ECONOMIST IMPACT

Catalyzing investment for advanced energy technologies

Supported by EFI FOUNDATION

Contents

About the research

This Economist Impact report, supported by the EFI Foundation, investigates the barriers slowing capital deployment into clean energy technologies, and where catalytic finance mechanisms can help bridge risk–return gaps. The analysis is informed by a survey of 300 investor leaders in countries across North America, Europe, Asia-Pacific and the Middle East, as well as expert interviews.[1]

The report presents survey findings and qualitative insights, with recommendations to help government and business leaders align capital deployment for clean energy technologies with both financial returns and strategic imperatives.

We would like to thank the following experts for their time and insights:

- **Vineet Agarwal,** climate finance specialist, International Finance Corporation
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Economist Impact bears sole responsibility for the content of this report. The findings and views expressed herein do not necessarily reflect the views of our sponsor, partners or interviewed experts.

[1] Our survey covers the following countries: Canada, China, France, Germany, India, Japan, Saudi Arabia, Singapore, UAE, the UK and the US.

Executive summary

Clean energy investment is accelerating globally, but not at the pace or scale required to avoid the worst effects of climate change. Public capital is playing a critical role in addressing key externalities and delivering public goods like climate change mitigation and national security—but there is not enough of it. Therefore catalyzing private capital by using public, philanthropic and patient funding to reduce investment risk is essential.

This Economist Impact report, supported by the EFI Foundation and informed by a global investor survey and expert interviews, examines the barriers slowing capital deployment into clean energy technologies and the catalytic mechanisms that can help to overcome them. The survey, conducted in the aftermath of the 2024 US elections, covered 300 investor leaders across North America, Europe, Asia-Pacific and the Middle East.

Because markets can misprice long-term risks, conventional finance is often insufficient to deploy new technologies and build infrastructure at speed and in riskier markets. There are various policy options to mobilize investment, but catalytic financing plays a particularly important role in bridging the 'missing middle' of the finance landscape. While early-stage innovation and commercially bankable projects often find support, catalytic capital is most needed to scale proven but high-risk technologies or deploy mature solutions in emerging and volatile markets where commercial capital remains hesitant. By absorbing early-mover risk or improving expected risk-adjusted returns, catalytic finance can crowd private capital into assets aligned with long-term national security, economic development and/or climate goals.

Drawing from a global survey and case studies, our research identifies the most pressing needs for catalytic mechanisms based on investor perceptions and highlights which mechanisms investors view as most effective in overcoming those barriers.

When structured effectively and tailored by technology, investor profile and market, even modest public or philanthropic investments can unlock substantially larger flows of private capital by improving risk-adjusted returns. But doing so requires intentional collaboration and for policymakers and philanthropists to understand investor preferences so they can provide the most effective and efficient mechanisms.

More specifically, our analysis seeks to answer the following questions:

Why
should we accelerate clean energy technology development and scaling?

What
are the barriers to scaling clean energy project capital formation?

How
should we tailor catalytic mechanisms to risk barriers?

Key findings

Accelerating the deployment of clean energy assets is not just important for mitigating climate change, but also for reaching other critical national priorities. It is necessary to improve energy security in a turbulent global market; promote technological and strategic leadership; realize cost savings for consumers and returns for investors; and reduce local pollution for citizens. Each of these goals is time-sensitive and calls for mobilizing finance to rapidly deploy clean energy technologies and infrastructure.

Investors view clean energy competing on returns, and not just as an environmental, social and governance (ESG) issue. While policy incentives and corporate sustainability goals still play a role, investors perceive profitability and long-term returns as a primary driver when allocating investment to clean energy technologies—especially renewables, energy efficiency and enabling grid technologies. Survey results indicate that the overwhelming majority of respondents (97%) view clean energy assets as competitive with or superior to other asset classes in terms of expected returns.

Capital is available but deterred where perceived risks remain high. Private capital flows readily to mature technologies like solar and wind in low-risk environments. However, support is needed to scale those technologies either in critical early phases (eg, demonstration) or in markets where regulatory, market and/or political risks are significant. Respondents showed less readiness to deploy capital to assets with higher risk profiles due to regulatory/permitting challenges (eg, grid infrastructure), maturity (eg, e-fuels) or both (eg, long-duration energy storage). This is especially the case in emerging and developing economies where risks are compounded by macroeconomic and institutional constraints.

Barriers to investment are market-specific. In developed markets, respondents were primarily concerned with project-level risks such as long payback periods, interest-rate risk, market risk, technology risk, reputational exposure and measuring impact. In emerging markets and developing economies, they were more concerned with external or macroeconomic risk such as geopolitical and policy risk, currency volatility, inflation, supply chains and liquidity risk.

Consequently, capital needs and de-risking mechanisms to unlock investment are also market-specific. Funding gaps in emerging markets and developing economies (EMDEs) remain especially significant. Survey respondents identified first-loss capital, credit guarantees and currency hedging as the most effective financial de-risking tools to address more external risks in these markets. In developed economies, the most effective de-risking tools cited are instead tailored to address project-level risk. Examples of these include blended finance structures, subordinated debt more generally,[2] and public-private risk-sharing.

Understanding risk profiles is critical to designing and applying the right tools. Financial de-risking mechanisms are ineffective if they are poorly sized, mistimed or misaligned with project, technology or market conditions. Tools should be calibrated to the maturity of the underlying technology and particular market risks, and sufficiently sized and timed to shift investor perceptions without distorting incentives or displacing private capital.

A diversified technology approach is essential for a flexible, reliable and resilient electricity system. While solar and wind are especially attractive to capital and remain central to the energy transition, financing strategies must balance intermittent renewables with energy storage, grid improvements, baseload generation and energy efficiency measures. Our survey confirms that while some of these technologies are perceived as more risky than mature generation technologies, capital providers are expected to increase allocations toward energy storage and advanced grid solutions, recognizing their role in delivering system flexibility, coping with variability, improving reliability and driving down clean energy costs.

Targeted financial tools to unlock private investment into underfunded but essential technologies are critical to bridging the gap between innovation and deployment. For clean energy technologies like green hydrogen, long-duration storage and carbon capture, the challenge often lies not in early research and development (R&D), but in capital-intensive, first-of-a-kind commercial deployments, where private markets remain hesitant due to high technology and market risks. Catalytic mechanisms can help bridge this 'missing middle' between R&D and wider commercialization, but such interventions must be targeted and time-limited to help early movers overcome initial barriers without displacing private capital over the long term. Strategic public-private partnerships (PPPs) will be essential to structure these tools effectively and accelerate commercialization pathways.

2 First-loss capital may sometimes take the form of subordinated debt, but is more likely to be provided as cash outlays to absorb more front-end risk typical of EMDE contexts.

Introduction

The world crossed a key climate threshold in 2024, surpassing 1.5°C above pre-industrial levels and becoming the warmest year on record. While the impacts of climate change on societies and asset portfolios remain profound, the urgency of that challenge is increasingly matched by near-term geopolitical and economic imperatives. Rising volatility in global energy markets, geopolitical instability, evolving industrial policy, a turbulent inflationary environment, and rapidly rising electricity demand—including from artificial intelligence and advanced manufacturing—are reshaping the investment landscape.

Scaling clean energy technologies and building out the infrastructure is no longer just an environmental necessity—accelerating that process is also necessary for achieving other critical goals such as driving national competitiveness (which has implications for national security and development); mitigating exposure to volatile fossil fuel markets; and nurturing sectors that can deliver compounded returns and lower energy costs. Doing so requires mobilizing enormous amounts of capital that conventional markets fail to provide in time or in risky markets. There is not enough public capital to do the job, but there is a strong case for using investment finance to crowd in private capital, speed-up scaling and deployment, and achieve critical policy goals.

