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De-Risking Green Supply Chains

A Policy Management Framework for a Bankable Energy Transition

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External trade uncertainty and internal pressure are forcing the EU to rethink its decarbonization strategy. The Green Deal needs a new implementation plan. The time is right: under Trump, the US is falling behind in renewable energies, while China remains in the crosshairs of American protectionism. To offer the world a credible alternative to fossil-fueled growth, the EU must abstain from regulatory micromanagement and treat decarbonization as a practical financing issue. Financing costs are the culmination of almost all obstacles to the green transformation. This cepInput analyses the challenges from investor perspective and develops proposals for a framework to manage political risk.

- In the current environment, decarbonization policies should primarily be understood as risk management policies. De-risking measures should target the non-diversifiable risks inherent in green investments relating to technology development, external policies, and the geography of supply chains. To avoid excessive public risk-taking, it is essential to balance instruments for short-term risk compensation with instruments for long-term risk reduction.
- Given the limitedness of domestic resources, de-risking activities should put particular emphasis on securing investments in resource access in third countries. To this end, the EU should expand its Global Gateway Initiative to include transparent market platforms and insurance mechanisms that protect investors against the risks of expropriation and political turmoil in developing countries.
- To support internal market development for infant green technologies, the EU and its Member States should partially compensate for revenue risks during the early commercialization stage, using tender-based Contracts for Difference as the standard tool.
- Long-term risk reduction should prioritize the removal of market barriers by supporting cross-border infrastructure cooperation and enhancing regulatory convergence, both inside and outside the EU.

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1 Background

The European Green Deal is at a crossroads. Rising opposition to the societal costs of decarbonization policies is putting regulators under increasing pressure. Uncertainty over the long-term regulatory path threatens to hinder the transformative investments necessary for success. In this situation, policymakers would be wise to refocus their attention on the Green Deal's core principle, recognizing the green transformation as a societal investment project. According to this approach, Green Deal policies should not stifle entrepreneurship by setting numerous sub-targets and micromanaging regulations, but should focus on bridging the gap between societal and investor returns on decarbonization projects.

In addition to using CO_2 pricing as a steering signal, regulators must address investment-specific risks that are difficult to hedge or diversify due to strong interdependencies (chicken-and-egg problems) or because they are shaped by factors outside the market sphere, such as regulatory risks and technical supply disruptions. Although the EU has recognized this issue and taken steps to monitor risks in areas such as critical raw materials and technologies, it still lacks a central framework that links risk monitoring across the supply chain with targeted policy tools.

Given the EU's ongoing reliance on external sources for raw materials and energy, managing external risks requires specific attention. For some of the EU's trading partners, the set of country-specific risks extends beyond technical and regulatory issues and touches fundamental questions such as political stability and the reliability of local institutions. Capital markets force investors to compensate for these risks by demanding higher average returns, thus inflating the cost of capital and raising the societal cost of the green transformation. Therefore, lowering these risks through targeted policy support is not a form of political patronage, but is central to ensuring the bankability of the green transformation.

A multi-faceted policy strategy is required to address the multitude of global and country-specific risks. At the highest level, it must distinguish carefully between risk-absorbing and risk-reducing measures. The former aim to reduce the risk burden on transformative investment projects by redistributing parts of the project's risks to public budgets or other segments of the economy. These measures are suitable for the short term and focus on managing existing risks, which take time to address. In contrast, risk-reducing measures aim to eliminate risks by addressing their root causes, including instruments for long-term economic cooperation and enhanced diplomatic engagement. They are essential for establishing competitive, self-sustaining business models and supply chain relations. An effective policy strategy should make complementary use of both risk-absorbing and risk-reducing tools to ensure a smooth transition from temporary risk management to long-term risk elimination.

This cepInput contributes to the current debate by making the case for a Green Deal strategy that is more risk-focused. First, it sheds light on the variety of relevant investment risks by proposing an own classification scheme. It then discusses the specifics of financing renewable energy projects and their impact on financing costs. Finally, it provides a structured overview of policy instruments for managing hard-to-diversify risks, and examines existing Green Deal policies against this benchmark. A case study on import projects for renewable hydrogen quantifies the effects of public risk absorption for hydrogen supply from different world regions, emphasizing the role of partner choice in supply chain risk management. Finally, it presents an own proposal for a multi-level risk management framework.

