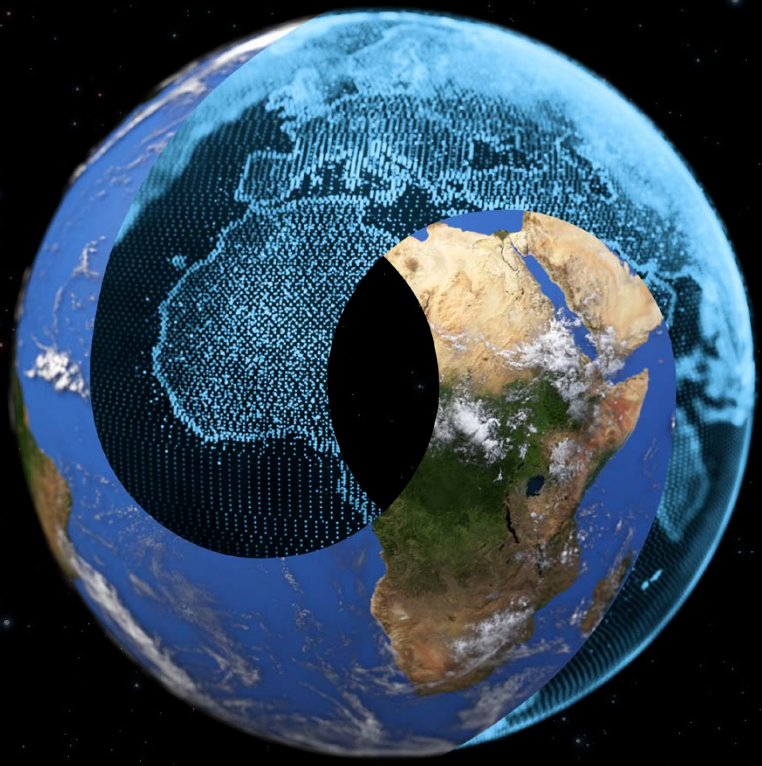
Deloitte.

May 2024



Financing the Green Energy Transition

Innovative financing for a just transition

Extended summary

Reaching net-zero greenhouse gas (GHG) emissions globally by 2050 requires a fundamental transformation of society from the current fossil fuel-centric model to a highly renewable and electrified energy system. To successfully propel the green energy transition at speed and scale, it is essential to focus on financing and improving the bankability of key technologies. This question of bankability, though, tends to be inherently complex given the relative uncertainty that surrounds new green technologies and investments, the need for innovative financing mechanisms across differentiated products and markets, and the need to address the geoeconomic challenges of the abundance of green resources in comparatively more risky jurisdictions. This latter challenge is core to both addressing the equitable aspects of a just transition and helping drive the most efficient and cost-effective transition for both developed and developing economies.

The energy transition is an unprecedented challenge, which **could cost up to US$200 trillion** if the financing of the necessary investments is not improved.[1] Reaching climate neutrality in the global energy sector will require investing in clean electricity (chiefly solar photovoltaic [PV] and wind farms), electrolyzers for renewable hydrogen production, energy storage (e.g., batteries), bioenergy, electrification of end uses, and energy efficiency improvements.[1] These solutions are generally perceived as riskier than their fossil counterparts because they are often highly capital-intensive, more disruptive, in some cases costlier or their respective markets are missing.[2]

While key risks and de-risking mechanisms through climate finance have been assessed and identified previously, the parameters influencing the costs of debt and equity of green projects and the relationships between those and other factors, such as financing structures, are often not fully understood. Furthermore, the current project finance environment fails to internalize the climate benefits of green projects and the negative externalities of fossil-based assets, another reason for the disproportionate risk perception of investors and lenders regarding green investments. Therefore, on top of de-risking, the challenges related to the current project finance ecosystem should be assessed to not only help reduce the perceived risk of green investments, but also create the grounds for an efficient and affordable energy transition.

This new report builds on earlier analysis, Deloitte's 2023 *Financing the Green Energy Transition – A US$50 trillion catch*,[1] which outlines the state of play of the energy transition and its financing, key barriers to investments in green projects, and potential instruments to help leapfrog those barriers and make those projects bankable. This report canvasses these challenges with the objective to provide the theoretical foundations for a new concrete set of public-private measures which can unlock capital and help drive economic growth and development, consistent with United Nation's Sustainable Development Goals (SDGs) and the reshaping of the global project finance architecture. The report helps to demonstrate how we can collectively reduce the cost of capital by mobilizing de-risking instruments and innovative financing mechanisms, making the green transition possible and affordable, that **could save US$50 trillion globally through 2050**.

Deloitte's extensive analysis is based on detailed cost of capital modeling with a technology- and geography-specific lens covering a wide range of instruments and levers to help reduce costs and enhance the bankability of green projects. It also goes beyond the assessment of different de-risking instruments and their combined effects, and underlines the implementation challenges associated with them. Using a holistic approach, this report provides practical solutions and recommendations, and calls for a new project finance ecosystem for green projects that focuses on the aspects of enhanced aggregation capabilities, ease in transfer of ownership, and integration of the environmental and social benefits of green projects. These solutions can lead to reduced costs, even for projects already under construction or operational, and ultimately lower the financial and economic burden of the green energy transition, helping accelerate a smooth and equitable path to net zero.

The current project finance environment fails to internalize the climate benefits of green projects and the negative externalities of fossil-based assets, another reason for the disproportionate risk perception.