The case for acceleration

Accelerating the deployment of clean energy technologies positions countries as leaders in the global energy transition, enhances national security and promotes sustainable development. Major economies have invested in scaling strategic clean energy industries to secure long-term competitive advantages. China is a prime example: starting in the mid-2000s and especially since its 12th Five-Year Plan in 2011, China's government had the strategic ambition to lead in clean energy.[3]

China now dominates several global clean energy value chains—including solar photovoltaics[4] (PV) and critical minerals—due to state-backed financing, economies of scale and a push to develop domestic expertise. In 2024 it accounted for two-thirds of the global increase in energy transition investment and 40% of the total.[5] The motivations were more

[3] Yale Environment 360, "How China Became the World's Leader on Renewable Energy", March 2024, https://e360.yale.edu/features/china-renewable-energy
[4] China controls 80% of solar PV global supply chains. See: IEA, "Solar PV Global Supply Chains Executive Summary", https://www.iea.org/reports/solar-pv-global-supply-chains/executive-summary
[5] BloombergNEF, "Global Investment in the Energy Transition Exceeded $2 Trillion for the First Time in 2024, According to BloombergNEF Report", January 2025, https://about.bnef.com/blog/global-investment-in-the-energy-transition-exceeded-2-trillion-for-the-first-time-in-2024-according-to-bloombergnef-report/

economic than environmental; China's rush to seize the upside opportunities of clean energy were not matched by an enthusiasm for cutting its own emissions.[6]

Other countries have pursued similar industrial policy, if on a smaller scale. The US Inflation Reduction Act unleashed about US$400bn in clean energy funding[7] to onshore supply chains and to strengthen domestic manufacturing, partly in response to Chinese competition. The EU's Green Deal Industrial Plan and Japan's Green Transformation strategy aim to support domestic capabilities, enhance competitiveness and reduce dependence on potentially unreliable foreign technology suppliers. In developing countries, clean energy industries support sustainable development goals, by expanding electricity access and affordability, and creating jobs.

Clean energy technologies make energy systems more stable, diverse and less vulnerable to geopolitical or supply chain disruptions. Energy security has long been a pillar of national policy, and recent geopolitical events further underscore its importance. The Russian invasion of Ukraine in 2022 triggered an energy crisis and revealed the risks of heavily relying on gas imports—not only in Europe, but also among liquefied natural gas importers worldwide as global prices spiked. Global oil and gas production is concentrated in the Middle East, making fuel markets susceptible to regional conflicts there. And geopolitical fragmentation and the growing use of trade policy for political leverage could also make volatility a more persistent feature of the energy landscape.

Reducing exposure to such volatility can yield significant cost savings. The International Renewable Energy Agency estimates that every additional US$1 spent on renewables reduces long-term fossil fuel import costs by US$3-7.[8] But renewables may also be subject to supply chain shocks, like China's restrictions on critical mineral exports. This highlights the need for co-ordinated efforts to secure not only end-use technologies, but also the supply chains enabling their deployment.

Nurturing clean energy sectors and helping them overcome vulnerable development stages can unlock significant gains for private sector first movers. While much catalytic finance is associated with public or philanthropic initiatives, it can also take the form of private and profit-driven investments. Patient capital and impact investing by corporations help bridge financing gaps for high-risk, long-payback-period technologies that conventional investors may avoid. Institutional investors, private equity firms, venture capitalists and corporations also engage in long-term investments to establish first-mover advantage. Indeed, investment firms like Generation Investment Management and Engine No. 1 deploy patient capital into early-stage technologies, aiming to prove commercial viability and attract follow-on investment in markets where they hold a strong position.

The world needs to reduce emissions quickly to avoid the most catastrophic consequences of climate change, protect long-term portfolio value from these impacts and mitigate the health effects of local pollution. The International Energy Agency (IEA) estimates that global clean energy investment must reach US$4.5trn annually by 2030—more than twofold current levels. Many of the key technologies required for decarbonization (eg, low-carbon fuels and industrial electrification) in hard-to-abate sectors face financing barriers that slow

[6] Yale Environment 360, "How China Became the World's Leader on Renewable Energy", March 2024, https://e360.yale.edu/features/china-renewable-energy
[7] McKinsey & Company, "The Inflation Reduction Act: Here's what's in it", October 2022, https://www.mckinsey.com/industries/public-sector/our-insights/the-inflation-reduction-act-heres-whats-in-it
[8] International Renewable EnergyAgency, "Transforming the energy system", 2019, https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2019/Sep/IRENA_Transforming_the_energy_system_2019.pdf

their deployment. The longer the transition takes, the more economic and environmental damage accumulates—including stranded assets, higher adaptation costs, declining portfolio values and negative health impacts.

Despite growing economic and strategic incentives, capital markets do not always allocate funding to clean energy technologies at the speed required to meet these urgent goals. Catalytic finance can address these gaps—but when it involves public funding in particular, it may be subject to shifting political dynamics around climate change.

A changing climate policy landscape

Between December 2024 and January 2025 Economist Impact surveyed finance providers[9] globally to assess investor sentiment about the drivers, challenges and solutions for accelerating clean energy investments. Participants were responding to the survey in the wake of the 2024 US presidential elections, amid the prospect of weaker climate policy under an incoming Trump administration. With President Trump's first 100 days in office behind us, the direction and pace of policy shift are becoming clearer. This places the US at odds with much of the world—although signs of parallel shifts are emerging elsewhere. Indeed, similar political trends in parts of Europe, alongside a pull-back in sustainability goals by major corporations, appeared to signal a clear change in narrative—if not in policy.

Yet when it comes to the clean energy sector itself, global investors continue to be optimistic about future growth. Some mature technologies are now profitable independently of policy support, delivering stable and long-term financial returns. And some earlier-stage technologies (eg, low-carbon fuels or electrified end-uses) and enabling grid investments (eg, storage, grid digitalization or efficiency) can enhance the future value of existing investments by improving utilization rates (eg, of renewable generation or midstream infrastructure). Our survey results confirm that investor enthusiasm for clean energy technologies is not just a commitment to sustainability or social responsibility, but also rooted in their view of clean energy as a high-growth asset class with amenable risk-adjusted returns.

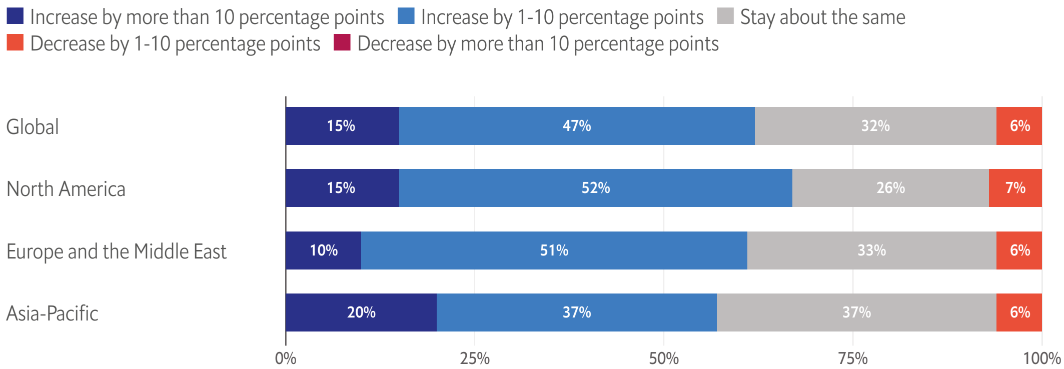
Investments in clean energy are generally expected to rise, indicating that investors see ongoing value despite near-term climate policy uncertainty. Sixty-two percent of respondents expected their organisation to increase its capital allocation to clean energy assets over the next three years, with a further third expecting allocation to remain steady. Given the prospect of major climate policy shifts in the US and their global implications, this finding suggests that the investment case for some clean energy assets—particularly mature technologies—may remain strong.