2 Classification of risks in green supply chains

In order to design de-risking policies for green supply chains, it is essential to have a clear understanding of the risks that threaten their functioning and stability, as well as the sources of these risks. One way to categorize the different types of risk is to distinguish between internal and external forms of risk within the supply chain. Risks inherent in integrating a green technology project into a supply chain include upstream supply and downstream sales risks. Upstream supply risks encompass the risk of price fluctuations or upward price trends in critical inputs, such as specialized raw materials or energy carriers needed for production. In some cases, they can also encompass physical supply risks if access to inputs is concentrated among a few unreliable suppliers. Given that many renewable energy technologies depend on hard-to-substitute raw materials, this risk poses a significant threat to the stability of green supply chains.[1] Downstream sales risks are influenced by uncertainty regarding the development of demand and market prices for green products. This type of risk is particularly significant for emerging green technologies (e.g. renewable hydrogen, CCS), where markets are still developing and the adoption of technology is uncertain.

Relevant risks that are external to the supply chains concern the infrastructure needed for transport and supply chain organization. Disruptions to physical transport infrastructure and a lack of efficient communication infrastructure can create bottlenecks or misallocations across supply chain stages, particularly when production processes are divided into numerous steps and/or spread across many different regions. Secondly, external risks also involve the potential environmental consequences of production and transport at local and global levels. In addition to greenhouse gas emissions, these can include dangers to local ecosystems and the living conditions of the local population. In particular, for many green technologies, the initial stage of raw material mining is prone to such risks, as evidenced by the invasive nature of current mining practices for minerals such as rare earth metals and lithium.[2] These, in turn, endanger public acceptance of projects and thus jeopardize the formation of new supply chains.

Effective management of these risks requires targeting their sources. Although risks are rarely monocausal and the causes tend to overlap, it is intuitive to separate them into the following categories: geographical, political-regulatory, market-related and technological. Geographical risk sources are the direct result of the geography of supply chains. These are physical supply chain disruptions caused by natural disasters or other natural disturbances, as well as uncertainty regarding future transport costs. Green supply chains tend to be heavily exposed to such risk sources because global centers of upstream production are located far from relevant downstream markets.[3] Political-regulatory sources include the disruptive effects of general political events like wars and internal conflicts. They also comprise unexpected changes to the regulatory frameworks of host countries with respect to policies on external trade, climate, competition, and technical standards. Recent trade policy turbulences and the fragile geopolitical climate have clearly documented the immense relevance of these influencing factors.

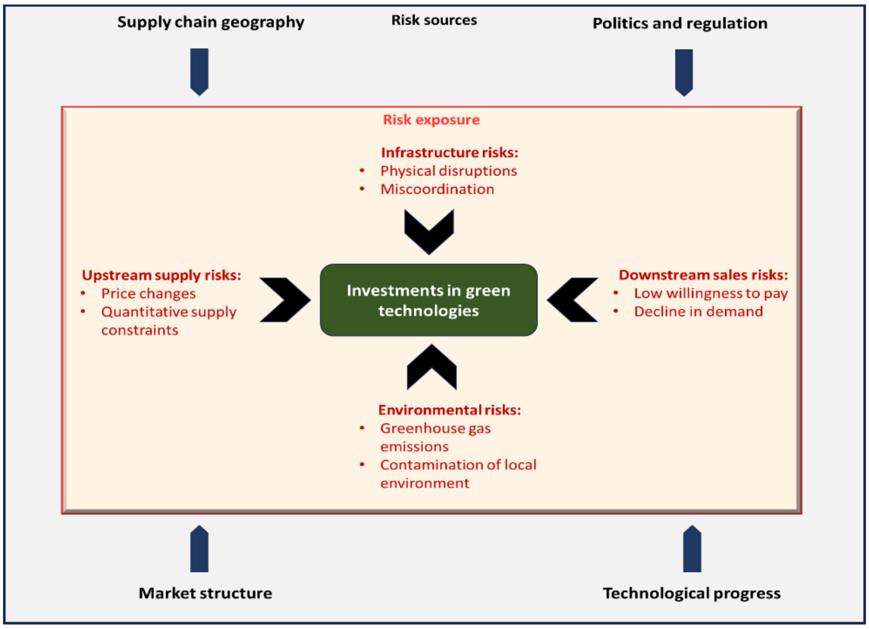
[1] Wolf, A. (2022). Europe's Position on Raw Materials of the Future. cepInput No.11/2022.

