Towards%20a%20peaceful%20energy%20transition%20July%202023.pdf.

avoid this result. Comprehensive conflict assessments help identify risks including displacement, inequality, or community resistance, by analysing local socio-political and economic dynamics. These assessments serve as the framework for risk mitigation strategies that enable adaptive implementation, while ongoing engagement with affected communities builds trust, fosters public acceptance, and ensures equitable benefit distribution throughout.[293] Other important strategies include flexible financing mechanisms, such as blended finance and local currency financing. Blended finance combines concessional and private funds to mitigate risk and attract broader investment.[294] Local currency financing shields projects from exchange rate volatility thereby ensuring more stable revenue streams. For example, public entities can provide local currency loans or guarantees to reduce investor risk and debt burdens in fragile states. Additionally, local intermediaries, such as banks or investment funds who are familiar with regional dynamics can be important for financing smaller renewable projects in conflict-prone areas to better align investments with local needs. Investors can support these efforts by channelling funds through such intermediaries. Finally, and importantly, documenting and sharing lessons from conflict-sensitive renewable projects can strengthen best practices, improve risk assessments, and demonstrate the long-term benefits of peace-oriented approaches in the energy transition.

Given the nascency of the field, successful examples of deliberate conflict-sensitive renewable energy financing are rare, but many examples exist of projects that have fallen short. Across Ethiopia, Kenya and Morocco, for example, the mismanagement of large-scale wind and solar projects highlights conflict risks. In Kenya, a lack of community involvement in decision-making regarding land acquisition and disputes over the distribution of project benefits increased conflict. The Lake Turkana Wind Power Project, the largest wind power plant in sub-Saharan Africa and Kenya's biggest public-private investment, demonstrates how lacking conflict-sensitive mechanisms allowed energy companies and international financial institutions to sidestep frameworks that safeguard Indigenous rights.[295] Land ownership was revoked without appropriate consultation, and relocation payments were scarce, eliciting conflict. In Morocco, RES projects have intensified existing conflicts in Western Sahara, as the export of energy from this region to Europe exacerbates long-standing tensions and triggered armed conflict in the winter of 2020, breaking a 1991 UN-brokered ceasefire that had promised a referendum on independence for local Saharawi people.[296] Ethiopia's wind farm

[293] Ibid.
[294] Luis Alvarado, "How Blended Finance Initiatives Can Align Capital Behind Climate Action," *World Economic Forum*, July 3, 2024, https://www.weforum.org/stories/2024/07/blended-finance-initiatives-can-align-capital-behind-climate-action/.
[295] Priscilla Ateyo, *Fuelling Conflict? The Impact of the Green Energy Transition on Peace and Security* (London: International Alert, September 2022), https://www.international-alert.org/app/uploads/2022/09/Green-Energy-Transition-Peace-Security-Impact-EN-2022.pdf.
[296] Ibid.

projects, including the French-financed Ashegoda Wind Farm and the Chinese-financed Adama Wind Farms, highlight the importance of effective financing, government experience, and community engagement, as tensions over land requisition and inadequate compensation caused significant delays and displacement of over 1,000 farmers.[297] These examples illustrate the need for conflict-sensitive financing that accounts for the complexity of conflict context. Drawing on conflict-sensitive frameworks, these broad examples highlight the need for 1) inclusive stakeholder consultation, where engaging with local communities early and consistently can avoid conflicts like land disputes; 2) flexible financing models designed to support adaptable loans and grants tailored to local needs and contexts, and 3) long-term local capacity development that prioritizes local skills and employment opportunities to foster long-term benefits and mitigate conflicts.[298]

Aligning Peacebuilding Goals with Renewable Energy Financing

Aligning renewable energy development and peacebuilding is a burgeoning opportunity to reduce the risks of the energy transition financing conflict. Much of the research within this effort focuses on local and small-scale decentralized renewable energy (DRE) sources as a peacebuilding tool in specific contexts. As not all renewables have the same characteristics, investing in certain sources is more appropriate as part of peacebuilding strategies than others. DRE systems can boost local agency, reassert democratic control, and reduce corruption risks that are often associated with larger infrastructure projects in FCAS.[299] On a larger scale, aligning the energy transition and peacebuilding to avoid financing conflict will require greater conflict sensitivity, including an actor's 1) awareness of the context where a project is or will be implemented; 2) understanding of interactions between the local environment and the project, and 3) leveraging of this information to guide the design, implementation, monitoring, and adaptation of the project. This approach will minimize harm while maximizing conflict prevention and resilience.[300] While the unintended adverse effects of interventions have long been recognized in peacebuilding fields, awareness of the negative impacts of renewable development in the private sector is relatively low.[301] This may partly be due to the limited documentation of the negative impacts renewable energy projects can have in both stable regions and conflict-affected areas. Demand for this sensitivity is growing and can be aided by peacebuilding principles. As the private sector increasingly acknowledges the conflict-sensitive approaches needed to invest in fragile and conflict-affected

[297] Sharon Beijer et al., Towards a Peaceful Energy Transition (Ecorys, PeaceNexus Foundation, and International Growth Centre, 2023).
[298] Ibid.
[299] Isobel Edwards, *The Role of Decentralized Renewable Energy in Peacebuilding* (Quaker United Nations Office, 2022), https://unfccc.int/sites/default/files/resource/Inputs%20from%20Quaker%20United%20nations%20office_Role.pdf.
[300] Sharon Beijer et al., Towards a Peaceful Energy Transition (Ecorys, PeaceNexus Foundation, and International Growth Centre, 2023).
[301] Ibid.

settings, these approaches can apply to the energy transition as a whole, in order to minimize unintended negative impacts of conflict and maximize financial and social returns. In conjunction with implementing conflict-sensitive financing mechanisms, aligning RE development and peacebuilding efforts is a continuous opportunity across all stages of financing, decision-making and project implementation.[302]

Conclusion

Global conflict has reached an all-time high, with the past three years marking the most violent in the last three decades.[303] In an increasingly complex conflict landscape, the urgency of the climate crisis needs to be met with a carefully funded and timely energy transition that is rooted in the principles of human rights, justice, international solidarity, public participation, and conflict sensitivity.[304] Given the geopolitical and conflict risks associated with the energy transition, governments and financiers have a responsibility to ensure that sustainability applies not only to the generation, distribution, storage, and consumption of energy but also to the conflict implications of their activities. Further research and mainstreaming conflict-sensitive frameworks and peacebuilding objectives can help prevent conflict escalation and support a just, peaceful energy transition.