Our survey results confirm that investor enthusiasm for clean energy technologies is not just a commitment to sustainability, but also rooted in their view of clean energy as a high-growth asset class.

[9] The survey only includes investors who are allocating a share of their portfolio to clean energy assets.

Figure 1. Investors across North America, Europe and the Middle East, and Asia-Pacific express optimism about clean energy investments, with the majority expecting their organisation's allocation to increase in the next three years; very few anticipate a decrease.

Share of respondents who mention the extent to which their organisation's allocation in clean energy assets will change over the next three years, by region.



More mature technologies (like solar PV, onshore wind, energy efficiency and some battery storage) or those serving strategic energy security goals (such as nuclear power, resilient transmission infrastructure and critical minerals) are less exposed to weakening political support for climate action. But earlier-stage technologies that are not yet proven at commercial scale could find it harder to secure financing, especially if they are explicitly climate-related—like carbon management.

Investors see strong returns in clean energy investments broadly—and enabling technologies are key. Respondents were generally positive on investment opportunities within the clean energy sector, which were driven almost as much by the prospect of financial returns as by corporate sustainability goals or policy incentives (see Figure 2). The overwhelming majority (97%) of respondents globally reported that the expected returns from clean energy assets are similar or higher than other asset classes. These results indicate that much clean energy investment is transitioning from a niche ESG- or policy-driven activity to a core financial opportunity.

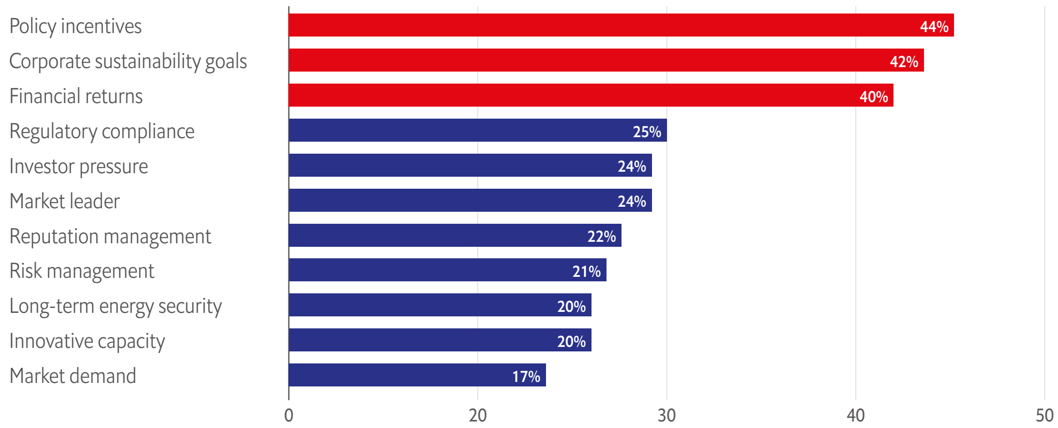
Some clean energy technologies, particularly renewables, have already progressed along the growth curve, and are currently attractive even for investors with lower risk appetites, such as commercial banks, insurers and pension funds (72% expect renewable energy to be more of a priority). Investors also expressed enthusiasm for energy efficiency and energy storage solutions, which are critical to making variable renewables competitive after accounting for intermittency and curtailment. Almost half of respondents cited storage as one of their top three investment priorities today.[10]

Over the next three years, investors were most bullish about renewables and low-carbon energy (including nuclear). Three in four respondents expected these to be more of a priority in the near term, with even higher rates among respondents in North America and Asia, where electricity demand is growing rapidly.

[10] IEA, "LCOE and value-adjusted LCOE for solar PV plus battery storage, coal and natural gas in selected regions in the Stated Policies Scenario, 2022-2030", April 2024, https://www.iea.org/data-and-statistics/charts/lcoe-and-value-adjusted-lcoe-for-solar-pv-plus-battery-storage-coal-and-natural-gas-in-selected-regions-in-the-stated-policies-scenario-2022-2030

Figure 2. Financial returns were perceived as an equally important driver as corporate sustainability goals and policy incentives.

Share of respondents who ranked the following drivers as the most critical for their organisation to invest in clean energy assets.



"The planet needs a rapid buildout of existing technologies, at a much faster pace than we are currently building. I'd advocate for a set of policies that support scaling renewables, nuclear and other technologies that we know how to do well," says Lara Pierpoint, managing director at the Trellis Fund.

Regional differences in energy policy frameworks among surveyed investors suggest that local environments play a key role in shaping sentiment. Supportive policies in Europe and the US (in place at the time of the survey, which followed the US election) are effectively sustaining investor confidence, while weaker sentiment in Asia-Pacific indicates regulatory uncertainties or competitive pressures from incumbents. A wider spread in expectations among Asian respondents—where more investors than other regions anticipate capital allocation increasing by >10%, but a greater proportion of that same cohort also expect no increase—suggests a high variation within the sample. India may see more aggressive expectations due to market growth or policy outlook, compared with other lower-growth countries like Japan.

Policy interventions perceived to be effective also differ by region. Survey respondents considered long-term purchase agreements to be the most effective, but they are particularly favored by Asian respondents (63%). The specifics of power purchase agreements (PPAs) are later discussed in more detail, but their reception in Asia-Pacific may be due to more recently liberalized markets and higher growth potential. Respondents from Asia-Pacific were more keen on government-backed insurance in their own markets than in foreign developed or emerging markets, perhaps reflecting closer government ties. Direct subsidies or grants are seen as less effective by European investors, compared with their counterparts in Asia-Pacific and North America.

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Lara Pierpoint, managing director at the Trellis Fund

Barriers to scaling capital deployment

Despite the need to accelerate the deployment of clean energy technologies, policy uncertainty, infrastructure bottlenecks, risk-return mismatches, and other financial and non-financial risks continue to limit the speed and scale of investment.

Systemic barriers

Regulatory instability and inconsistent policy signals remain among the most cited deterrents for clean energy investment domestically (see Figure 3), particularly for long-term and capital-intensive projects. Policy reversals and shifting market structures undermine the confidence investors need to make commitments. In India, abrupt changes to solar tariffs and safeguard duties on April 1, 2022 may have led to project delays. Meanwhile, the EU's attempt to reform its electricity market after the Russian invasion of Ukraine created uncertainty over price caps, due to uneven implementation across member states—ultimately slowing investment in renewables.[11] In the US, a January 2025 executive order mandated a pause on approvals, permits, leases and loans for both onshore and offshore wind projects.[12]

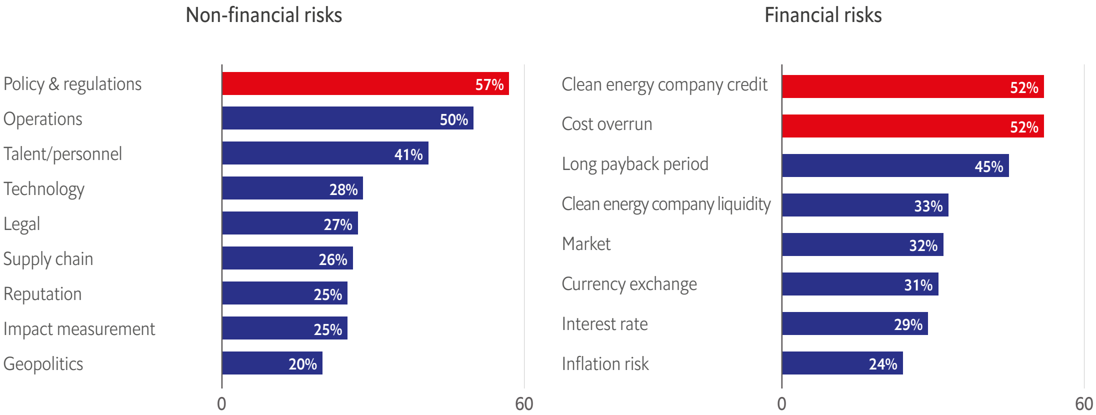
Permitting delays, driven by complex and fragmented regulatory frameworks, slow project timelines, even in countries with otherwise stable policy environments. Permitting for onshore wind farms in Germany can take up to six years, delaying deployment despite strong policy support.[13] In the US, the average timeline for a clean energy project to obtain necessary National Environmental Policy Act reviews was 4.5 years in 2023—while transmission projects took 6.5 years.[14] Extended timelines can inhibit grid capacity and exacerbate infrastructure constraints, creating additional barriers.