[2] Kaunda, R. B. (2020). Potential environmental impacts of lithium mining. Journal of energy & natural resources law, 38(3), 237-244.

[3] JRC (2023). Supply chain analysis and material demand forecast in strategic technologies and sectors in the EU – A foresight study. JRC Science for Policy Report. Joint Research Centre.

In contrast, market-related sources refer to the competitive structure of relevant markets. Firstly, supply concentration in upstream markets makes green investment projects vulnerable to strategic decision-making of dominant suppliers. Secondly, on the demand side, dominance by a few fossil-driven companies can slow down the adoption of green technology and threaten the ability to pass on transition costs. Finally, technological risk sources refer to the uncertainty of future technological progress in green technologies. Specifically, uncertainty over which technologies will prevail can lead to a wait-and-see approach by investors. Uncertainty on the extent of cost-reducing learning effects from adopting green technologies is a relevant concern as well.

Figure 1: Risk classification for green technology investments



Source: own illustration

By influencing the required risk premiums on interest, all of the risks contribute to raising the financing costs of investments in renewables, and thus the societal costs of decarbonization in general. A policy strategy for enabling a cost-minimal green transition should thus primarily focus on making green investments bankable. This can only work when accounting for the specificities of investing in green technologies, both in Europe and in partner countries worldwide.

3 Financing characteristics of green technology projects

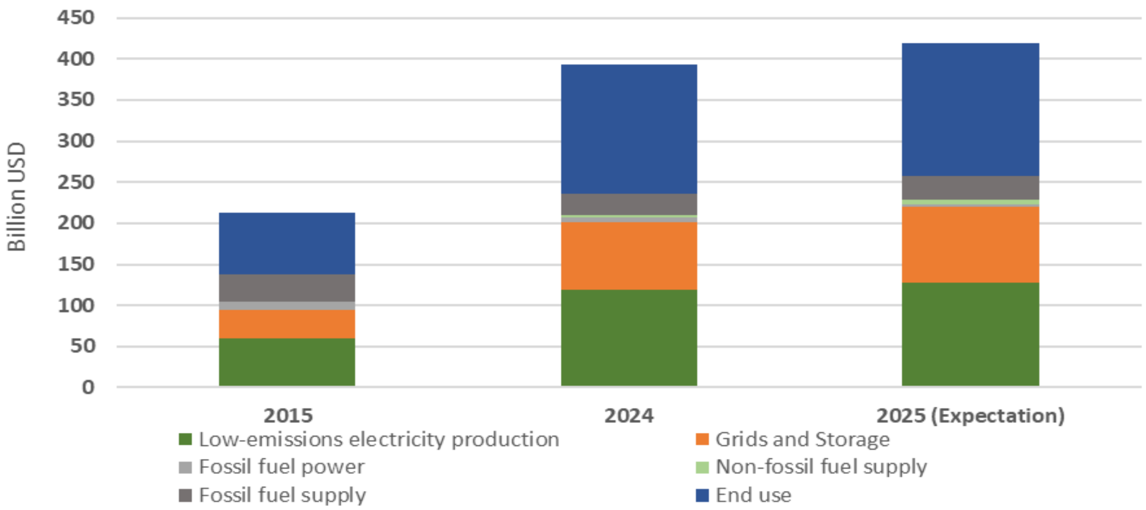
3.1 EU-internal

In recent years, the challenge of decarbonizing the EU's energy supply has sparked significant investment activity in Europe's energy system. The International Energy Agency (IEA) estimates that annual energy investments in the EU rose from 2015 to 2024 by 84%[4], by far exceeding total nominal GDP growth over this period (46%)[5]. This boom was coupled with a shift in investment targets (see Figure 2). While annual investment volumes in fossil fuels and power capacity shrank, investments in low-emission electricity production, in grid and storage infrastructure as well as in end use technologies by

4 IEA (2025). World Energy Investment 2025 – European Union. International Energy Agency.
5 Eurostat (2025). Gross domestic product at market prices.

industries and households more than doubled. This reflects the nature of the energy transition as a task requiring system-wide adaptation efforts. To achieve the 2030 climate goals, further massive investments will be needed in the upcoming years. The Commission estimates that an additional 477 billion EUR of green investment will be required each year[6], a value clearly above the IEA estimates for 2024 and their expectation for 2025. Unlocking the necessary sums will thus require a thorough analysis of existing investment barriers.