[302] Ibid.
[303] "New Data Shows Record Number of Armed Conflicts," *Peace Research Institute Oslo (PRIO)*, accessed January 2, 2025, https://www.prio.org/news/3532.
[304] Cara Priestly, *The Peacebuilding Implications of Energy Transitions to a Carbon-Neutral Future* (Geneva: Quaker United Nations Office, 2020), https://unfccc.int/sites/default/files/resource/Inputs%20from%20Quaker%20UN%20Office%2C-%20The%20Peacebuilding.pdf .

From Pledges to Practice: Using AI-Driven Real-Time Risk Analytics to Improve Investor Confidence in EMDEs

Wenxi Jiang
Master in International Energy Transitions, Sciences Po

Wenxi Jiang (Fumiki Kyo) is a first-year student in Master in I*nternational Energy Transitions at Sciences Po Paris. He completed his undergraduate studies in three European capitals and obtained a BSc in Management at ESCP Business School. With a passion for energy issues and finance to shape a more sustainable future, he has several internship experiences in renewables, hydrogen, and banking. He served as a Japanese delegate to the G7 Youth (Y7) Summit in 2023.*

Romain Cabanes
Master in International Energy Transitions, Sciences Po

A graduate of Sciences Po Paris and Columbia University, Romain returned to Sciences Po to pursue a master's degree in International Energy Transitions. Interested in the energy transition from his early undergraduate years, he gradually turned his attention to the issue of financing in emerging countries. Today, he aspires to a career in international renewable energy project financing.

Introduction

Discussions at COP29 in Baku were focused on the amount of climate financing that developed countries should direct to developing countries. This aid is based on the principle of "common but differentiated responsibilities and respective capabilities" in the face of climate change.[305] The resulting amount agreed is $300 billion a year by 2035.[306] While some consider this agreement disappointing, given the initial request

[305] German Council on Foreign Relations (DGAP), "Common but Differentiated Responsibilities (CBDR)," German Council on Foreign Relations (DGAP), accessed January 3, 2025, https://dgap.org/en/research/glossary/climate-foreign-policy/common-differentiated-responsibilities-cbdr.

[306] UNFCCC, "COP29 UN Climate Conference Agrees to Triple Finance to Developing Countries, Protecting Lives and Livelihoods," United Nations Climate Change, November 24, 2024, https://unfccc.int/news/cop29-un-climate-conference-agrees-to-triple-finance-to-developing-countries-protecting-lives-and.

of $1,000 billion per year,[307] others point to the tripling of the initial amount pledged in 2009, which is only a doubling of the initial amount when adjusted for inflation over the period.[308]

Investing in the decarbonisation of emerging and developing economies (EMDEs) is more efficient than in advanced economies from a climate perspective. According to the International Energy Agency (IEA), emission reductions in EMDEs are on average half as costly as in advanced countries due to the opportunity offered by the need for new infrastructure and the absence of retrofitting.[309]

The aid from developed countries agreed at the COP is intended to supplement and attract private capital that does not naturally flow into EMDEs. Private capital investments into EMDEs excluding China, which represent two thirds of the world population, were only 15% of world clean energy investment.[310] Yet, to keep pace with the Paris Agreement, these countries need to increase their annual investment in clean energy sevenfold between 2022 and 2030, reaching $2,000 billion.[311]

While public funding from advanced countries is essential for justice and solidarity among countries, it should not be forgotten that under the IEA's climate driven scenarios, "over 70% of clean energy investments are privately financed."[312] Consequently, reducing the perceived risks of investing in EMDEs, particularly in the energy sector, and increasing the number of bankable projects are essential to attract the capital needed for their energy transition.

This paper examines how AI could play a key role in providing a better risk analysis of projects in EMDEs and thus reduce investor bias and uncertainty. First, it looks at the main challenges faced by EMDEs power projects in attracting private capital and then examines some ways to mitigate them. Finally, it looks at how AI could play a role in assessing the remaining risks in EMDEs and ensuring that these risks are correctly estimated.

The Challenge of Bankability in EMDE Projects

Due to higher perceived risks in EMDEs, securing affordable financing

[307] LSE, "New Report Recommends COP29 Negotiations on Climate Finance Should Focus on Mobilising $1 Trillion per Year for Developing Countries by 2030," Grantham Research Institute on Climate Change and the Environment, November 14, 2024, https://www.lse.ac.uk/granthaminstitute/news/new-report-recommends-cop29-negotiations-on-climate-finance-should-focus-on-mobilising-1-trillion-per-year-for-developing-countries-by-2030/.
[308] Federal Reserve Bank of Minneapolis, "Inflation Calculator," Federal Reserve Bank of Minneapolis, accessed January 25, 2025, https://www.minneapolisfed.org/about-us/monetary-policy/inflation-calculator.
[309] IEA, "Financing Clean Energy Transitions in Emerging and Developing Economies," IEA, June 2021, https://www.iea.org/reports/financing-clean-energy-transitions-in-emerging-and-developing-economies.
[310] IEA, "World Energy Outlook 2024," IEA, October 2024, https://www.iea.org/reports/world-energy-outlook-2024, 21.
[311] IEA, "Scaling Up Private Finance for Clean Energy in Emerging and Developing Economies," IEA, June 2023, https://www.iea.org/reports/scaling-up-private-finance-for-clean-energy-in-emerging-and-developing-economies.
[312] IEA, "Financing Clean Energy Transitions in EDMEs," 15.