Operational risks, particularly those tied to grid constraints and interconnection delays, slow clean energy deployment even where capital is available. Solar capacity additions in the US doubled between 2022 and 2024, reaching 39.4 GW.[15] But the grid has been unable to keep up, partly due to permitting delays, resulting in long interconnection queues and transmission buildout challenges. Indeed, the time from the initial grid connection request until a plant is fully operational reached 4 years for projects built between 2018-2023, compared to less than 2 years for projects built between 2000-2007.[16]

[11] SolarPower Europe, "Global Market Outlook For Solar Power 2023 - 2027", https://www.solarpowereurope.org/insights/outlooks/global-market-outlook-for-solar-power-2023-2027/detail
[12] Re-Source, "Extended inframarginal revenue caps on electricity markets continue to harm investments in the energy transition", https://resource-platform.eu/wp-content/uploads/Joint-Industry-Letter-on-inframarginal-revenue-caps.pdf
[13] McKinsey & Company, "Renewable-energy development in a net-zero world: Land, permits, and grids", October 2022, https://www.mckinsey.com/industries/electric-power-and-natural-gas/our-insights/renewable-energy-development-in-a-net-zero-world-land-permits-and-grids
[14] American Clean Power, "U.S. Permitting Delays Hold Back Economy, Cost Jobs", https://cleanpower.org/resources/u-s-permitting-delays-hold-back-economy-cost-jobs/
[15] World Resources Institute, "US Clean Power Development Sees Record Progress, As Well As Stronger Headwinds", https://www.wri.org/insights/clean-energy-progress-united-states
[16] Energy Markets & Policy, Berkeley Lab, "Grid connection backlog grows by 30% in 2023, dominated by requests for solar, wind, and energy storage", April 2024, https://emp.lbl.gov/news/grid-connection-backlog-grows-30-2023-dominated-requests-solar-wind-and-energy-storage

Figure 3. Across all surveyed markets, investors identified policy and regulations as the top non-financial risks in their domestic markets, while clean energy company credit risk ranked as a top financial concern alongside cost overrun.

Share of respondents who cited the following as the most critical non-financial and financial risks to their organisations investing in clean energy assets domestically.



Meanwhile, China is proactively deploying ultra-high-voltage transmission lines to integrate distant wind and solar resources and avoid the same interconnection challenges, but interprovincial grid bottlenecks still limit clean energy utilization. India has faced curtailment of wind and solar energy in some states due to lack of grid flexibility. For example, wind power plants operated by the Tamil Nadu Spinning Mills Association experienced curtailment rates averaging 30–35 percent during peak seasons between 2012 and 2015.[17] These kinds of issues often contribute to cost overruns by imposing uncertainty and creating delays in connecting to users, increasing financing and construction costs beyond initial projections. This discourages potential investors and impacts the financial viability of future projects.

Capital intensity and risk-return mismatches also create a structural financing problem. Significant upfront capital and long payback periods make many clean energy investments less attractive to investors focused on short-term returns. Rich Swanson, director of climate and energy at Blue Strike Environmental, notes that long payback periods for some building decarbonisation upgrades—such as the electrification of boilers—can make these investments unattractive without predictable subsidies or incentives.

Unlike fossil fuel infrastructure, which benefits from well-established financial models and often shorter depreciation cycles, the capital intensity and long payback periods of some clean energy technologies exacerbate financing hurdles that delay their deployment. It makes them more susceptible to the elevated cost of capital in emerging markets and high interest rates. Analysis by the IEA suggests that a 5% increase in interest rates can increase the levelized cost of electricity of wind and solar by almost a third—a much greater impact than the same increase would have on natural gas.[18]

[17] Down To Earth, "Renewable energy: Curtailment is a bane", January 2020, https://www.downtoearth.org.in/energy/renewable-energy-curtailment-is-a-bane-68857
[18] TIME, "What High Interest Rates Mean For U.S. Renewable Energy," https://time.com/6281021/renewable-energy-interest-rates/

While wind and solar involve high up-front capital costs, early- and mid-stage technologies like green hydrogen and carbon capture are even more capital-intensive—making them less attractive to investors in the near term. These technologies also face longer commercialization timelines and more uncertain revenue models, which further increases risk aversion. Carbon capture projects, for example, remain heavily reliant on public subsidies or regulations, with few market-driven business models supporting widespread deployment.

Human capacity constraints or a lack of technical, managerial or financial expertise can limit the bankability and scalability of clean energy assets in both early-stage innovation ecosystems and EMDEs. Survey respondents were especially likely to perceive this risk in their own domestic market. Even where capital is available, investors hesitate to commit if project developers lack the capacity to manage complex permitting, procurement or financial structuring processes. In EMDEs, this shows up as limited local expertise in project development, engineering or utility regulation, which slows approvals, increases overall risk and contributes to cost overruns.

For deep-tech and science-based startups in Silicon Valley, there's often a gap between technical innovation and the business, financial and operational skills needed to scale, says Jeff Johnson, general partner at B Capital. This disconnect can undermine investor confidence, even when the underlying technology or market opportunity is strong. He suggests investors use the United States Department of Energy (DoE) Adoption Readiness level framework during due diligence to assess and support commercialization readiness–a method that has shown promising results.

Barriers in developed and emerging/developing markets

In **developed markets**, survey respondents cited long payback periods, market risk and interest-rate risk as the most critical financial risks. Long payback periods and the capital intensity of some larger projects make them sensitive to rising interest rates, which can cut profit margins enough to sink projects and bankrupt companies, especially if revenue is too low.[19] For example, offshore wind developers in the US were forced to cancel or reconsider projects in 2023 due to rising interest rates.[20,21] Hesitancy in these markets is driven by

[19] Bloomberg, "SunPower Plunges on Default Risk and Going-Concern Warning", December 2023, https://www.bloomberg.com/news/articles/2023-12-18/sunpower-plunges-amid-default-risk-and-going-concern-warning?sref=uFaJcogC
[20] The New York Times, "What Ails Offshore Wind: Supply Chains, Ships and Interest Rates", December 2023, https://www.nytimes.com/2023/12/11/business/energy-environment/offshore-wind-energy-east-coast.html
[21] In 2023, Ørsted said it would be writing off up to US$5.6bn after it canceled two large offshore wind projects planned in the waters off New Jersey, and BP had to write off US$540m of its investments in Equinor's US offshore wind portfolio—both cited high interest rates.

uncertainty around long-term returns rather than a lack of capital. Upfront capital requirements are often provided as debt, which is then repaid through customer revenue.[22]