Figure 2: Composition of annual energy investments in the EU



Source: IEA (2025)

Traditionally, the discussion on promoting climate-friendly technologies has focused on total investment volumes as target variable. As a consequence, support policies were designed with a view of an anonymous investor in mind, who judges the costs and benefits of green investments independent from her overall portfolio and her individual financing restrictions. Such a policy design can only be maintained in times when marginal returns to investments in renewables are still high and framework conditions are stable. However, in the current stage of the energy transition, both conditions are no longer fulfilled. The most efficient geographical spots for renewable energy deployment are largely taken. Ongoing capacity growth intensifies competition among renewable installations on electricity markets, provoking cannibalization effects on market prices.[7] System constraints in the form of insufficient grid expansion and storage investments increasingly impede an efficient use of renewable capacities. On the demand side of renewables, unsteady and increasingly unpredictable conditions on global markets lower the willingness of industrial companies to engage in long-term decarbonization investments. This is aggravated by internal policy uncertainty in the EU, in particular concerning the long-term evolvement of the CO_2 price as a key parameter for the returns to green investments. Further technological progress could remedy these effects, but is itself partly dependent on the speed of future capacity growth (learning effects).

The worsening investment climate requires policymakers to adopt a more surgical approach. Rather than relying on one-size-fits-all instruments, the design of policies must be more precise in addressing

6 European Commission (2023). Investment needs assessment and funding availabilities to strengthen EU's Net-Zero technology manufacturing capacity. Commission Staff Working Document. SWD(2023) 68.

7 Peña, J. I., Rodriguez, R., & Mayoral, S. (2022). Cannibalization, depredation, and market remuneration of power plants. Energy Policy, 167, 113086.

investment- and investor-specific incentives and constraints. To achieve this, the focus should shift from the total amount of financing to the composition of investment flows by financial actors and area of investment. This begins with acknowledging that different types of investors have different risk preferences. Currently, the technological readiness level of renewable energy technologies varies considerably, ranging from well-established solutions such as PV-based electricity generation to areas of research such as carbon removal technologies that are still in their infancy.[8] In order to implement the green transformation at minimal societal cost, Europe must make use of the broadest possible portfolio of complementary technologies. This, in turn, requires policymakers to manage a wide range of risk profiles. Technological diversification presupposes diversification of investor groups, ensuring targeted financing solutions for technology-specific challenges.

Against this background, policy support to specific forms of financing and technologies (e.g. tax incentives for venture capital invested in carbon removal projects) might be a tempting solution. However, such a political micromanagement always runs the risk of provoking unintended technological lock-in, undermining the diversification goal. [9] A more fruitful approach would be to target the barriers that investment forms typically face, with the aim of creating a level playing field for financing options. Firstly, research literature on financing renewables suggests paying particular attention to the role of project finance. Project finance generally refers to financing solutions where the invested debt and equity are repaid based solely on the cash flows generated by the investment project. To this end, equity investors establish a joint project company whose assets serve as security for all financial claims. This means that project debt does not burden the balance sheets of the shareholding firms (it is off-balance sheet), thus avoiding the contamination of unrelated firm assets and reducing the risk of debt overhang. It also allows to integrate capital from both private and public sources, thus serving as a legal basis for Public-Private-Partnerships.[10] This form of financing is particularly attractive for long-term and large-scale investments which are hard to manage under the umbrella of corporate finance.

Given the long investment horizon and the high capital intensity of many renewable energy technologies, investors in this area are especially likely to resort to project finance. Moreover, the ability to jointly fund large projects with limited liability is a promising channel for new and small investors beyond the energy sector to enter the renewables business, thus contributing to institutional diversity.[11] Existing barriers primarily relate to project-specific risks. The fact that financial claims are exclusively covered by project-internal flows implies that project finance can carry significant long-term risk. In particular, it makes it highly sensitive to both market- and policy-related uncertainty. In the current environment, this represents a particular hurdle for renewable energy projects. For instance, in the absence of public support or private long-term contracts, expected cash flows from investments in green electricity projects face multiple sources of uncertainty regarding the long-term evolution of wholesale electricity prices in Europe, including future regulatory design, prices of imported energy carriers as well as capacity development in grids, storage systems and peak-load generation. Policies tackling this uncertainty should aim at strengthening perspectives for a long-term revenue base.