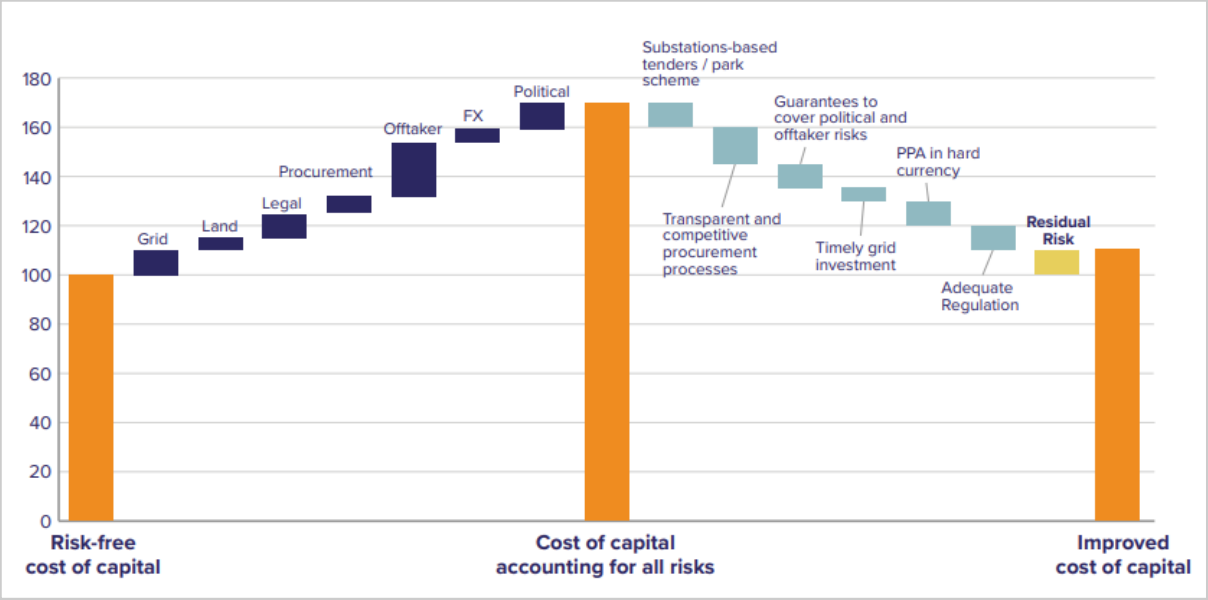


Figure. 1. Impact of Operational and Development Risks on the Cost of Capital and their Associated Mitigants.

for clean energy projects remains an acute challenge. The high cost of capital associated with the perception of high risks has an impact on the level of returns required to complete a project, which limits the number of projects that can be financed in EMDEs. Investors judge the value of projects and its risks by assessing total costs, project timelines, stakeholders, return on investment and other factors.[313] A project is therefore 'bankable' when it is considered sufficiently low-risk and generates predictable revenues and returns with reliable counterparties. However, in EMDEs, investors still receive higher uncertainty due to several factors as shown in Fig. 1.[314,315]

One of the main obstacles to investment is regulatory unpredictability, as many EMDEs do not have stable medium- to long-term energy transition plans that can withstand changes in government administration. This inconsistency in policy, as manifested in unpredictable subsidy structures or frequently renegotiated Power Purchase Agreements (PPAs), often results in lower investor confidence. Hence, long-term strategies and predictable frameworks to allow for transparent and competitive tender processes are

[313] Felix I. Lessambo, "Bankability," *International Project Finance*, 2022, 33–41, https://doi.org/10.1007/978-3-030-96390-3_4.
[314] IEA, "Financing Clean Energy Transitions in EMDEs," 17.
[315] Sabine Mathilde Isabelle Cornieti and Claire Marion Nicolas, "How to Unlock Pipelines of Bankable Renewable Energy Projects in Emerging Markets and Developing Countries? - Position Paper (English)," World Bank Group, December 2023, http://documents.worldbank.org/curated/en/099120623171525006/P1742021cf52b60e6196b81854984124388, 12, fig. 1.

essential in attracting private capital while keeping down perceived risks and the cost of capital.[316]

Moreover, underdeveloped grid infrastructure is another barrier that lowers the bankability of power projects in EMDEs. In many emerging economies, power grids lack the capacity and flexibility to accommodate variability and intermittency of renewable energy due to limited grid connections and outdated grid management practices, leading to higher curtailment risks. For example, nearly 30% of Variable Renewable Energy (VRE) was curtailed in Vietnam by 2021 due to unclear guidance on grid connection in policy.[317] As these risks erode the certainty of project returns, there are higher perceived risks for investors, which necessitates grid reinforcement and clear curtailment provisions in PPAs, such as "take-or-pay" clauses.[318]

Currency risks stand as another important obstacle for investors. In many EMDEs, local currency markets are not fully developed and PPAs are therefore signed in international currencies. Consequently, exchange rate fluctuations can significantly impact electricity costs for end-users. For instance, if the local currency devalues, end-users will need more local currency to pay for electricity denominated in foreign currencies, which can significantly undermine their ability to meet payment obligations. Another related situation arises when capital costs (e.g. solar panels) or debt are priced in international currencies while PPAs are signed in local currencies.[319] In such cases, a devaluation of the local currency will lead again to a higher amount of local currency required to reimburse the debt in foreign currency. These country-level factors can lead to higher perceived bankability risks and thus contribute to elevated project costs.[320]

Last but not least, in many EMDEs existing interests in fossil fuels can reinforce a system which disadvantages the development of renewables. For example, fossil fuel subsidies and legacy contracts for coal or gas can lock in grid capacity or crowd out financing, which prevent clean energy from further expanding.[321]

Overall, these hurdles showcase why renewable projects struggle to raise funding in EMDEs. To address the bankability gap, consistent regulatory frameworks and grid investments are essential to reduce perceived risks and attract capital to accelerate energy transitions.

[316] Cornieti and Nicolas, "How to Unlock Pipelines of Bankable Renewable Energy Projects in EDMEs," 13.
[317] Ibid., 14.
[318] Ibid., 6.
[319] Ibid., 16.
[320] IEA, "ASEAN Renewables Investment: Opportunities and Challenges," IEA, March 2023, https://www.iea.org/reports/asean-renewables-investment-opportunities-and-challenges.
[321] Sikandar Abdul Qadir et al., "Incentives and Strategies for Financing the Renewable Energy Transition: A Review," *Energy Reports* 7 (November 2021): 3590–3606, https://doi.org/10.1016/j.egyr.2021.06.041.

Existing Solutions and Limitations

A variety of policy and financial measures have been introduced to enhance the bankability of clean energy projects in EMDEs. Multilateral Development Banks (MDBs) and other development institutions offer a combination of technical support, concessional financing, and risk mitigation tools, such as guarantees or political risk insurance. By easing early-stage financial constraints, these measures help attract private funding at reduced interest rates.[322] In some cases, blended finance, where subsidized capital from MDBs or other public institutions is combined with private investments, has effectively addressed specific risks in pioneering projects, which has instilled market confidence in countries with limited track records, such as Kenya which has received the highest amount of blended financing.[323]

A growing strategy for advancing utility-scale renewables involves competitive auctions linked to long-term PPAs, where companies submit bids to build and operate power plants. These auctions promote cost transparency, open competition, and provide developers with reliable revenue streams through financially stable and creditworthy offtakers.[324] To further cultivate investor confidence, public authorities can allow public funds to access transmission infrastructure or include "take-or-pay" provisions in the contracts to mitigate curtailment risks.[325] In other words, these provisions ensure that the energy producer receives payment even if the grid cannot use all the electricity generated. At the same time, green bonds and other sustainability-linked instruments have gained more attention, which appeal to institutional investors who might otherwise avoid individual projects in EMDEs. In addition, carbon markets, whether operating on a voluntary basis or formally recognized under Article 6 of the Paris Agreement, serve as a complementary revenue stream by allowing project developers to derive income from emission reductions.[326]