The current state of green finance

Need for a finance ecosystem to support the growth of green markets

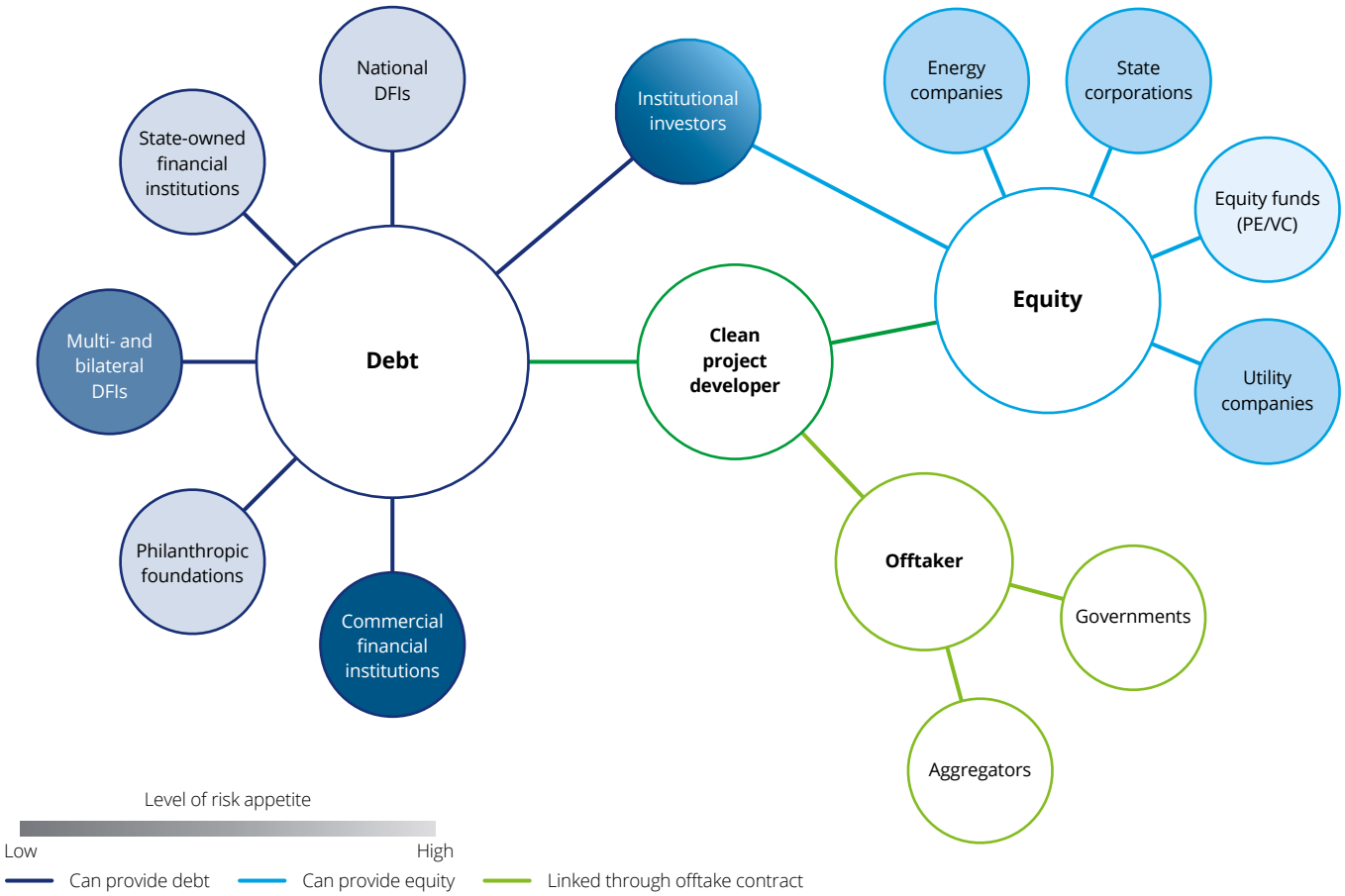
The green finance ecosystem is made up of a constellation of different actors that interact together and face different objectives and constraints. These actors can be broadly categorized as project developers, offtakers and debt and equity providers (Figure 1). Today, public institutions are the driving force of climate finance, accounting for about 50% of all investments in green energy around the globe in 2021 and 2022.[3] In contrast, despite hopes that they would lead climate finance, institutional investors added up to less than 1% of global climate investments during the years 2021 and 2022.[3]

The current project finance ecosystem is missing four elements that could help facilitate investments in the green energy transition:

- **Enhanced aggregation capabilities** to facilitate the aggregation of investors and help overcome lending or investing constraints.
- **Transfer mechanisms** that can provide a more fluid transfer of ownership and help maximize the benefit of an ecosystem of players with different risk appetites.
- **Investment leadership** to help decrease private capital providers' risk perception through reputable institutions like multilateral development finance institutions (DFIs) making visible investments or loans to the project.
- **Climate dimension** that accounts for the environmental and social benefits (including health impacts of reduced pollution) of green projects and the social costs and climate risks of fossil fuels to help close the gap between the two strands of technologies.

These four elements are needed to centralize assessments, decision-making and information gathering in relation to existing concessional loans, funds and grants, thereby enhancing the fluidity of investments into the green energy transition.

Figure 1. A broad view of a clean project finance ecosystem with key actors and their action levers



Source: Deloitte analysis based on Climate Policy Initiative (2023)[3] and Mazzucato and Semienuk (2018)[4]

Risks impacting the cost of financing

The risks associated with green investments can be categorized as **macro, market, technical and financial risks**, each with specific cost impacts.[5,6]

- **Macro risks** encompass political and regulatory risks, which stem from a lack of political visibility and stability, incomplete or inadequate regulatory frameworks, or poor administrative procedures, as well as currency risks.[7] They account for 45% to 90% of the cost of capital of current renewable energy projects.[8]
- **Market risks** consist of commercial and economic risks such as revenue, liquidity, missing market, commercial track record and economic competitiveness risks. While most new projects in developing economies sign offtake agreements to reduce these risks,[9] market risk premiums still account for up to 20% of the cost of capital of the green energy projects today.[8]
- Underperformance, missing infrastructure, construction delays and cost overrun risks make up the **technical risks** category. Their induced risk premiums depend significantly on technological maturity, and thus vary across geographies and technologies.[10]
- Finally, **financial risks** encompass the risks that make it difficult for projects to access capital. These risks mainly stem from the limitations of the current project finance environment and of underdeveloped capital markets.[11]

The risks associated with investments directly increase their cost of capital, which in turn can raise the cost of the energy transition. The risks of nascent markets and technologies due to a lack of experience and commercial track record tend to be too high for private entities to bear. Thus, transferring risks to risk-absorbing public entities is a vital step to help secure the rollout of green technologies. Such cooperation, notably between public and private actors (including international and multilateral organizations) falls under the umbrella of so-called blended finance mechanisms that address residual risks and thereby help facilitate the flow of private capital into green projects.[12]

Catalyzing change through innovative financing

Driving down financing costs through an efficient and timely combination of de-risking instruments