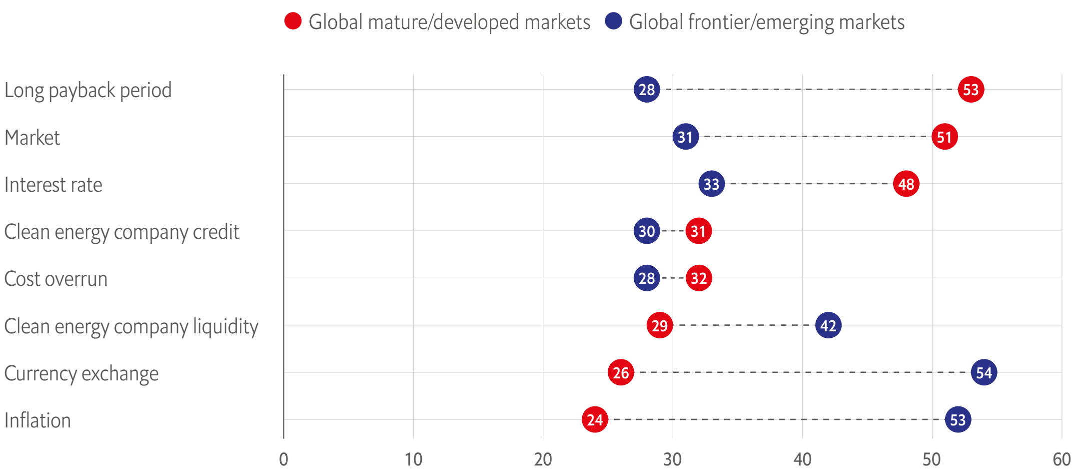
The most frequently cited non-financial risks in developed markets were reputation risk, technology risk and impact measurement. Investors here face greater public and regulatory scrutiny; more complex ESG reporting requirements; and heightened expectations around transparency, innovation credibility and measurable climate impact. Although policy and regulatory risks were a top concern in major markets like the US, the UK, France and Germany, investors perceived these risks to be less severe than in developing countries, owing to relatively stronger governance frameworks.

In **EDMEs**, investors perceive currency risk and inflation as the most critical financial risks, reflecting a heightened concern about external macroeconomic and political factors in these markets, which increase the cost of capital for projects that might otherwise have similar risk profiles.[23] Another major concern in EMDEs is clean energy company credit risk. Developers often have weak balance sheets, limited access to working capital and operate in shallow local credit markets, making it harder to raise affordable finance or withstand delays in revenue or construction.

The most frequently cited non-financial risks in EMDEs were regulatory, supply chains and geopolitical risks. Supply chain risks are especially pronounced in EMDEs due to weaker local manufacturing capacity, import dependence, infrastructure bottlenecks and limited access to affordable logistics. These factors can magnify the impact of global material shortages and delays (including from critical mineral shortages) on project timelines and costs.

Figure 4. Developed markets identified long payback periods and market as most critical financial risks, while developing markets placed greater emphasis on currency and inflation risks.

Share of respondents who cited the following as the most critical financial risks to their organisations investing in clean energy assets



[22] Politico, "Building wind power, canceling coal — it's all drowning under borrowing costs", https://www.politico.com/news/2023/12/09/climate-talks-newest-threat-interest-rates-00130949

[23] Macroeconomic volatility, regulatory instability, and geopolitical uncertainty can discourage investment even when projects are technically and financially viable. The LCOE of utility scale solar PV in 2021 was US$46/MWh in Europe, compared to US$111/MWh in Indonesia, US$79/MWh in Brazil and US$68/MWh in South Africa. But if these were to assume the same cost of capital as in Europe, their LCOE drops to US$70/MWh, US$45/MWh and US$30/MWh respectively.

Importance of tailored financial de-risking mechanisms to overcome identified risks

These differentiated challenges also demand different de-risking tools, as reflected in the survey results. In **developed economies**, investors point to the importance of subordinated debt (64%), blended finance structures (48%) and risk sharing mechanisms via PPPs (43%). This focus on structured financial products makes sense to optimize capital efficiency in markets where capital is abundant, but investors are sensitive to risk-adjusted returns and payback timelines. These products enable investors to allocate risk more precisely; enhance the creditworthiness of projects; and therefore stretch limited public or concessional capital further by crowding in larger pools of private capital.

In **EDMEs**, most survey respondents identified currency hedging instruments (56%) as the most effective de-risking tools, followed closely by first-loss capital (55%) and credit guarantees (53%). Credit guarantees were particularly favored among low-risk appetite investors (62%) compared with medium-risk (45%) and high-risk (52%) investors.

Here, the preferred de-risking tools prioritize mechanisms that directly address external risks. Hedging tools directly mitigate losses from devaluation or currency mismatch; first-loss capital provides a buffer against low-probability high-impact tail risks like political upheaval or currency collapse; and credit guarantees directly reduce counterparty risk from utility offtakers or lack of legal enforcement. While first-loss capital may sometimes take the form of subordinated debt, it is more likely to be provided as cash outlays to limit financial exposure and bolster the balance sheet of clean energy companies. In these environments, tools like subordinated debt or blended finance may improve project bankability, but are less effective at mitigating macroeconomic or political risks outside the project's control.

The specific mechanisms for risk-sharing must be tailored to the investment challenge, considering the stage of technology development, the investment rationale and the capital structure of investors.

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Table 1. Risks, type of capital needed and financing solutions for clean energy sectors across technology maturity.

Technology maturity	Market type	Types of risks	Capital needed (investor type)	Financing solutions
Mature technologies (eg, renewables)	Developed	Policy/regulations, permitting delays, cost recovery	Institutional investors, banks, utilities	PPAs, contracts for difference (CfD), credit guarantees, permitting-stage guarantees (eg, InvestEU and the European Investment Bank, or EIB)
	EMDEs	Currency, inflation, utility credit, political	Development finance institutions, concessional lenders, blended finance partners	Currency hedging (eg, TCX Fund), credit guarantees, first-loss capital, results-based finance
Mid-stage technology (eg, grid infrastructure and storage)	Developed	Cost overruns, market risk, long payback periods, interest-rate risk	Pension funds, infrastructure investors, public-private platforms	Subordinated debt, blended finance, public-private infrastructure platforms
	EMDEs	Inflation, liquidity constraints, regulatory/ policy risk	Multilateral banks, concessional co-financiers, philanthropic capital	First-loss capital, concessional co-finance, partial guarantees (eg, SDG Indonesia One)
Early-stage technology (eg, electric steelmaking, long-duration storage and carbon management)	Developed	Technology risk, commercialization uncertainty, long development timelines	Public grants, impact investors, patient venture capital (VC), philanthropists	Grants (eg, ARPA-E, Horizon), first-loss catalytic capital (eg, Breakthrough Energy), early-stage philanthropy
	EMDEs	Capital scarcity, regulatory instability, weak innovation ecosystems	Concessional funding, development banks, innovation grants	Clean Energy Innovation Facility (CEIF), concessional funding for pilots, technical assistance (eg, GEAPP, World Bank)

Scaling mature clean energy technologies in risky market conditions

Clean energy deployment at scale requires large infrastructure investments in the kinds of mature technologies that under the right policy and market conditions can already produce reliable returns—like renewable energy, low-carbon generation and efficiency upgrades.

In **developed markets**, these projects are principally exposed to political and regulatory risks, such as permitting delays, changes in energy policy and cost-recovery uncertainty—precisely what survey respondents reported to be the top non-financial risks in their domestic markets (see Figure 3). To overcome permitting-related barriers and long lead times, financial mechanisms such as development-stage guarantees, bridge financing and credit enhancements can be used to carry projects through uncertain regulatory timelines.