Although various initiatives have been introduced, major constraints still hinder their effectiveness. First, many EMDEs still lack robust and diversified capital markets to maximize the potential of these instruments. While green bonds and carbon credits can indeed serve as drivers for change, their effectiveness rests on regulatory frameworks and credit enhancements, which are not yet fully established in a number of markets.[327] Furthermore, public guarantees and concessional

[322] Ibid.
[323] Samantha Attridge and Lars Engen, "Blended Finance in the Poorest Countries: The Need for a Better Approach," EconStor, 2019, https://hdl.handle.net/10419/206745.
[324] IEA, "Scaling Up Private Finance for Clean Energy in EDMEs," 16.
[325] Cornieti and Nicolas, "How to Unlock Pipelines of Bankable Renewable Energy Projects," 6.
[326] World Bank, "Scaling Up to Phase Down: Financing Energy Transitions in the Power Sector," World Bank, April 20, 2023, http://hdl.handle.net/10986/39689, 36.
[327] IEA, "Financing Clean Energy Transitions in EDMEs," 47.

financing are still limited in scale, which makes the so-called "billions to trillions"[328] optimism more questionable. Essentially, every dollar invested by MDBs mobilizes, on average, less than a dollar of private capital in developing economies, which suggests that these mechanisms alone will not suffice to bridge the investment gap in energy transitions.[329]

Additionally, structural and governance challenges reduce the effectiveness of existing solutions. Many state-owned utilities operate under precarious financial conditions, which have been exacerbated by external shocks such as pandemics and fluctuating fossil fuel prices. Large debt burdens reduce their capacity to serve as reliable *offtakers*, which weakens PPAs and increases risk premiums.[330] At the same time, bureaucratic procedures, corruption risks, and weak contract enforcement extend project timelines. These broad governance challenges cannot be fully resolved by financial instruments.[331] Therefore, a more holistic shift of the institutional, policy and regulatory environment is needed to attract large-scale private investment in clean energy projects in EMDEs.

Potential of AI-Driven Real-Time Risk Analytics

Given the myriad risks and uncertainty that persist in EMDE energy transition projects, AI could be a powerful tool to enable investors to assess them and ensure that they are estimated precisely. Although it is not yet entirely clear to what extent AI will change our lives, it is possible to see how risk analysis could benefit from it.

AI has already transformed individual credit scoring by using non-traditional data sources. Credit assessment is traditionally based on historical data, such as loan repayment history, as well as on fixed data such as income level and current debt level. This analysis is, however, rather limited due to its non-dynamic nature, favouring individuals having already borrowed in the past. AI makes it possible to analyse much more data to assess individuals' ability to repay, such as activity on social networks, banking transactions and bill payments.[332] Several firms emerged in that sector and are thus helping individuals with no borrowing history to borrow for the first time.

In the same vein, by collecting and analysing a large amount of data, AI could help investors assess the risks of

[328] Development Committee, "From Billions to Trillions: Transforming Development Finance Post-2015 Financing for Development: Multilateral Development Finance," World Bank Group, April 2, 2015, https://pubdocs.worldbank.org/en/622841485963735448/DC2015-0002-E-FinancingforDevelopment.pdf.
[329] Attridge and Engen, "Blended Finance in the Poorest Countries," 12.
[330] World Bank, "Scaling Up to Phase Down: Financing Energy Transitions in the Power Sector," 7.
[331] IEA, "Africa Energy Outlook 2022," IEA, June 2022, https://www.iea.org/reports/africa-energy-outlook-2022.
[332] Muhammad Ashraf Faheem, "AI-Driven Risk Assessment Models: Revolutionizing Credit Scoring and Default Prediction," IRE Journals | 5, no. 3 (2021), https://www.irejournals.com/formatedpaper/1702907.pdf.

investing in a country, a specific economic sector or projects.

Based on information such as a country's macro-fundamentals, national regulations, jurisprudence, political stability, cost of capital and projects under development, an AI model can serve as the basis for analysing a country's investment environment. AI can also be useful when foreign players have no track record in a country's specific economic sector. By analysing comparable countries with such a track record, AI can provide investors with rudimentary forecasts and information.

In addition to a country's macroeconomic data, AI can also use information on previous investments in a country, or on the results of comparable investments in similar countries, to create multiple predictive scenarios for specific projects. These scenarios, based on the identification of patterns, enable investors to anticipate key financial metrics such as future cash flows and future loan repayment capacity. In addition, it can anticipate hazards such as extreme weather events and run simulations on the various ways of mitigating them.[333]

A valuable feature that AI brings to project risk assessment is its ability to automatically collect data from different databases. This function keeps the AI tool up to date and provides continuous real time analysis.[334] This is a significant feature for investors, given the number of variables to be taken into account when making an investment, as well as the speed at which they evolve.

Ultimately, the goal would be for investors, with access to greater data analysis power, to be able to accurately identify the risks and reduce uncertainty associated with their investment. This better analysis could potentially lower the level of financial returns they demand in exchange for their investment, which could increase the number of projects likely to be financed and thus help attract more private capital.

Considerations and Potential Criticisms

The main problem that investors may encounter in using AI in their risk assessment is access to data. Information related to specific projects, for example, is often subject to confidentiality clauses. Consequently, AI-based risk analysis can only benefit from calls for the disclosure of information relating to private investment in emerging countries, such as the "*Publish What You Fund*" or the

[333] Bilal Ahmad Pandow, Khurshid Ali Ganai, and Gousiya Hussain, "A Review on AI-Powered Advancements in Climate Finance and Its Impact," 2024 11th International Conference on Computing for Sustainable Global Development (INDIACom), February 28, 2024, 1409–13, https://doi.org/10.23919/indiacom61295.2024.10498959.

[334] Ibid.

"*Cost of Capital Observatory*."[335,336] Further calls for anonymous disclosure of private information should be launched to provide better information to investors and thus reduce the risks of investing in emerging countries.

Finally, the use of AI does not foster transparency. AI is still very opaque, and it is not always clear how it reaches a conclusion. AI developers should communicate how the AI model makes its decisions, and publicise the criteria used and their respective importance in decision-making.

Conclusion

In short, bridging the investment gap for the energy transition in EMDEs extends beyond merely gathering financial resources, much less unlikely to simply be filled by public funds from advanced economies. Despite the steps taken by EMDEs to increase the number of bankable projects, much remains to be done to instil confidence in the profitability of clean energy companies, mitigate risks, and attract private capital.