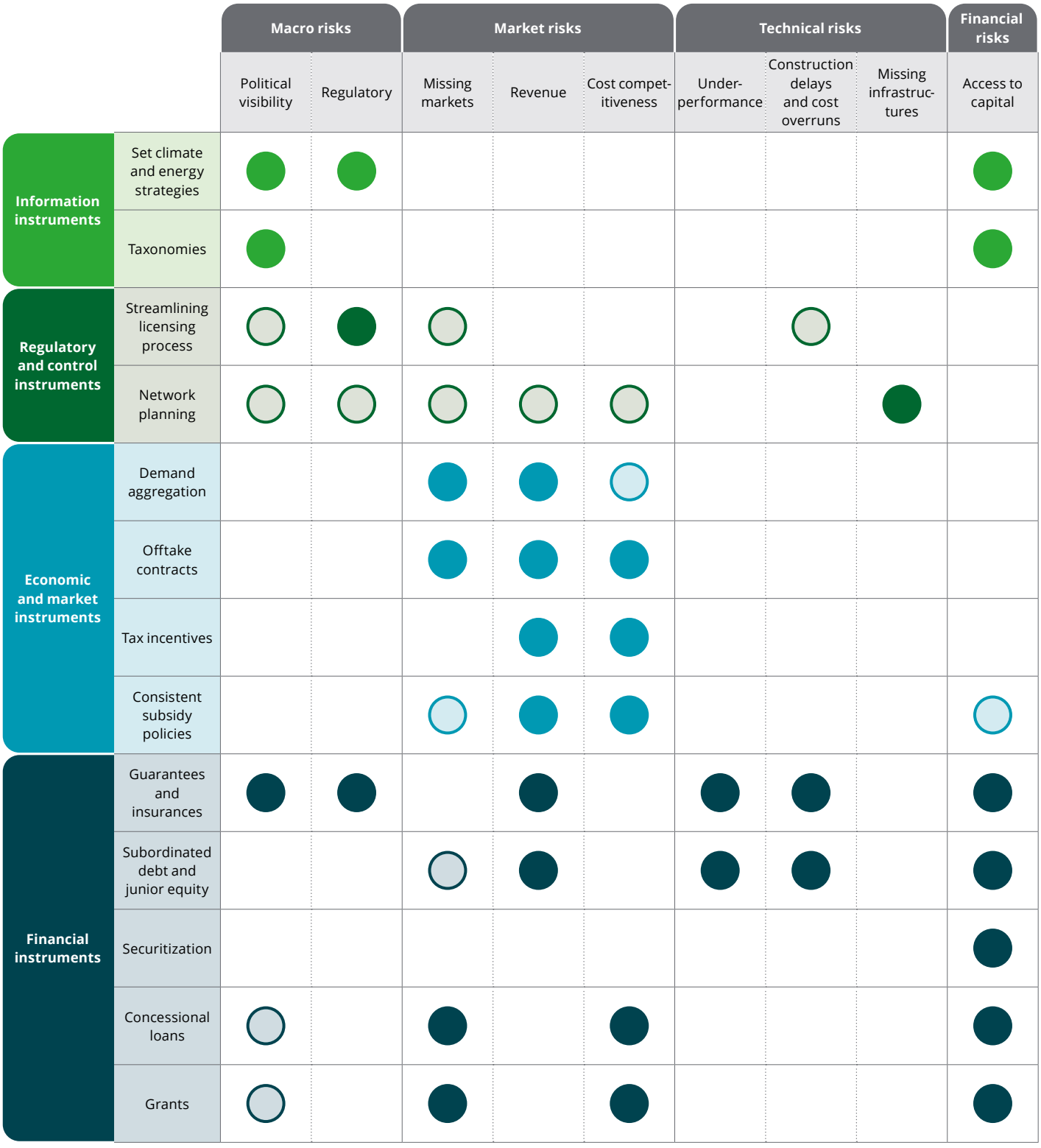
While the risks are broad and complex, the range and scale of mitigation tools is generally extensive, and have the benefit of addressing many of the critical pain points for stakeholders. Systemic de-risking instruments like information, regulatory, institutional, and economic instruments, deal with market information asymmetries, regulatory framework, and market signal adjustments. While these risk-mitigating instruments can drastically reduce systemic risks, project- and market-specific instruments, notably risk-transfer instruments, are needed to help manage any residual risk. These are mainly financial instruments relying on the cooperation between risk-averse capital providers (often private) and entities capable of bearing higher risks (public).

Blended finance is seen as a promising strategy to help address residual risks and thereby facilitate the flow of private capital into the clean transition. Concessional loans, grants, securitization, and different mezzanine instruments are some of the key blended finance mechanisms that employ concessional capital and risk transfer to reduce the risk perception of private lenders and investors.[12]

De-risking tools, including financial instruments, have a certain level of risk-specificity (Figure 2). Therefore, the nature of the residual components should be considered on a project-level basis to help ensure the effectiveness of de-risking measures.

Blended finance is seen as a promising strategy to help address residual risks and thereby facilitate the flow of private capital into the clean transition.

Figure 2. Tools to help de-risk the investments in green and sustainable energy projects



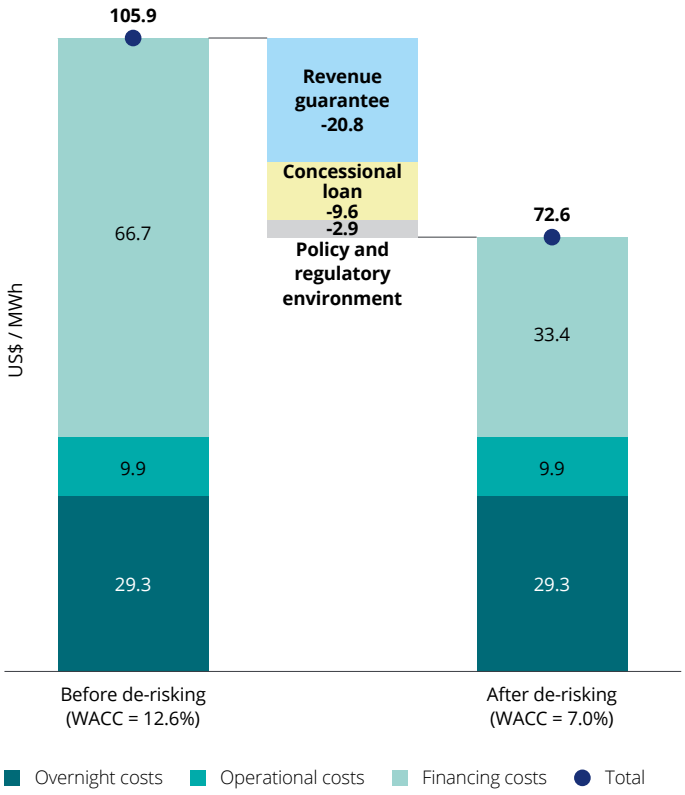
Source: Deloitte analysis based on Deloitte (2023),[1] Blended Finance Taskforce (2018)[5] and Green Climate Fund (2021)[13]

To help gauge the effect of de-risking instruments, specific cases provide clarity on savings as well as motivation for action. As an illustrative example, in Indonesia the cost of capital for a utility-scale solar PV project is estimated to be 12.6% on average.[8] This yields a levelized cost of electricity (LCOE) of US$106/MWh.[14] Offtake contracts and adequate policy and regulatory frameworks can decrease the cost of capital by as much as 3.5 and 0.5 percentage points respectively. Concessional loans can reduce it by an additional 1.7 percentage points, resulting in a final de-risked project cost of capital of 7%. This brings the LCOE of the project down to US$73/MWh (Figure 3).