The InvestEU programme, alongside the EIB, supported renewable developers through credit risk-sharing schemes and early-stage project finance that covers development costs even before permits are finalized.[24] This kind of backing has been crucial in countries like Germany and the Netherlands, where permitting bottlenecks for offshore wind have historically delayed deployment. In 2024 the EIB initiated counter-guarantees designed to share credit risks faced by commercial banks when dealing with players in the wind industry.[25] The instrument, first extended to DeutscheBank under its €5bn wind initiative, facilitates access to advance payment and performance guarantee lines, benefitting both the banks and the industry. The €1bn EIB-DeutscheBank guarantee facility, and a subsequent facility supported by InvestEU with Intesa Saopaolo, are each projected to generate up to €8bn in private investments.[26]

Investors' cost recovery concerns highlight the importance of stable revenue mechanisms across both developed and EMDE market contexts. Long-term PPAs have been among the most effective tools for attracting clean energy investment, especially when supported by policy mandates, utility procurement obligations or credit enhancements. State-level policies such as California's Renewable Portfolio Standard effectively catalyzed private investment by requiring utilities to sign PPAs with renewable developers—backed by regulated revenue and federal tax incentives. While not direct public subsidies, these policy-driven contracts played a catalytic role by reducing revenue risk and enabling project bankability. In parallel, CfD programs act more explicitly as a catalytic instrument by guaranteeing strike prices through public contracts. In both cases, risk-sharing contracts require sufficient flexibility to succeed amid fluctuating cost and revenue environments.

"If you have a PPA or a contract-for-difference at the right price, you massively reduce risk. Getting to a final investment decision becomes a lot easier. And that doesn't necessarily have to come from the government," says Craig Douglas, partner at the World Fund.

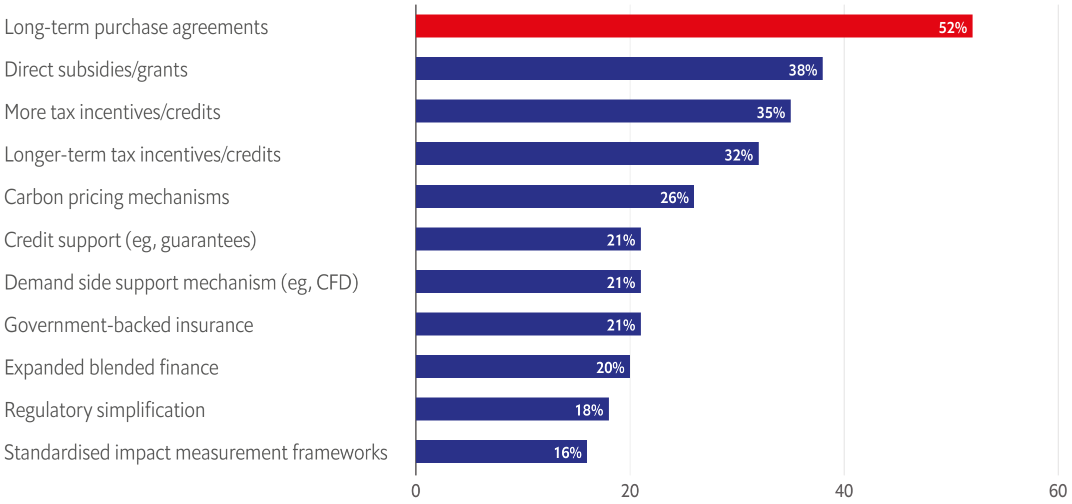
"If you have a power purchase agreement or a contract-for-difference at the right price, you massively reduce risk. Getting to a final investment decision becomes a lot easier. And that doesn't necessarily have to come from the government."

Craig Douglas, Partner at the World Fund

[24] See: https://investeu.europa.eu/index_en
[25] EIB, "Germany: EIB and Deutsche Bank to boost Europe's wind energy manufacturers", July 2024, https://www.eib.org/en/press/all/2024-308-eib-and-deutsche-bank-to-boost-europe-s-wind-manufacturers
[26] EIB, "Italy: EIB and Intesa Sanpaolo announce agreement to stimulate up to €8 billion investment in the wind industry", October 2024, https://www.eib.org/en/press/all/2024-368-eib-and-intesa-sanpaolo-announce-agreement-to-stimulate-up-to-eur8-billion-investment-in-the-wind-industry

Figure 5. Long-term purchase agreements along with fiscal incentives are considered the most effective policy interventions to attract clean energy investments.

Share of respondents who mentioned the following policy interventions as the most effective to encourage their organisation to increase investments in clean energy assets.



In the US, several major offshore wind projects relied on fixed-price PPAs with state utilities, but rising interest rates and inflation in 2023 made these contract prices unprofitable, forcing major developers like Ørsted, BP and Equinor to cancel projects.[27]

The UK's 2018 offshore wind sector deal under Theresa May's government aimed to deliver over £40bn to 2030, supported by CfD mechanisms that set strike prices and guaranteed long-term revenue streams.[28] Early CfD prices implied the sector would be subsidy-free by 2023, and it technically was, thanks to high wholesale prices during the energy crisis— revenue was capped and wind farms actually had to reimburse the governmentt.[29] But the same tough cost conditions (supply chain disruptions, interest rates and inflation) pushed up development costs by 40%.[30] Renewed auctions were unsuccessful, forcing the government to raise both subsidies and the revenue cap to attract investment, which later drew criticism when rate-payers had to pay operators of under-utilized farms for not producing.

These cases reflect the difficulty of calibrating risk sharing between often public utilities and developers amid volatile costs and revenue, and highlight the value of more flexible risk-sharing structures like indexed or floating PPAs.

In **EDMEs**, renewable energy continues to lag due to persistent macroeconomic risks. Currency exchange risk was cited as the leading financial risk in EDMEs by survey respondents, particularly in Asia, and currency hedging was consequently cited as the top de-risking tool. But commercial hedging tools can be expensive

[27] World Economic Forum, "The wind power industry is facing major cost headwinds. What's going on (and what can be done)?", November 2023, https://www.weforum.org/stories/2023/11/why-offshore-wind-cost-pressures-rising/
[28] UK government, "Policy paper, Offshore wind Sector Deal," 4 March 2020, https://www.gov.uk/government/publications/offshore-wind-sector-deal/offshore-wind-sector-deal
[29] Current+, "Wind farms to pay back £660m under CfD scheme amid high gas prices", March 2022, https://www.current-news.co.uk/wind-farms-to-pay-back-660m-under-cfd-scheme-amid-high-gas-prices/
[30] Catapult, "Renewable energy auction results in no bids for offshore wind", https://ore.catapult.org.uk/resource-hub/blog/renewable-energy-auction-results-in-no-bids-for-offshore-wind

and are lacking for many developing country currencies, particularly at the long tenors, low cost and large scale required to support needed investments.[31] Donor-backed currency exchange and guarantee facilities provide more tailored solutions, such as the Mission 300 Local Currency Guarantee Facility launched in January 2025 to mobilize US$5bn to support clean energy access projects across Africa.

First-loss capital was identified by respondents as another preferred solution in EDMEs, where it can be particularly effective to address tail market and company liquidity risk.[32] It is provided by public entities or philanthropists to absorb the initial tranche of losses in a blended finance structure, improving the risk-reward profile for commercial lenders and equity investors. But successfully providing effective first-loss protection instruments can be challenging. Extensive and generous protection instruments may induce moral hazard behaviors among investors, while too-limited protection may fail to appeal to buyers in the market—the costs associated with providing these structures and the price charged to investors must be enough to remunerate the provider without pricing the instrument out of the market.[33]

Credit guarantees can play a vital role to address utility creditworthiness. In Chad, the African Development Bank provided a partial risk guarantee for a 34-MW solar project at Djermaya with a weak state utility. The guarantee reduced investor concerns over delayed payments and helped crowd in capital from Proparco and PIDG.[34] However, guarantees must be large enough to actually shift the perceived risk calculus, otherwise they add complexity without meaningfully improving bankability. Results-based finance mechanisms can complement such guarantees by tying disbursements to verified project milestones such as commissioning a solar plant or connecting customers, so private sponsors avoid upfront exposure to delays caused by political interference, regulatory reversals or underperforming counterparties. And government-backed insurance (eg, the Multilateral Investment Guarantee Agency or national political risk schemes), cited by roughly a quarter of respondents, can complement credit guarantees in markets with high sovereign or expropriation risk.