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8 IEA (2025). ETP Clean Energy Technology Guide. International Energy Agency.

9 Mazzucato, M., & Semieniuk, G. (2018). Financing renewable energy: Who is financing what and why it matters. Technological Forecasting and Social Change, 127, 8-22.

10 Kurniawan, F., Mudjanarko, S. W., & Ogunlana, S. (2015). Best practice for financial models of PPP projects. Procedia Engineering, 125, 124-132.

11 Steffen, B. (2018). The importance of project finance for renewable energy projects. Energy Economics, 69, 280-294.

Another potentially limiting factor for project finance are transaction costs. While project finance principally offers an opportunity to integrate a large number of small investors, providing a framework for acceptance-raising citizens participation[12], it also requires well-balanced contractual arrangements and the project-internal dissemination of expert knowledge on cash flow risks. Hence, besides energy and climate policies, a financial market environment is required that encourages cooperative financing models and secures the rights of minority investors.

Another concern of the financing literature is the incentive situation for different types of financial institutions in the EU. Due to their business model, the willingness of commercial banks to finance renewable energy projects is limited. Large parts of the resources of the banks consist of deposits, which are short- to medium-term. This causes an imbalance with the long-term financing needs of these projects.[13] Moreover, the lending restrictions imposed by the Basel capital requirements induce banks to refrain from engaging in risky renewables projects.[14] Therefore, steps are needed to unlock capital from other groups of private investors. In particular, non-banking financial institutions like pension funds and insurance companies are attractive due to the long-term focus of their investment strategies. Their large share of long-term capital induces them to prefer long-term investment projects as a vehicle to achieve asset-liability matching.[15] The large and stable asset base of these institutions can make an important difference when trying to reallocate the European capital stock to sustainability goals. Indeed, recent empirical research reveals a significant positive relationship between the level of green investments by pension funds/insurance companies and energy efficiency improvements in OECD countries.[16]

Nevertheless, the riskiness of green projects conducted in an uncertain long-term regulatory environment presents a particular obstacle for these institutional investors, given their obligation to provide payments at a regular basis and at a high degree of certainty. Besides, lack of project liquidity can be a specific issue as well, especially when investing in infant green technologies whose markets are only about to develop.[17] A further barrier is the need to invest in knowledge capital to make informed decisions on green investments. Renewables are assets whose risk-returns profiles are shaped by many idiosyncratic factors, both in the technological and regulatory realm. Entry costs in this investment segment are thus high, further limiting the willingness of investors to accept policy-induced revenue uncertainty.

Under these circumstances, targeted policy support can exert positive impulses through a variety of instruments. Direct investment or guarantees by public development banks act as a risk buffer for private investors, thus partly compensating the impact of regulatory risk. Financial support to renewables projects in the form of price mechanisms (e.g. feed-in tariffs, Contracts-for-Difference (CfDs)) directly targets revenue risks of investors. Moreover, by adjusting market rules and public procurement requirements in favor of green technologies, it can stabilize the revenue base through demand

12 Yildiz, Ö. (2014). Financing renewable energy infrastructures via financial citizen participation–The case of Germany. Renewable energy, 68, 677-685.

13 Taghizadeh-Hesary, F., & Yoshino, N. (2020). Sustainable solutions for green financing and investment in renewable energy projects. Energies, 13(4), 788.

14 Sachs, J. D., Woo, W. T., Yoshino, N., & Taghizadeh-Hesary, F. (2019). Importance of green finance for achieving sustainable development goals and energy security. In Handbook of green finance (pp. 3-12). Springer, Singapore.

15 Boermans, M. (2023). Preferred habitat investors in the green bond market. Journal of Cleaner Production, 421, 138365.

16 Liu, B., Sun, H., & Xiao, S. (2024). Potential of pension funds and insurance companies for investment in resources: Policies for sustainable transition. Resources Policy, 89, 104618.