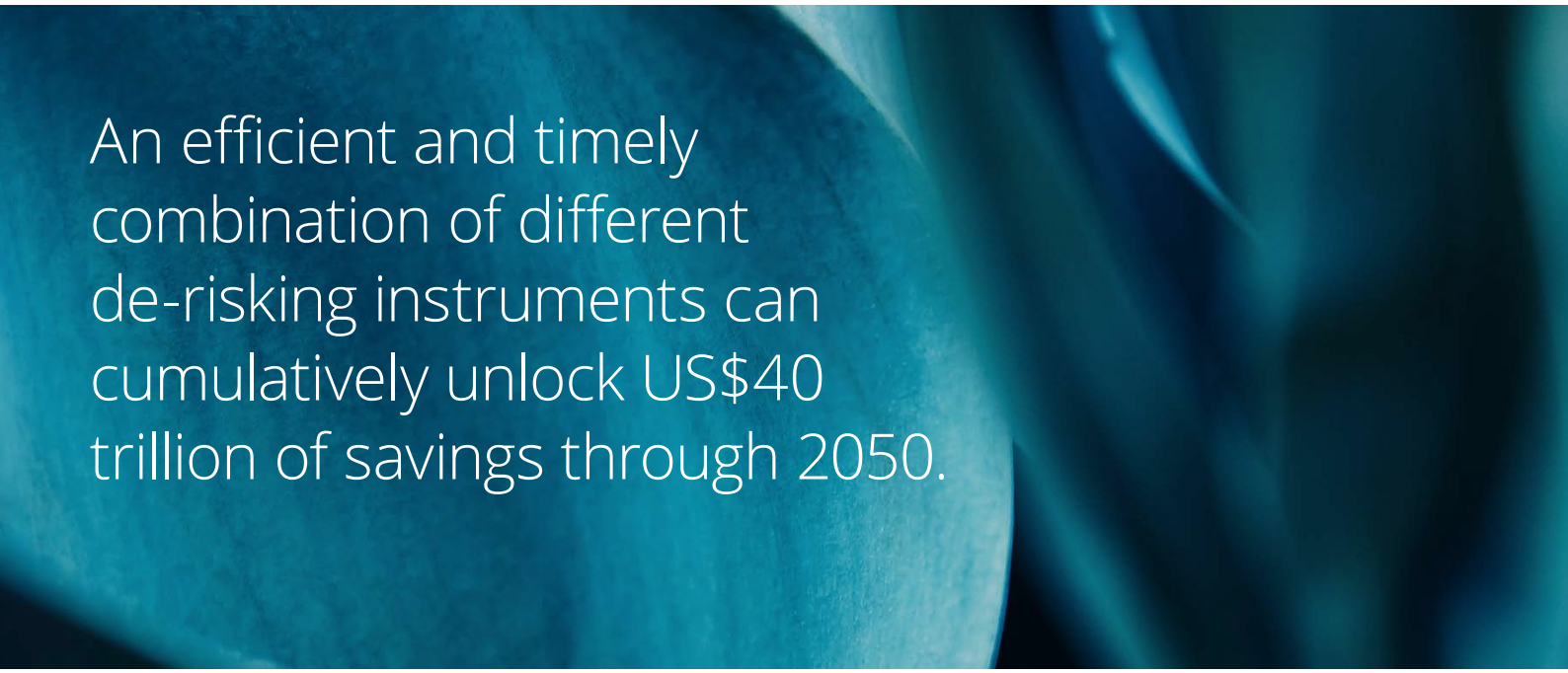
For the case of less mature technologies the cost cutting can be even more impressive. Take green hydrogen in Namibia as an example. High political risks, financial instability, missing markets, and low green premiums add up a 14.4% cost of capital, which induces financing costs as high as 60% of the levelized cost of hydrogen production (LCOH).[8] Once de-risking instruments are applied, the impact can be substantive. Revenue, performance, and political risk guarantee can slash the LCOH by 37%. Political risk guarantees can prove to be one of the most effective de-risking instrument, achieving cost of capital reductions of up to 14 percentage points.

Each of the different instruments can vary in effectiveness, cost efficiency, and timeliness. As the previous examples illustrate, systemic de-risking is more effective in developing countries where policy, market and capacity barriers are greater. Regardless of country or technology, the relevance of instruments changes over time and no single instrument is the silver bullet. The objective is to combine the right instruments to help deliver a maximum effect. An efficient and timely combination of different de-risking instruments can cumulatively unlock US$40 trillion of savings through 2050.

Figure 3. The impact of de-risking instruments on the levelized cost of solar power production in Indonesia (illustrative example)



Source: Deloitte analysis based on cost of capital calculated in Appendix 2 and the LCOE calculation in Appendix 3 of the main report[15]