De-risking mid-stage/early adoption technology and infrastructure across markets

Clean energy deployment increasingly depends on large-scale infrastructure and mid-stage/early adoption technologies that fall between proven commercial models and early-stage innovation. These include grid-scale storage, clean hydrogen hubs, grid upgrades and carbon transport infrastructure. Despite being technically demonstrated, these assets are frequently underfunded due to major up-front capital requirements and the need for co-ordinated large-scale planning. Risk-sharing mechanisms must therefore account for uncertain returns, multiple project phases and a heavier reliance on public oversight, as well as supply chain risks.

One effective tool to address these concerns in **developed markets** is subordinated debt or junior capital tranches within infrastructure funds or project finance structures. These instruments allow public or concessional financiers to absorb first losses or take on higher-risk positions, improving the credit profile for senior investors and reducing the weighted average cost of capital. Germany's national promotional bank, KfW, through its subsidiary IPEX-Bank, has provided subordinated loans

[31] Center on Global Energy Policy, "Policy Note | Scaling Clean Energy through Climate Finance Innovation", October 2022, https://www.energypolicy.columbia.edu/publications/policy-note-scaling-clean-energy-through-climate-finance-innovation/
[32] GIIN, "Catalytic First-Loss Capital", October 2013, https://missioninvestors.org/sites/default/files/resources/CatalyticFirstLossCapital.pdf
[33] Climate Policy Initiative, "Risk Gaps: First-Loss Protection Mechanisms", January 2013, https://climatepolicyinitiative.org/wp-content/uploads/2013/01/Risk-Gaps-First-Loss-Protection-Mechanisms.pdf
[34] Africa Energy Portal, "Pioneering Djermaya Solar project attracts new lenders to Chad", https://africa-energy-portal.org/news/pioneering-djermaya-solar-project-attracts-new-lenders-chad

for renewable energy and battery storage infrastructure. For instance, the bank helped unlock private co-financing from the Arkansas Teacher Retirement System by reducing their risk exposure, enabling the construction of a 105MW solar installation paired with a battery energy storage system.[35]

Public-private infrastructure platforms can also play a catalytic role by aggregating risks and co-financing large infrastructure systems. The European Green Deal Investment Plan created a framework for blending private capital with EU-level guarantees and subordinated loans, targeting infrastructure categories like smart grids and clean hydrogen transport. Through the InvestEU guarantee facility, it leverages capital markets while shielding investors from political and cost-related risks that often arise during long development timelines. Framework procurement agreements are public programs that de-risk development by providing standardised contracts, offtake guarantees or pre-approved permitting.

In the UK, the Low Carbon Hydrogen Business Model includes revenue support combined with capital co-funding and policy clarity, helping early hydrogen projects bridge the cost gap and avoid early-stage cost overruns that could otherwise make them unbankable.[36] Similarly to offtake guarantees, demand guarantees can also address volume risk by committing to purchase unused capacity. For example, the DoE's Transmission Facilitation Program ensures demand for new transmission capacity.

In **EMDEs**, grid infrastructure investments face additional external and macroeconomic risks. Like with generation projects, first-loss capital can be effective for addressing liquidity risk if it is carefully calibrated. Credit guarantees are well suited to mitigating off-taker risk where state-owned utilities lack strong credit profiles. And carbon pricing frameworks, where credible, can also create forward revenue certainty and support blended finance for long-duration infrastructure like hydrogen corridors or carbon pipelines.

[35] KfW IPEX-Bank, "KfW IPEX-Bank: Financing for solar and energy storage project in Arkansas/USA", December 2024, https://www.kfw-ipex-bank.de/Presse/News/Pressemitteilungsdetails_831424-2.html
[36] UK Government, "Hydrogen production business model", https://www.gov.uk/government/publications/hydrogen-production-business-model

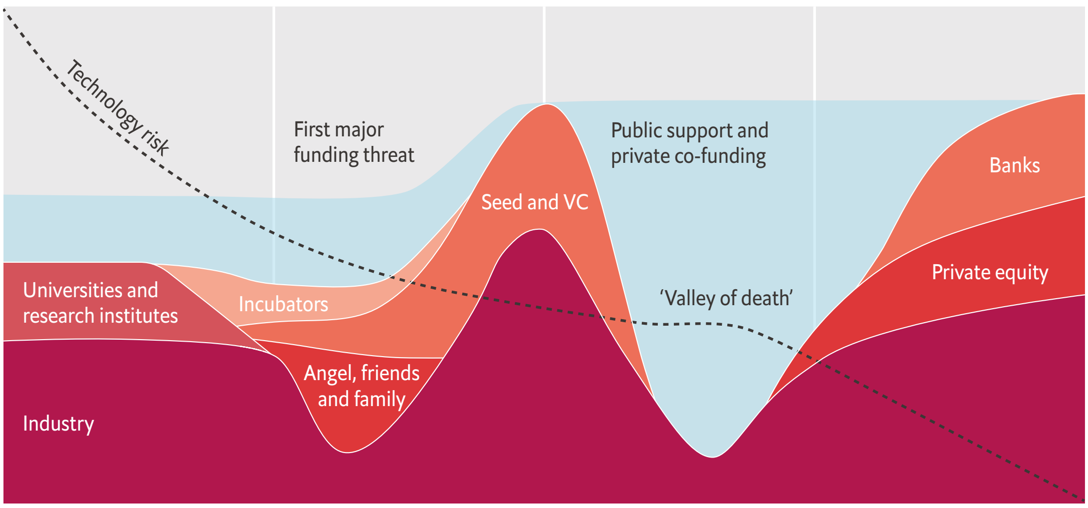
Catalytic capital to grow early-stage innovations

The IEA estimates that nearly 30% of the cumulative emission reductions needed for net-zero must come from technologies still in prototype or demonstration phases. These innovations include storage technologies (liquid metal or flow batteries); decarbonized fuel technologies (e-fuels, anion exchange membrane electrolysis); industrial decarbonization technologies (electric steelmaking, green cement); and carbon management technologies (direct air capture, carbon mineralization). Despite their importance, these technologies face severe financing gaps because their technical feasibility is uncertain and they lack immediate commercial markets.

Although there is strong investor appetite toward clean energy technologies at various stages of maturity, less survey respondents anticipated increasing outlays to technologies in the prototype phase (55%) than to technologies in later phases. But when considering technologies in the demonstration stage—currently being piloted in real-world settings—seven in ten investors (68%) based in Europe, the Middle East and Asia-Pacific anticipated increasing outlays. This suggests that capital might be available to technologies promising long-term financial viability.

Traditional VC, which is typically structured for high-multiple returns over short investment horizons, is often unsuitable for capital-intensive clean energy start-ups with longer development trajectories. Meanwhile, institutional investors like pension funds and commercial banks are constrained by solvency regulations, preventing them from taking high-risk, long-duration assets. This leaves many early-stage companies stranded in the 'valley of death', where funding shortages prevent promising technologies from advancing from R&D to commercialization.