The perception of these risks in EMDEs is an important factor limiting investments. Although concessional loans, blended finance, and other financing instruments have enabled some projects to secure funding and reach final investment decisions, significant hurdles remain. AI, by being able to collect and analyse data from a variety of sources in real time, can be a useful tool for investors. By finding patterns, AI can ensure that perceived risks are neither overestimated or underestimated, and that risk perception and reality match as closely as possible and with as little delay as possible. This could potentially further attract private capital when paired with consistent and predictable regulatory measures, such as reliable PPAs.

Ultimately, adopting and scaling clean energy depends largely on a balanced combination of technical expertise, financial innovation, and effective policy frameworks. EMDEs striving to mitigate investment risks could benefit from AI, as investors would have better access to information due to greater data analysis capability.

Other areas of research could be explored on AI and EMDEs as many challenges are yet to be solved. How can EMDEs exploit the efficiency gains from using AI in bureaucracy, and thus significantly shorten the timeline for investment projects? How can countries work together to create favourable regulatory environments for AI integration so that AI-related gains can be benefited for all around the globe? Addressing these questions would further facilitate project viability and pave the way toward a more sustainable and inclusive energy landscape.

[335] Paul James, "What Works: How to Measure and Disclose Private Capital Mobilisation to Increase Private Investment and Close the SDG Financing Gap," October 2024, https://www.publishwhatyoufund.org/app/uploads/dlm_uploads/2024/10/What-Works.pdf.

[336] IEA, "ASEAN Renewables Investment: Opportunities and Challenges," 22.

Show me the money (and outcomes): the promise and progress of Indonesia's JETP experience

Leo Gordon
Master in Public Affairs, Columbia University

Leo Gordon is a Dual Degree Masters of Public Policy/Masters of Public Administration candidate at the Hertie School/Columbia University School of International and Public Affairs. He is majoring in Climate Change, Energy, and Environment. He has previously worked in Energy and Climate policy at the Australian Department of Prime Minister and Cabinet and the Federal Treasury.

Executive Summary

This article analyses the effectiveness the Just Energy Transition Partnership (JETP) in stimulating Indonesia's nascent energy transition. The article considers the scale of Indonesia's net-zero journey and assesses why the JETP has not delivered the promised financing. The article concludes that the JETP is insufficient to affect the scale of challenges facing emerging market power systems like Indonesia's. Recommendations to improve Indonesia's JETP are provided, while also contributing lessons for other JETPs.

What is a JETP? Green Financing… and Geopolitics

JETPs are international agreements aiming to mobilise finance to help Global South countries transition from coal and accelerate socially just renewable energy deployment.[337] The financial instruments include concessional and commercial loans and grants; concessional loans are the preferred instrument on aggregate. The first JETPs were rapidly developed and announced at COP26 in 2021 and the following G20 in 2022, surprising many observers. The driver of the financial mobilization underpinning the first JETP, with South Africa and announced at COP26, was the Glasgow Financial Alliance for Net Zero coalition (GFANZ). GFANZ aimed to

[337] Mafira, T., *Indonesia's JETP is a glass half full*, Climate Policy Initiative, 2023

bring USD$130 trillion[338] together from over 450 firms in 45 countries across the financial spectrum to fight the climate crisis. However, it is unclear what portion of this funding has been mobilised. GFANZ focused on three workstreams: innovative financial decarbonisation solutions, mobilising capital for EMDEs, and contributing to public policy. GFANZ announced at the start of 2025 that it is transitioning to an "Independent Principals Group", led by finance CEOs and focusing on mobilizing financing (through, amongst other things, JETPs) and supporting the work of Multilateral Development Banks (MDBs).[339]

The goal of JETPs is to therefore combine leader-level political support with the provision of concessional capital, targeting near-term investments with a specific focus on easing the transition for workers in affected industries. JETPs signalled the beginning of rich countries fulfilling their UNFCCC obligations at scale to "provide financial resources to assist developing country Parties in implementing the objectives of the UNFCCC".[340]

A geopolitical imperative also lies beneath JETP commitments.[341] China leads on investments in the energy transition worldwide by a huge margin, at $676 billion it is one-third of total global investment; the next highest is the US at $303 billion, followed by Germany at $95 billion.[342] The race for geopolitical influence contextualises the haste with which JETPs were developed and announced. When the first JETPs were agreed, developed countries had not delivered anywhere close to their promise to mobilize $100 billion in climate finance, while China was ramping up its developing world investments through the Belt and Road Initiative. While the counterbalancing geopolitical aim of JETPs was never explicitly stated, the ODI identify Western country concerns about Chinese political influence in the global South and their action to counter the Belt and Road Initiative.[343]

The promise: Indonesia's JETP

JETP host countries must first develop an investment and implementation plan before finance can be accessed.[344] Finance, in turn, is based on donor pledges. Indonesia was in the first round of countries to receive a JETP and it is a formal $21.6 billion agreement between the Government of Indonesia and the International Partners Group (IPG)[345], making it the

[338] All financials are in $USD unless otherwise stated.
[339] GFANZ Secretariat, "2025 New Year Update from GFANZ Secretariat," January 2, 2025,
[340] United Nations Framework Convention on Climate Change (UNFCCC), *Climate finance in the negotiations.* 2023
[341] Simpson, Jacobs, and Gilmour, *Scaling a just energy transition: Policy brief*. Published by Overseas Development Institute (ODI), (November 2023).
[342] Fernandez, Lucia, *Investments in the energy transition worldwide in 2023, by leading country* (in billion U.S. dollars), Statista (September 2023)
[343] Simpson et al, *Scaling a just energy transition,* p.4
[344] Except for South Africa's, which was the first announced JETP at COP26 and had no investment plans at the time of announcement.
[345] Comprising the US and Japan as joint leads, along with the UK, Germany, France, the EU, Canada, Italy, Norway and Denmark; Simpson, Jacobs, and Gilmour (2023)

largest JETP to date.[346] Yet, Indonesia's investment and implementation plan projected financial requirements far above what was pledged: "approximately $97.3 billion of cumulative power sector investments are required by 2030 under the JETP scenario."[347] Appendix 1 identifies the breakdown of expected required investment in Indonesia to 2030, from the JETP.[348]

Indonesia's $21.6 billion JETP focuses on transmission grid enhancements, early retirement of coal-fired power plants and developing dispatchable and variable renewable energy, while "the commercial financing under the JETP can also be invested in efforts to build the renewable energy value chain".[349] Indonesia's National Energy Policy aims to increase renewable energy capacity to 23 percent by 2025. The focus on the electricity sector is a necessary component of the energy transition process: renewables accounted for only 14 percent of Indonesia's energy mix in 2022 and welfare losses from early coal retirement are very high, requiring a large 'sustainability premium'. [350,351] Indeed, Bahar et al (2023) finds that continuing to operate Coal Fired Power Plants (CFPP) or retiring them early without renewable substitutes would impose significant welfare costs on Indonesia. Of the former, "welfare losses of keeping the power plant in operation are close to seven times larger than retiring the plant earlier and replacing it with alternative renewable sources". Losses are minimized when plants are retired and replaced with new sources of renewable electricity. Adding a 'sustainability premium' to financing models would help ensure early CFPP retirement is welfare enhancing.