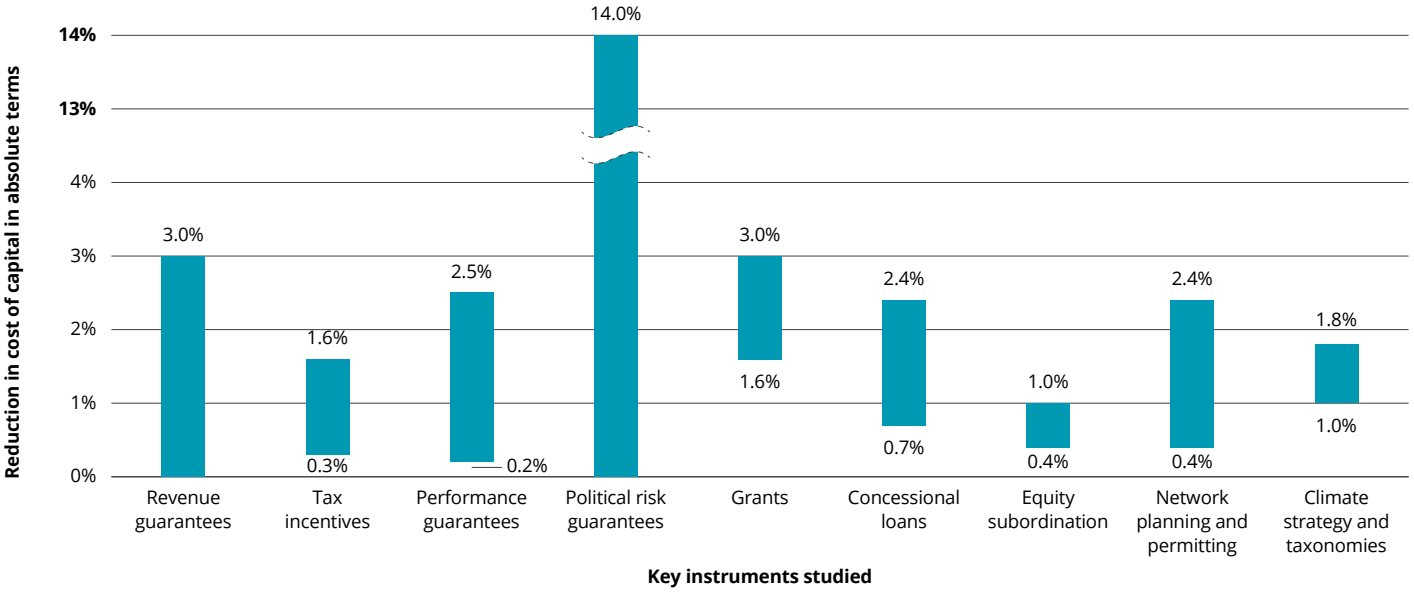
Effectiveness of available instruments

Effectiveness is measured based on the reduction in cost of capital. Depending on the project, geography and maturity of the considered market, the effectiveness varies (Figure 4). Political risk guarantees can be the most or the least effective instruments depending on the geography. Grants and revenue guarantees are some of the other highly effective instruments, which can reduce the cost of capital by around 3 percentage points.[8]

Cost-efficiency of instruments

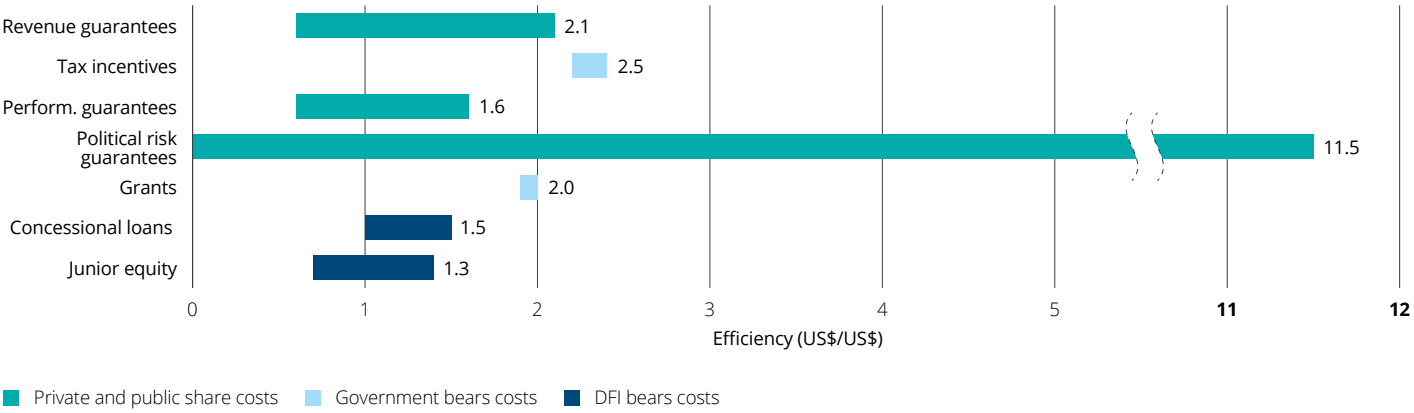
Effectiveness is a useful metric but is not enough, as these instruments also come with a cost to society,[7] creating the need to also consider cost efficiency. The cost efficiency is calculated by dividing the difference in the net present value (NPV) of the project by the public cost of the considered instrument. The political risks vary, while we can see in Figure 5 that guarantee mechanisms are generally the most efficient instruments in developing economies, their efficiency reduces drastically as we move to developed economies. The most efficient and effective tools are grants, but they are also among the most expensive ones, together with tax incentives and premiums.

Figure 4. Effectiveness range of key de-risking tools on the cost of capital



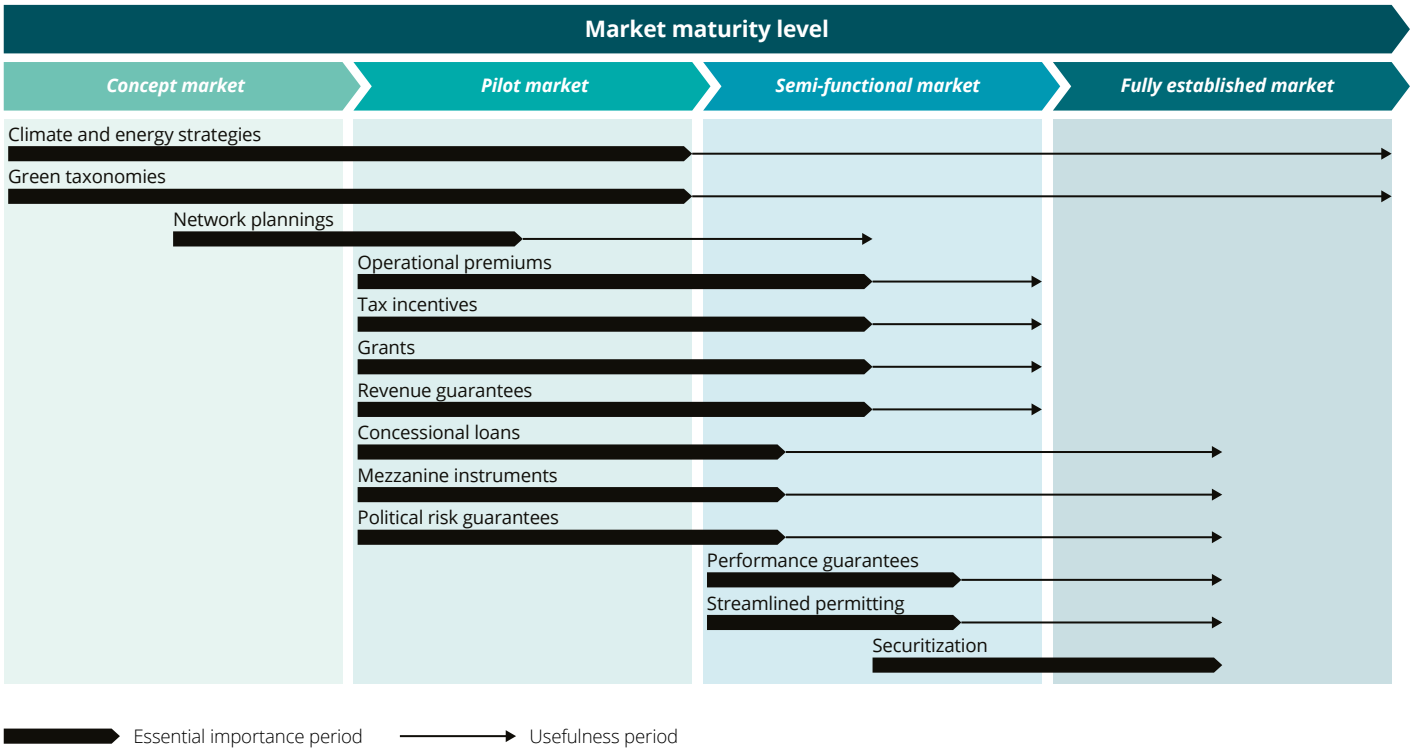
Source: Deloitte analysis based on the calculation of cost of capital in Appendix 2 of the main report[8]