Figure 6. Representative capital provision pathways for new clean energy technologies



Source: IEA

For these technologies, public capital may be warranted to absorb technology risk—identified by survey respondents as a top concern in **developed markets**. Grants from the DoE's ARPA-E program and EU Horizon Fund provide early-stage funding for high-risk energy technologies. Impact investors and philanthropists, such as Breakthrough Energy Ventures, offer first-loss early-stage capital with downside protection, providing catalytic equity that allows institutional investors to enter at lower risk.

For example, Quidnet Energy explored the novel concept of using abandoned oil and gas wells to store and release water, thus generating hydropower.[37] Initially, the company struggled to secure VC, as testing this technology could have resulted in a multimillion-dollar loss within hours. Instead, Prime Coalition brought together a syndicate of philanthropists to finance a first round seed for an initial pilot. When it went better than expected, more funding became available, with each subsequent round attracting a larger proportion of commercial investors.[38]

Another untested solution involves leveraging insurers for risk engineering and risk-transfer solutions relevant to climate technologies in pre-commercialisation stages. According to a Geneva Association survey, an overwhelming majority of insurance executives indicated that clients, governments and investors are beginning to show interest. Insurers can significantly advance the understanding and accurate pricing of untested risks through collaboration with equipment manufacturers and contractors, particularly when insurers participate early in the project cycle. Early involvement helps avoid the need to redesign projects to make them insurable, thus accelerating their implementation. This approach also offers insurers a first-mover advantage, allowing them to gain a competitive edge and capture a larger market share.[39]

On the other hand, poorly designed public finance programs can fail to attract private capital. The UK government's £1bn carbon capture and storage (CCS) competition initially promised support for commercial-scale CCS projects but did not establish a clear revenue model or stable carbon pricing mechanism. As a result, private investors were unwilling to commit and the program was abruptly canceled in 2015, resulting in sunk costs incurred by project developers prior to the program cancellation and a loss of investor confidence.

Early-stage technology development in **EMDEs**, where capital scarcity and regulatory instability create unique challenges, may require differentiated mechanisms. The CEIF, supported by the UK government and managed by the World Bank, funds proof-of-concept and pilot-stage energy technologies, specifically tailored for low-income contexts.[40] Projects range from solar-powered cold storage for agricultural markets in Nigeria to decentralized green ammonia production for fertilizer in Bangladesh, covering solutions that require adaptation and testing in very different market conditions than counterparts in developed markets.

[37] Power Technology, "Could depleted oil wells be the next step in energy storage?", November 2016, https://www.power-technology.com/features/featurecould-depleted-oil-wells-be-the-next-step-in-energy-storage-5680002
[38] Interview with Sarah Kearney, executive director at Prime Coalition.
[39] Interview with Maryam Golnaraghi, director of climate change and environment at Geneva Association. Source: The Geneva Association, "CLIMATE TECH FOR INDUSTRIAL DECARBONISATION: What role for insurers?", January 2024, https://www.genevaassociation.org/sites/default/files/2024-01/climate_tech_full_report.pdf
[40] See: https://ayrtonfund.info/clean-energy-innovation-facility-ceif/

Conclusion and recommendations

Accelerating the deployment of clean energy technologies is key to public policy priorities like mitigating climate change, promoting industrial competitiveness and national security, and safeguarding energy security. But when it comes to mobilizing private sector capital at the necessary speed and scale to achieve these goals, the energy transition is driven by attractive risk-adjusted returns.

Political and private sector leaders must therefore align capital deployment with both financial returns and strategic or public imperatives. This report, based on a survey of 300 investor leaders across North America, Europe, the Middle East and Asia-Pacific, highlights key takeaways and next steps for catalyzing clean energy investment efficiently and sustainably.

Recommendations for applying catalytic mechanisms

Match de-risking tools to risk type and market maturity. In developed markets, catalytic tools should generally focus on project-level risks (eg, long payback periods, market risk, permitting delays) using subordinated debt and blended finance to improve capital efficiency, and credit enhancements and permitting-stage guarantees to accelerate project timelines and reduce policy exposure. In EMDEs, tools should generally focus on mitigating external and macroeconomic risks, such as currency hedging facilities to address exchange rate risk; first-loss capital to absorb tail risks (such as political or liquidity); and credit guarantees to improve utility off-taker bankability in markets with weak state-owned enterprises.

Align catalytic tools with technology maturity. Different stages of technology development demand distinct forms of catalytic support. Technologies still in pilot or demonstration phases—such as green hydrogen, carbon capture and long-duration energy storage—require concessional financing to reach commercial viability. Support is particularly necessary to bridge the valley of death between R&D and deployment, where capital scarcity prevents promising innovations from scaling. Catalytic capital in the form of first-loss equity, concessional loans and public-private co-investment is most effective here. These mechanisms not only reduce financial risk, but also support learning-by-doing, cost curve improvements and performance validation—building the confidence that commercial investors need to enter. Tools should be tailored to the maturity of both the technology and the market into which it is being introduced.

Build flexibility into long-term revenue contracts. PPAs and CfDs reduce investor risk, but only if they are responsive to inflation and market changes that impact cost and revenue. Indexed pricing and demand guarantees help avoid cancellation or stranded projects, and mitigate difficulties like those faced by the US and UK offshore wind sectors in 2023.

Prioritize catalytic capital for transmission and grid infrastructure. Clean energy deployment increasingly depends on large-scale, enabling infrastructure (such as transmission networks, grid-scale storage and carbon transport systems) that falls between traditional public infrastructure and purely commercial projects. These assets are often technically proven but face high upfront capital costs, regulatory bottlenecks and revenue uncertainties that make private financing difficult. Catalytic tools for grid investments must address both financial risk and structural challenges such as slow permitting, fragmented oversight and the lack of bankable offtakers. But these investments are particularly valuable since they can leverage the value of other clean energy technologies, by increasing grid flexibility and improving utilization rates of generation assets.

Recommendations for investors

Support capacity building across the start-up ecosystem. In places like Silicon Valley, many clean energy start-ups are led by scientists who lack the business expertise needed to commercialize innovations. Their culture, built around rapid experimentation and iteration, differs from the discipline required to deploy new technologies at scale. This disconnect often hinders cost control, investor engagement and strategic planning. Accordingly, philanthropic institutions, international financial institutions and corporations can provide catalytic support by connecting start-ups with experienced advisors and financial consultants to strengthen their commercialization capacity.

Collaborate with public entities to scale first-of-a-kind projects. Because only a small share of emerging technologies ultimately succeed, investors need better signals to guide capital allocation. Partnering with public-private platforms that conduct rigorous due diligence can offer valuable insights (eg, the DoE's ARPA-E program and the EU Horizon Fund). Engaging insurers early in the process can also help innovators to develop tailored risk mitigation strategies and insurance products, enhancing the commercialisation and deployment of new technologies.

Recommendations for policymakers

Strengthen policy certainty to reduce investor risk. Most survey respondents (57%) cited policy and regulatory risks as a critical non-financial risk, more than any other risk. Governments can reduce investor risk by ensuring that carbon pricing, industrial policy and investment incentives are aligned with long-term transition goals. Embedding clean energy targets and incentives into law or establishing independent regulatory bodies can provide needed predictability.

Reform grid interconnection and transmission planning policies to accelerate deployment. Governments should set permitting time limits, prioritize shovel-ready generation projects and co-ordinate proactive grid planning to enable rapid interconnection of such resources. In Chile, reforms that aligned generation and transmission planning accelerated grid buildout and reduced interconnection delays.[41] Grid-enhancing technologies and transmission upgrades are also key to incorporating new generation in the near-term. Catalytic finance can de-risk transmission technologies during the early stages of commercialization, particularly in emerging markets.

[41] ReGlobal, "Chile's Net-Zero Plans: Focus on RES, transmission and storage systems", December 2023, https://reglobal.org/chiles-net-zero-plans-focus-on-res-transmission-and-storage-systems/

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