The Process: How the money is meant to flow

Climate finance flows in Indonesia are dominated by the public sector, mostly from Indonesia's State budget. At the last measurement preceding the JETP, from 2015-2021, investment from the private sector in climate action constituted only 22%, or $21.6 billion, from 2015 to 2019.[352] This is a fraction of the total investment needs of US$97.3 billion to achieve Indonesia's 2030 power sector transition goals and is in contrast with the other JETP recipient, South Africa, where over 80

[346] The finance committed under the first JETPs ($8.5 billion to South Africa and $21.6 billion to Indonesia) targeted two of the largest coal-dependent countries in the world.

[347] This breaks down to $49 billion in dispatchable renewables (mainly geothermal and hydro), $25.7 billion in variable renewables (solar and wind) and nearly $20 billion in transmission and grid improvements. JETP Secretariat, *Comprehensive Investment and Policy Plan*, 2023

[348] In transmission and grids, managed coal phase-out, dispatchable renewable power, variable renewable power and renewable energy supply chains

[349] JETP Secretariat, *Comprehensive Investment and Policy Plan*

[350] Note that renewables in use are mostly made up of hydro and geothermal. International Energy Agency (IEA). (2022). *Indonesia: Energy mix*. Retrieved November 10, 2024,

[351] Bahar, Erbas, Gallagher, and Bhandary, *Sustainability Premium for the Early Retirement of Coal Plants with Evidence from Indonesia,* Global Economic Governance Initiative, 2024

[352] Meattle, C. and Zeki, M. *Uncovering the Private Climate Finance Landscape in Indonesia*, Climate Policy Initiative, 2020

percent of climate financing comes mostly from the private sector.[353] Indonesia's domestic private sector is vastly underdeveloped (see Appendix Figure 1).[354] The risk in the short term is the inability to scale the domestic private sector at the pace required to meet the JETP's 2030 targets. The underdevelopment, however, could also be a long-term opportunity for dramatic scale-up if the JETP succeeds in 'crowding in' investment. Of the $21.6 billion promised in the JETP, $11.6 billion comes from IPG members (see Appendix Figure 2), and $10 billion from private sector finance mobilized by GFANZ "subject to catalytic public finance".[355] The largest share of financing comes from concessional loans, the second largest from commercial loans, and the smallest comes from grants.[356] Increasing grant funding is a large opportunity to stimulate decarbonization investment, especially for smaller and innovative domestic developers.

Importantly, developing the JETP has boosted Indonesia's domestic decarbonisation planning.[357] Indonesia increased its Nationally Determined Contribution emissions target after the JETP was announced. The updated 2030 NDC has an unconditional emissions reduction target of 29% and a conditional target of 41% as compared to business-as-usual scenarios.[358] Most recently, newly elected President Prabowo announced at the 2024 Brazil G20 conference that Indonesia would seek to phase out coal by 2040. This will require increasing the renewables share to 65 percent of the overall electricity mix by 2040 (from the current 14 percent), while retiring 3 GW of coal annually.[359] This target aligns with the renewable energy goals outlined in Indonesia's JETP; however, it is the political signal to wind down the coal industry (and its network of vested political interests across the country) that is most significant.

The Progress: Why hasn't Indonesia's JETP (yet) delivered?

JETPs must mobilise extremely large volumes of public concessional and other private finance. The process of "crowding in" investment from $11.6 billion of IPG finance to deliver $97 billion by 2030 is highly ambitious. The causal pathway theoretically exists but

[353] Meattle, C de Aragão Fernandes, P and Wignarajah, D *The South African Climate Finance Landscape 2023.* Climate Policy Initiative. Retrieved January 22, 2025.

[354] Larasati L.K., and Mafira, T. *Indonesia Green Taxonomy 1.0: Yellow does not mean go*, February 2023

[355] Mafira, *Indonesia's JETP is a glass half full*.

[356] Mafira, *Indonesia's JETP is a glass half full* and JETP Secretariat, *Comprehensive Investment and Policy Plan*, 2023

[357] International Energy Agency (IEA), (2023). *Navigating Indonesia's power system decarbonisation with the Indonesia Just Energy Transition Partnership*, p.5: Nationally, the Energy Law No. 30 of 2007 and the 2014 National Energy Plan guide the Indonesian government's efforts to reduce fossil fuel dependence. These are complemented by policies aimed at phasing out fossil fuel subsidies in line with Indonesia's goal to achieve net zero emissions by 2060. Previous policies to encourage private sector green financing have been limited to ESG disclosure requirements ("POJK 51"), green bond regulations ("POJK 60"), and a recent launch of Indonesia's green taxonomy, as part of a broader and longer-term Sustainable Finance Roadmap.

[358] Larasati and Mafira, *Indonesia Green Taxonomy*

[359] Setyawani, and Sucahyo, *Indonesia phasing out coal by 2040 requires ramping up renewables*, Ember Energy, 2024

in practice is unclear.[360] The value of the JETP, when compared to a counterfactual of inaction, is to provide a strong political-economic signal to bring multiple, very large public financiers together to catalyse investment.[361] The formal amount, however, is not yet enough to meet either Indonesia's development goals or its enhanced NDC commitments.

The lack of projects financed under JETPs (and the lack of a 'bankable' pipeline) suggests that JETPs have not been effective thus far.[362] This is particularly problematic given the urgency of the transition the JETP is trying to address, especially the scale of coal-fired power dominating Indonesia's power sector that contribute significantly to emissions.[363] Indeed, an issue for overall emissions reduction is Indonesia's plans over the next decade to build approximately 20 GW of off-grid captive coal plants that were not included in the JETP phase-out plan. The mining of coal, which is one of Indonesia's biggest export revenues and provider of valuable foreign exchange, is also not included in the JETP. Employment in the coal industry is a compounding issue. Despite the "just" aspect of the JETP, coal mining and energy employs over 500,000 workers across the Indonesian economy and their future employment prospects are unclear.[364] Concentration of coal workers runs as high as 8 percent in some regions.[365] The risk of a backlash from this constituency (as in other high coal use countries) as coal is wound down through the JETP is real; the "just" element of the partnership is meant to ensure workers and trade union blocs are taken along for the ride. The early signs of how the specific programs and policies addressing the status of workers affected by the transition are still under development; estimates of at least 1-2 billion before 2030 (in addition to what is included in the $21.6 billion) are needed to enable a smooth transition for coal workers employed in planning and constructing coal plants.[366] This will increase significantly in the decades after for workers currently operating and maintaining coal plants.