Figure 5. Efficiency range of instruments



Source: Deloitte analysis based on Appendix 4 and the calculation of cost of capital in Appendix 2 of the main report.[15]
Note: An efficiency below 1 means that the instrument is not well suited for the specific case, meaning that the public cost of the project is more than the NPV gains of it. This can happen for instruments applied to mature markets (mostly in developed countries).

Figure 6. Illustrative timeline of use of instruments to support market scale-up



Source: Deloitte analysis based on the feature of each of the instruments defined in Section 3.1 of the main report.[15]

Timeliness of instruments to help support market scale-up
Instruments vary in usefulness across different market maturity levels and stages of technology development. While climate strategies and different information instruments are generally useful in a conceptual market stage, for relatively mature markets, they may not have a specific impact. Similarly, for new technologies and renewable energies, like green hydrogen, network planning is crucial but once the considered commodity becomes a mainstream commodity, with a semi-functional market, the most useful instruments are financial instruments such as blended finance mechanisms and guarantees.

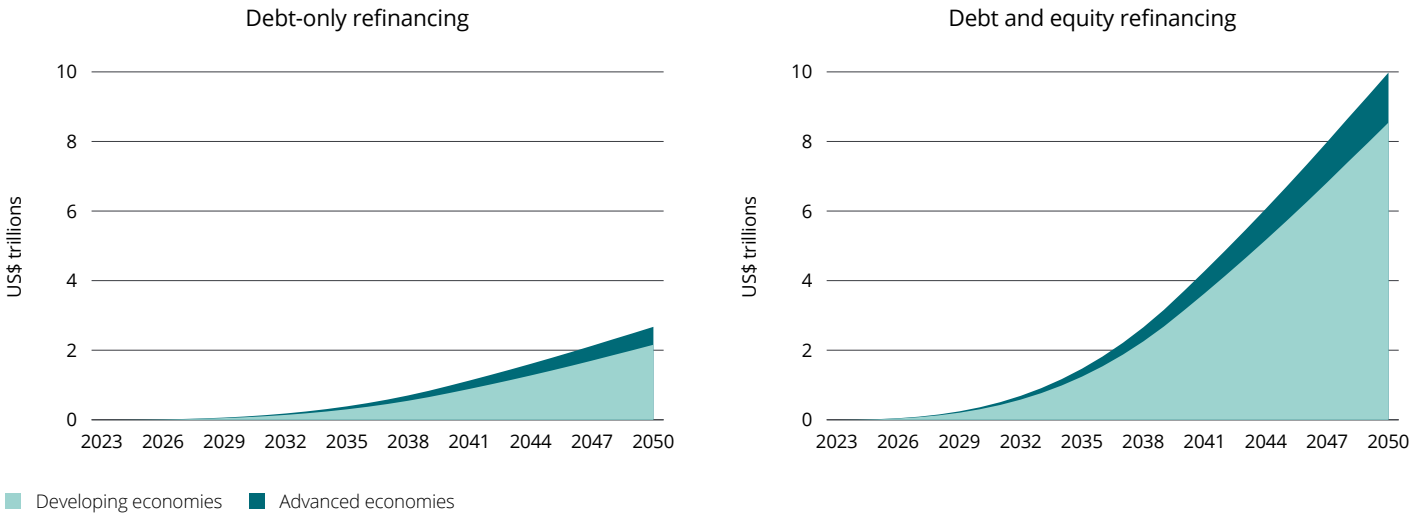
An efficient combination of de-risking instruments in a timely manner can bring up to US$40 trillion of cost savings over the transition period, accounting for 80% of the US$50-trillion cost reduction as highlighted in Deloitte's 2023 *Financing the Green Energy Transition – A US$50 trillion catch* report.[1]

Driving down costs through learning

Technological learning can reduce the upfront investment costs of projects as progress towards maturity contributes significantly to cost savings through economies of scale.[16] Green technologies, particularly renewables and batteries, have experienced significant cost reductions in the last decades thanks to the combined effects of learning-by-doing and economies of scale. Solar power plants and wind farms have seen upfront costs fall by 80% and 40% globally since 2010,[17] and this trend is expected to continue through 2050. This can lead to significant savings; for instance, only considering investment in solar power plants, learning-by-doing can lower upfront costs by US$5 trillion through 2050.[18] On top of decreasing capital spending, these cost reductions can help make green energy projects across the world bankable.

Another form of learning effect, i.e., financial learning, stems from the reduction in the cost of capital through investors and lenders improving their risk perception of green projects as markets and regulatory environments mature. It will be critical to help reduce the cost of the transition. The costs of capital for onshore wind and solar PV installations in Germany have, on average, decreased by more than 4 percentage points between 2005 and 2017, mainly due to financial learning.[19] Financial learning can not only reduce the cost of capital for new projects, but also for previously realized investments through refinancing: the cost of debt and equity can be reviewed each year and modified based on the market rates for new projects. Unlocking the maximal potential of financial learning through refinancing would require a flexible project finance environment with facilitated ownership transfer mechanisms, that can reduce the cost of the energy transition by about US$10 trillion through 2050.