17 Initiative, C. P., Nelson, D., & Pierpont, B. (2013). The challenge of institutional investment in renewable energy. CPI, San Francisco.

impulses. These direct and indirect forms of public investment support can be understood as attempts to internalize the positive social spillover effects from engaging in risky green investment projects for the investor. Through the tax-based financing of public support programs, society compensates investors for their contribution to capacity-building and technology development, and thus for the creation of a more certain long-term market environment.

3.2 Developing economies

Financing hurdles for renewable energy projects in developing countries require specific attention for several reasons. There is a consensus that the green transformation is highly unlikely to make the EU self-sufficient. The global distribution of energy and mineral resources relevant for green technologies is highly uneven and, from Europe's perspective, unfavorable. Regions such as South America and Northern Africa have high potential for wind power and solar energy, and are therefore able to generate green electricity at much lower cost and with fewer space restrictions than large parts of Europe.[18] As intercontinental transport costs for renewable hydrogen start to shrink, these discrepancies will increasingly become a relevant economic factor in the global market for energy-intensive products. Furthermore, the mining and refining of critical minerals that are difficult to substitute for green technologies, such as rare earths and lithium, is concentrated in regions far from Europe. Even with enhanced domestic exploitation activities and policy support, this is unlikely to change in the near future. High environmental standards and public resistance are significant obstacles to a European mining boom, as documented by the developments in Serbia, for example.[19] While there is potential of deepened resource cooperation with some resource-rich OECD members (notably Australia, Canada and Chile), the bulk of so far untapped global resources is concentrated in developing economies. Getting access to these resources and contributing to local capacity-building will be a crucial asset in the race for geoeconomic hegemony.

Accessing these hidden resources often requires a significant initial investment. This may not be limited to project-specific capacities. In regions such as Sub-Saharan Africa, a lack of reliable public infrastructure (e.g. inadequate or absent electricity grids to connect renewable energy sources with local consumers) can be a major obstacle. This creates a chicken-and-egg problem, as implementing renewable energy projects requires developing basic infrastructure and generation capacities simultaneously. European investors tend to be reluctant to invest in basic local infrastructure, as their long-term returns are typically shared among a large number of stakeholders external to the project. Furthermore, building capacity from scratch implies a long average waiting time between initial investment and the start of the cash flow period, which further increases financing costs.

Moreover, political and regulatory risk is a particular cause for concern when it comes to investing in developing economies. From a cross-country perspective, there is a clear negative correlation between the extent of a country's natural resource potential and indicators measuring its political stability and regulatory quality.[20] This gives rise to project-related risks at many levels. Specifically, the lack of transparency and arbitrariness in local administrative decision-making poses a risk to project approval procedures. Uncertainty regarding the stability of local market rules, or inconsistency in their application, poses a risk to local revenue potential and export costs. At a more fundamental level, political

[18] Moritz, M., Schönfisch, M., & Schulte, S. (2023). Estimating global production and supply costs for green hydrogen and hydrogen-based green energy commodities. International Journal of Hydrogen Energy, 48(25), 9139-9154.
[19] Baletic, K. (2025). Serbian Lithium Mine Opponents Undeterred by EU's 'Strategic' Listing. Balkan Insight.
[20] Wolf, A. (2023). Strategic Resource Partnerships. cepInput No.4/2023.

instability jeopardizes the continuity of cooperation with local public stakeholders and makes the infrastructure of international projects vulnerable to intended attacks, as has been seen many times before.[21]

For these reasons, crowding-in private investors from Europe requires some form of risk sharing mechanism. The potential for local public support is in many developing economies very limited, due to the overall lack of resources and the partly already high external indebtedness.[22] Engaging in risk sharing arrangements with local private stakeholders is often impeded by the lack of banking capital and an overall low degree of financial market development.[23] Once again, this calls for an active role for European policies. This goes far beyond financial mechanisms, such as the provision of public capital and insurance for private investors, and requires an overarching strategy involving continued diplomatic engagement with partner countries, as well as a roadmap for regulatory cooperation. Furthermore, in addition to providing risk-sharing services, public flagship projects can play an important signaling role for European private investors with limited knowledge of investment potential in developing economies, directing European capital towards new, promising markets.