Another risk for Indonesia is incurring more debt to finance an energy transition that is in its early stages. Making financing contingent on poor

[360] Simpson et al, *Scaling a just energy transition*

[361] Mafira also notes that domestic discussion of these issues is increasing: "Last year, there was no mention of captive coal power plants in the national discourse. There was no discussion of private sector investment into state-owned grids, and very few were seriously considering early coal retirement. This year, everybody is talking about these issues and how to make them work." This has changed considerably since the G20 announcement. Mafira, *Indonesia's JETP is a glass half full*.

[362] Curtin, *Scaling the JETP model: Prospects and pathways for action*. Rockefeller Foundation and Environmental Defense Fund, February 2024

[363] Mafira, *Indonesia's JETP is a glass half full*.

[364] NewClimate Institute. "Walking the Tightrope of Indonesia's Energy Transition: Boosting Jobs or Leaving Coal Behind?" Retrieved January 22, 2025.

[365] Baskoro, F., "30,000 Coal Workers Could Lose Jobs as Indonesia Shifts to Clean Energy." Jakarta Globe. Retrieved January 22, 2025.

[366] NewClimate Institute. "Walking the Tightrope of Indonesia's Energy Transition: Boosting Jobs or Leaving Coal?" *NewClimate Institute*, August 8, 2023.

countries creating an "enabling environment" for the private sector, including commitments to privatise their energy systems, can risk unintended outcomes for already heavily indebted governments. Indeed, Multilateral Development Banks (MDBs) are already skeptical of Indonesia being able to meet its current debt obligations.[367] The IMF note that while Indonesia's debt-to-GDP ratio is low, its debt-service is high (at about 2 percent of GDP), and the share relative to public revenues is higher than peers.[368] Concessional finance pledges from IPG donors have already been allocated mostly to improve the enabling environment and project preparation facilities. The process through which Indonesia can adequately de-risk private investment and further attract international finance from GFANZ members remains unclear.[369] Indonesia's underdeveloped private sector may not be able to scale at the pace necessary and, without the private sector stepping up and the State relinquishing more control over the energy sector, MDBs may also be reluctant to deliver.

Recommendations

Improving Indonesia's JETP

1. Attracting the necessary private sector finance to "crowd-in" the JETP will require consistent policy signals to reduce perceived investment risk, targeted incentives to private sector financial institutions, and a pipeline of bankable renewable projects. Both JETP parties should therefore **announce pilot projects as soon as possible**. For Indonesia, this entails the completion of an investment plan with bankable projects and offering regulatory reform to make renewable energy investments more attractive by relinquishing State controls over the energy sector and providing a clear coal retirement pathway.[370] The IPG should in turn **clarify the mechanism for accessing JETP funds**.
2. **Grant funding** should be considered as a larger proportion of the $11.6 billion in public finance, to immediately stimulate bankable project development and alleviate the Government's debt burden risk. Concessional finance pledges from IPG members have been primarily allocated to improve the enabling environment and project preparation facilities; however, little funding remains to de-risk and attract private finance from GFANZ members.[371] Grant funding would better catalyse

[367] Sweeney, S. *The Fad Is Dead: Why "Just Energy Transition Partnerships" Are Failing*. 2024, New Labor Forum, pp95-102.
[368] International Monetary Fund. Asia and Pacific Dept "Indonesia: 2024 Article IV Consultation-Press Release; Staff Report; and Statement by the Executive Director for Indonesia", *IMF Staff Country Reports* 2024, 270 (2024)
[369] Simpson et al, *Scaling a just energy transition*
[370] Marciel, *The high stakes of Indonesia's $20 billion Just Energy Transition Partnership*, The Diplomat, August 2023
[371] Simpson et al, *Scaling a just energy transition*

the private sector by appealing to domestic stakeholders, not just foreign developers, lenders, and financial companies.[372]

Learning from Indonesia's experience to improve all JETPs

1. **Streamline the application process** to ensure scalability by establishing country platforms with goal-focused, programmatic investment. The IPG should syndicate support for future JETP applicants, rather than each IPG member making discrete offers.[373] JETPs are currently administered in an ad-hoc manner coinciding with global political gatherings as stages for announcements. Indeed, there is no organisation through which JETP candidates can apply. A programmatic approach would ensure finance from multiple sources is made available for a bundle of coordinated actions that are sequenced to support a common goal, rather than being hastily conceived and allocated to discrete projects.[374] A report by the Rockefeller foundation helpfully suggests that JETP support would have greater success if a syndicated offer of support could be provided by the IPG, instead of each individual member making a discrete offer).[375] At a minimum, an entity functioning as a "front door" for country applications would give administrative coherence to the process by formalizing the relationship between GFANZ and IPG members. Such an organization could leverage the GFANZ group's infrastructure, with representatives from some or all IPG members to both negotiate and review JETP applications.

2. **Broadening the IPG to include new members**, for example through the COP process, would increase the aggregate pie of available JETP funding.

3. **Mobilising greater access to concessional finance** by leveraging lending countries' national budgets to underwrite loans would also increase available funding for current and future JETPs.

Conclusion

The scale of funding in the JETP has not matched Indonesia's transition needs.[376] The political-economic signal these agreements were meant to send risks invalidation and further setbacks if the money does not flow to projects. This alone is a huge issue given the urgency of the situation that JETPs are trying to address. Further, envisioning how the $97 billion by 2030 investment

[372] Marciel, *High stakes*

[373] Curtin, *Scaling the JETP model*

[374] Hadley, S., Mustapha, S., Colenbrander, S. et al. (2022) *Country platforms for climate action: something borrowed, something new?* London: ODI

[375] Curtin, *Scaling the JETP model*

[376] Attridge, Getzel, and Gilmour, *National Development Banks: Building markets for a net-zero world*. ODI, 2024

figure will be crowded in by $11.6 billion in public funding is difficult, especially given the slow start.