Figure 7. Cumulative cost saving potential of refinancing (debt refinancing only, and debt and equity refinancing)

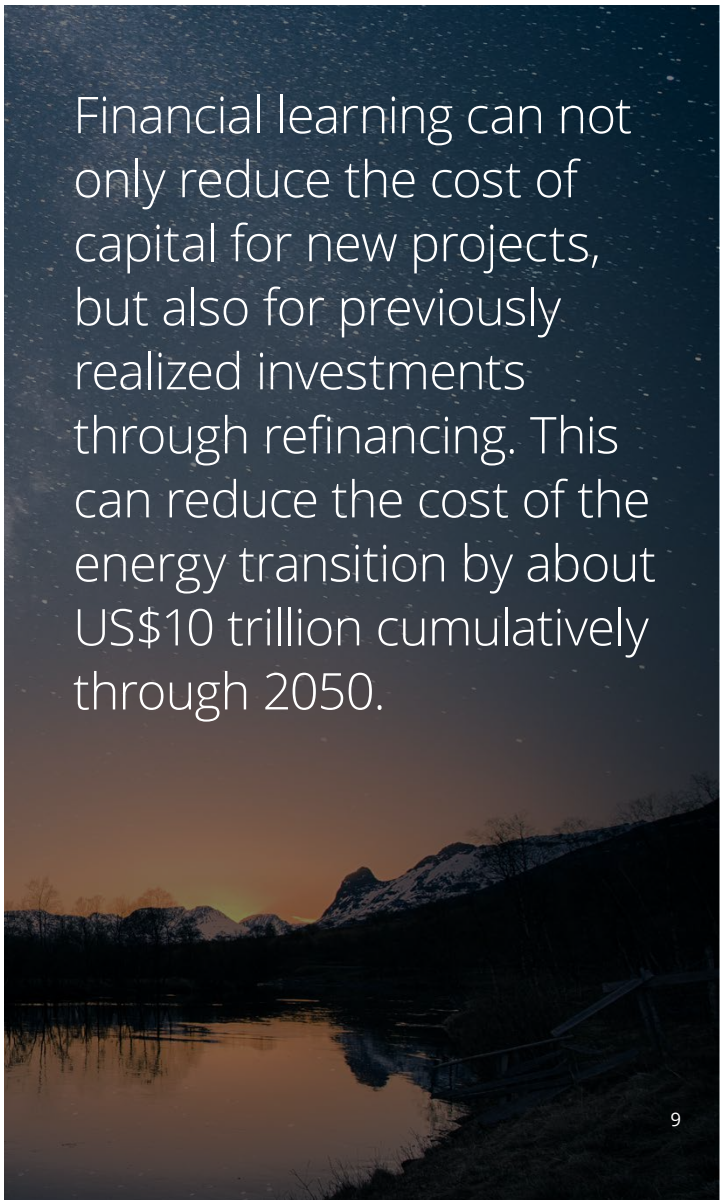


Source: Deloitte analysis[20]

Adding the US$10 trillion savings from refinancing to the US$40 trillion cost reductions from the efficient and timely activation of de-risking instruments, **the needed cumulative investments in the energy transition can decrease by 25%, or US$50 trillion, through 2050.**

Success depends on how quickly and efficiently the current project finance ecosystem can be redesigned to make sure the required financing conditions for green energy projects are met. First and foremost, the current project finance environment fails to include climate and environmental externalities, not only from an economic perspective, but also concerning risk-induced financial costs. Therefore, it should be included in financial evaluations to help ensure the risks associated with green energy technologies are not overestimated. Additionally, the current project finance ecosystem should facilitate the aggregation of investors and lenders and include ownership transfer mechanisms to leave no potential investor and lender behind, and to help enable a smooth and affordable energy transition. Given the need to make the most out of limited concessional capital, these elements reflect a missing piece in the project finance ecosystem which could manage the funds, centralize assessments and decision-making, and enhance the fluidity of investments in the green projects.

The window to help bring the world on course for net-zero targets for an affordable and just energy transition is closing fast. Policymakers, investors and lenders, DFIs and international organizations should work together to help reshape the current project finance environment into a **functional green finance ecosystem that can incorporate the climate impact of investments and enables refinancing.**



Recommendations: Guiding the green transition

Making the green energy transition affordable will require activation—obtained by the early de-risking of pioneer projects—and momentum—sustained by the reinforcement of learning potential and reshaped project finance ecosystem. To help open and channel the flow of capital towards green projects, especially in developing economies today, **investors and lenders** should:

- **Incorporate the green energy transition in their capital provision strategies.** Institutional investors made up less than 1% of global climate investments in 2021-2022.[3] More than ever, there are profits to make on green energy projects and losses to incur on fossil assets. The US$150 trillion to US$200 trillion of investments required to sustain the transition to net-zero call on capital providers to prioritize green finance in their investment strategies.
- **Adapt to the new ways of assessing and quantifying green energy and fossil-based projects.** The current misestimation of climate impact, costs and the risks of green and fossil projects blurs their real value. Indeed, the European Central Bank (ECB) has estimated that 60% of European banks currently fail to fully assess their exposure to climate risks.[21] In concrete terms, this is a call for investors and lenders to incorporate climate impact and risks into their assessment methodologies.

Managing systemic risks such as currency, regulatory or political risks paves the way for **policymakers** to ignite the transition and maintain its momentum, specifically by:

- **Creating the low-risk environment necessary for large-scale green projects to come online.** A low-risk environment is vital to help reduce financial costs by lowering risks, and to secure many of the checklist items without which projects do not get approved. This essentially calls for a mix of carefully crafted energy and climate strategies, taxonomies, and vetting procedures.
- **Setting up adequate instruments to support the first waves of green energy projects.** These projects are currently not viable without a mix of de-risking and risk-transfer instruments to help reduce the cost of capital and other critical cost items. Some direct support instruments like grants or tax credits can increase project added value by more than US$2 for each US$1 of public money spent. The deployment of de-risking instruments can save up to US$40 trillion in the cost of the transition through 2050. Equally, the gradual phase out of instruments as projects evolve toward a self-sufficient market will help save crucial public funds.

For **development finance institutions** in particular, the challenge will be to make the most out of limited concessional finance, which will require:

- **Learning to tailor blended finance instruments to specific contexts and projects.** The cost-efficiency, effectiveness, and indirect effects of financial instrument combinations vary with the location, technology, and maturity level of the underlying markets. This implies increasing DFIs' analytical depth, going beyond single pilot project realization perspective, and synchronizing their actions with market maturity and growth. If successful, the optimal deployment of de-risking instruments can reduce the cost of green energy by up to 35% in many typical cases.
- **Enabling refinancing to help unlock additional cost savings and foster the shift to brownfield investments.** This would both reduce the cost of the transition and help accelerate it by making capital transfers across different investor profiles faster. To enable refinancing, DFIs should adapt their investment models from "originate to hold" toward "originate to sell or share."

Together, **policymakers** and **development finance institutions** should aim to reduce the cost of the transition by:

- **Activating and maintaining techno-economic learning to cut upfront costs.** Continuous support and investment in green technologies can help reduce costs and exposure to supply chain risks, such as those linked to raw materials markets. Thanks to the learning-by-doing effect, the upfront cost of solar panels experienced a tenfold cost reduction in ten years (from 2009 to 2019),[22] and this trend is set to continue toward 2050. By setting a low-risk environment with adequate de-risking instruments, policymakers and DFIs can enable market players to build their first pilot projects and see subsequent waves of ever-larger projects reduce their costs as developers gain experience.
- **Unlocking the full potential of financial learning to help reduce the cost of capital.** The capital intensiveness of green projects calls for the activation of financial learning. In practice, financial learning has already proven its success, being the main factor lowering the cost of capital of renewables by more than 4 percentage points since 2010 in advanced renewable markets. Unlocking further financial learning will require a flexible project finance environment where project ownership transfer and refinancing are enabled by default. This can accelerate the creation of a commercial track record for new green technologies and help bring in a larger spectrum of investors and lenders. By enabling refinancing, policymakers and DFIs can capitalize on financial learning effects to reduce the cost of the transition by another US$10 trillion through 2050.

At the global level, **international organizations** should help secure the geopolitical foundations for the transition, which calls on them to:

- **Develop the diplomatic and economic ties needed to help create a global energy transition.** The transition will be built on electrification, technologies like electrolyzers and solar panels, molecules like hydrogen or biofuels, skilled labor, international commercial and capital flows, and global knowledge sharing. Geopolitical constraints will largely shape the movement of these vital resources around the globe through 2050 and international organizations should lay the foundations for a win-win global free trade environment to help reduce the cost of the energy transition and foster economic development everywhere on the planet.[23]
- **Harmonize climate and energy political and regulatory frameworks around the globe.** Common rulesets are necessary to help enable the global trade of future clean energy technologies, needed raw materials and molecules. In scope are taxonomies, definitions, carbon pricing practices, and other instruments that should be harmonized to avoid carbon leakage or arbitrage opportunities. For instance, the economic health of the future US$1.4 trillion global green hydrogen market largely depends on the establishment of common rules and open trade routes for clean molecules. In a world where the trade of hydrogen is limited by tensions or legal disharmony, market costs for green hydrogen can increase by as much as 25% on average.[23]

After *Financing the Green Energy Transition – A US$50 trillion catch* report called on stakeholders to share knowledge, this report urges for profound change in the green energy finance ecosystem. Once redesigned, the project finance environment can effectively take into account the climate impacts of green and fossil-based projects, facilitate the flow of capital towards green projects and in turn, scale up green markets. This rehauled green finance ecosystem could centralize and standardize financial assessments, help facilitate transfer mechanisms, improve funding decision-making, and make use of the latest data analysis tools. This report delivers some of the steps, mechanisms and stakeholder solutions to help foster an affordable transition, and ultimately turn urgency into action.

Endnotes

1. Deloitte, "Financing the green energy transition – A US$50-trillion catch", November 2023.
2. International Energy Agency, "Energy Technology Perspectives 2023", January 2023.
3. Climate Policy Initiative, "Global Landscape of Climate Finance 2023", November 2023.
4. Mariana Mazucato and Gregor Semieniuk, "Financing renewable energy: Who is financing what and why it matters", Technological Forecasting and Social Change vol. 127, February 2018.
5. Blended Finance Taskforce, "Better Finance Better World", January 2018.
6. International Energy Agency, "Scaling up Private Finance for Clean Energy in Emerging and Developing Economies", June 2023.
7. United Nations Development Programme, "Derisking Renewable Energy Investment", April 2013.
8. Based on the cost of capital calculation explained in Appendix 2 of the main report (see Financing the Green Energy Transition – Innovative Financing for a Just Transition).
9. International Energy Agency, "Cost of Capital Observatory", September 2022.
10. International Energy Agency, "Renewables 2022", December 2022.
11. Hyejun Kim, Jaeyong Song, "Filling institutional voids in emerging economies: The impact of capital market development and business groups on M&A deal abandonment", *Journal of International Business Studies* Vol. 48, 2017.
12. International Development Finance Club, "Blended Finance: A Brief Overview", October 2019.
13. Green Climate Fund, "Scaling up climate finance in the context of Covid-19", 2021.
14. With a capacity factor of 15.9%, according to Global Solar Atlas in Indonesia. See other assumptions in Appendix 3 of the main report (see Financing the Green Energy Transition – Innovative financing for a just transition).
15. Deloitte, "Financing the green energy transition – Innovative financing for a just transition", May 2024.
16. Deloitte, "Transform to react: Climate policy in the new world order", June 2022.
17. International Renewable Energy Agency, "Renewable power generation costs in 2022", August 2023.
18. Deloitte analysis based on the data from Deloitte's 2023 "Financing the green energy transition – A US$50-trillion catch" report and IRENA's 2023 "Low-cost finance for the energy transition" study.
19. Florian Egli, Bjarne Steffen and Tobias S. Schmidt, "A dynamic analysis of financing conditions for renewable energy technologies", *Nature Energy* vol. 3, November 2018.
20. Deloitte calculation of the savings from refinancing based on the results of cost of capital calculation in the full report (see Financing the Green Energy Transition – Innovative financing for a just transition).
21. European Central Bank, "2022 climate risk stress test", July 2022.
22. Lazard, "2023 Levelized Cost of Energy +", 12 April 2023.
23. Deloitte, "Green hydrogen: Energizing the path to net zero – Deloitte's 2023 global green hydrogen outlook", June 2023.

Download the full report
for further insights

Authors

Prof. Dr. Bernhard Lorentz
Deloitte Center for Sustainable Progress Founding Chair
Managing Partner | Deloitte Germany
+49 1511 4881437
blorentz@deloitte.de

Dr. Johannes Trüby
Deloitte Economics Institute
Partner | Deloitte France
+33 1 55 61 62 11
jtruby@deloitte.fr

Dr. Pradeep Philip
Deloitte Economics Institute
Partner | Deloitte Australia
+61 416 214 760
pphilip@deloitte.com.au

Dr. Behrang Shirizadeh
Deloitte Economic Advisory
Manager | Deloitte France
+33 6 70 26 84 19
bshirizadeh@deloitte.fr

Clémence Lévêque
Deloitte Economic Advisory
Consultant | Deloitte France
+33 1 40 88 28 00
cleveque@deloitte.fr

Vincent Jacamon
Deloitte Economic Advisory
Consultant | Deloitte France
+33 1 40 88 28 00
vjacamon@deloitte.fr

Designed by CoRe Creative Services. RITM1712756