The funding, then, is roughly one-tenth of what is required. The JETP alone will not adequately de-risk and catalyse the transition necessary for one of the world's largest coal consumers, which currently subsidises fossil fuel for 9 percent of its State Budget, compared with just 6 percent for climate action.[377] We can conclude that the JETPs are neither an adequate contribution to the challenge of the 'just' energy transition, nor are they likely to genuinely counterbalance potential Chinese influence. To attract private sector finance in addition to "crowding-in" the JETP, Indonesia needs consistent policy signals to reduce perceived investment risk, targeted incentives to private sector financial institutions, and a pipeline of bankable renewable projects.

[377] Carneiro, Luisa. "Blog: Indonesia Wants a Carbon Tax, but With Subsidies?" Climate Policy Initiative, January 2025.

Article Appendix

Source: (JETP Secretariat and Working Groups, 2023)

Focus Area	2023-2030	
	Units	Investment needs* (US$ Bn)
IFA1 Transmission lines and grid deployment	~8,000-14,000 kmc	19.7
IFA2 Early CFPP retirement** CFPP Managed phase-out ***	 1.7 GW 55.8 GWh (2030)	 1.1 1.3
IFA3 Dispatchable renewable energy deployment acceleration	16 GW	49.2
IFA4 Variable renewable energy deployment acceleration ****	40 GW	25.7
IFA5 Renewable energy supply chain enhancement	N/A	TBD
Just transition	N/A	
Assessment Interventions		0.2 (minimum)***** TBD
Total		**97.3**

**Investments are expressed in real US$ 2019 terms, in line with costs and investments presented in Chapter 5.*

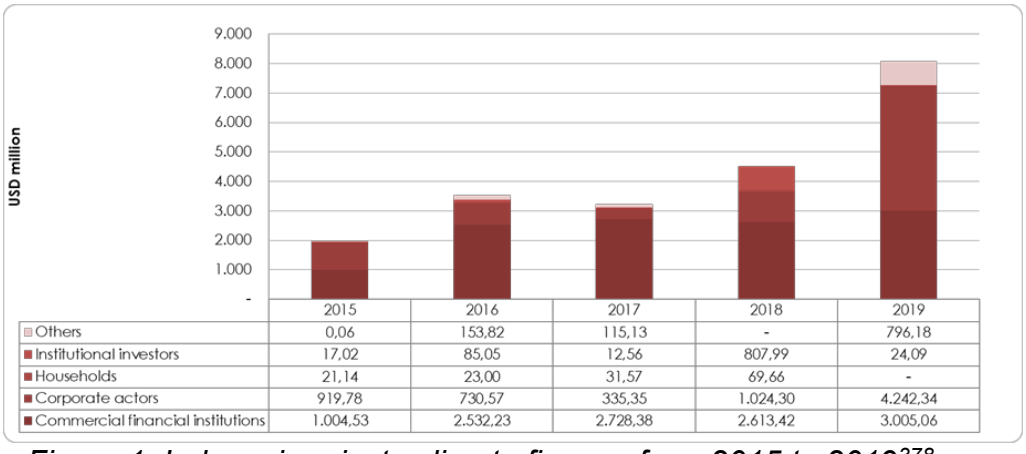
***US$1.1 Bn early retirement costs of 2 CFPPs (Cirebon-1 and Pelabuhan Ratu) based on available ETM funding, which is expected to be decommissioned by 2035/2036 but refinancing should start before 2030.*

****Investment needs include retrofits to implement coal flexibility requiring up to US$1.3 Bn by 2030, for further explanation, refer to subchapter 5.5.3.*

*****Inclusive of storage capacity additions and investment needs.*

******JT Assessment cost consists of US$18Mn for capacity building, scoping study and project piloting; and US$0.5Mn per priority project assessment, which equals to US$200.5Mn. Both comes down to an estimated total of US$218.5Mn. These are conservative estimates and inconclusive of all just transition needs.*

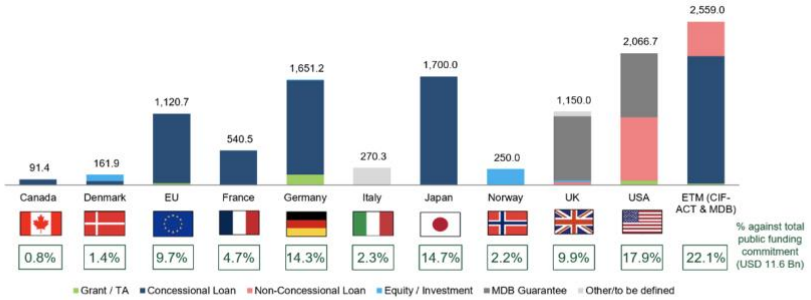
Table 1: Breakdown of expected required investment in Indonesia to 2030



	2015	2016	2017	2018	2019
Others	0,06	153,82	115,13	-	796,18
Institutional investors	17,02	85,05	12,56	807,99	24,09
Households	21,14	23,00	31,57	69,66	-
Corporate actors	919,78	730,57	335,35	1.024,30	4.242,34
Commercial financial institutions	1.004,53	2.532,23	2.728,38	2.613,42	3.005,06

Figure 1: Indonesia private climate finance from 2015 to 2019[378]

[378] Larasati and Mafira, *Indonesia Green Taxonomy 1.0: Yellow does not mean go*



Source: (JETP analysis based on the IPG submissions and consultations, 2023)

Figure 7.4-1 JETP Public Finance breakdown by country/entity and funding mechanism (in US$million)

Table 7.4-1 JETP Public Finance breakdown by country/entity and funding mechanism (in US$million)*

Source: (JETP analysis based on IPG submissions and consultations, 2023)

Countries/Entities	Grant / TA	Concessional Loan	Non-Concessional Loan	Equity	MDB Guarantee	Other / to be defined	Total
Canada	10.0	81.4					**91.4**
Denmark	1.9	60.0		100.0			**161.9**
EU	29.6	1,091.1					**1,120.7**
France		540.5					**540.5**
Germany	167.2	1,474.5		9.5			**1,651.2**
Italy						270.3	**270.3**
Japan		1,700.0					**1,700.0**
Norway				250.0			**250.0**
UK			50.0	25.0	1,000.0	75.0	**1,150.0**
USA	66.7		1,000.0		1,000.0		**2,066.7**
ETM	20.0	1,999.0	540.0				**2,559.0**
Total	**295.4**	**6,946.5**	**1,590.0**	**384.5**	**2,000.0**	**345.3**	**11,561.7**

Figure 2: IPG Country Contribution Breakdown

Sciences Po Energy Review, “Financing Global Energy Transitions: Past, Present, and Current Trends,” European Chair for Sustainable Development and Climate Transition, March 5, 2025.