4 Policy tools for risk management

The preceding discussion has illustrated the specificity and diversity of the barriers to strong investment dynamics in the field of renewable energy. Both economic theory and practical experience suggest that eliminating all relevant barriers requires a combination of policy measures. Instead, policymakers must establish a mix of diverse yet consistent policy measures structured by their specific contributions. One way to categorize measures is to distinguish between risk-absorbing and risk-reducing interventions, in line with our previous reasoning. The immediate objective of risk-absorbing measures is to transfer parts of the project-specific risks faced by private investors to public budgets or publicly financed institutions such as public development banks. To a limited extent, such reallocation could also be argued to have a globally risk-reducing effect due to public institutions' ability to diversify project-specific risk over a broad spectrum of assets. However, given the critical importance of the green transformation for future economic growth (and thus tax revenues), it will be highly correlated with overall budget risks, which limits the effectiveness of such diversification. Therefore, any risk-absorbing measure must be carefully targeted and justified.

Risk absorption can be implemented through investment financing or through the distributional effects of product markets. A further delineation of financial risk-absorbing measures can be made between measures directly involving public capital and measures providing financial guarantees. Public capital can be provided as equity investment, e.g. in the form Public-Private-Partnerships (PPPs). Typically, public shareholding should ex-ante be designed to be limited in time, to restrict public risk exposure and avoid well-known principal-agent issues with public decision-making in industrial strategies.[24] For many infant green technologies, the engagement of public development in venture capital operations is a promising avenue, ideally in the form of public capital teaming with experienced private investors

[21] OECD (2025). Roads and conflicts in North and West Africa. West African Studies. Organisation for Economic Co-operation and Development.

[22] Epaphra, M., & Mesiet, W. (2021). The external debt burden and economic growth in Africa: a panel data analysis. Theoretical & Applied Economics, 28(2).

[23] Abaidoo, R., & Agyapong, E. K. (2022). Financial development and institutional quality among emerging economies. Journal of Economics and Development, 24(3), 198-216.

[24] Bartel, A. P., & Harrison, A. E. (2005). Ownership versus environment: Disentangling the sources of public-sector inefficiency. Review of Economics and Statistics, 87(1), 135-147.

with sufficient industry knowledge. It helps to bridge risk capital bottlenecks required for the industrial commercialization of technologies arising from tax barriers and a lack of European venture capital culture, especially compared to the US.[25] Traditionally, public capital has been provided in the form of below-market-rate loans, which restricts public engagement to a passive role from the outset. Alternatively, risk absorption can be achieved without providing capital, by publicly backing private investment credits or providing collateral in other forms of private contracts (see below). Unlike direct forms of public involvement, such schemes do not involve initial payment flows from public budgets and therefore do not cause liquidity issues, for example when tax revenues are shrinking during a recession.

Product-related risk absorption can address the issue of insufficient demand. These forms mitigate the risk of insufficient demand for goods produced by renewable energy technologies. Again, multiple policy instruments can be envisaged for this purpose. One measure could be to directly boost demand through public expenditure. One such channel is public procurement rules. By adjusting the rules of regular public tender schemes to favor products based on renewable energy technologies, initial cost disadvantages in tendering can be partly offset. Another option is to set up schemes dedicated to buying and redistributing green products. Public agencies act as direct market intermediaries, responsible for acquiring and selling a pre-defined amount or value of products within the domestic economy. In terms of public risk-taking, this is the most extreme form of support policy conceivable. Not only does it completely absorb demand risks from producers, it also fully takes up the risks associated with future changes in production costs. Therefore, such mechanisms are only considered in scenarios where there are no liquid markets for a renewable energy technology established yet, such as in the case of renewable hydrogen.[26]

As an alternative, product-related risk absorption could be used to target the prices of goods relevant to renewable energy technologies. Such schemes have traditionally been used by Member States to promote electricity generation from renewables. The risk-absorbing effect involves shielding producers from short-term market price fluctuations and adverse price trends by guaranteeing a certain price level over a pre-defined period, which is often within the full depreciation period of the capacities. While price levels have traditionally been politically defined by law in Member States such as Germany, recent policy approaches prefer a tender-based determination in the form of Contracts-for-Difference (CfDs) (see below). In such tenders, producers compete by bidding on the required guaranteed price level. Successful bids receive compensation payments defined by the difference between the guaranteed price and the actual average market price over a given period. One variant is a tender-based minimum price, which provides compensation only against the downside risk of low prices. As well as insuring against sales price risks, measures can also focus on input prices. Most notably, Carbon Contracts-for-Difference (CCfDs) have emerged as a new support instrument for industrial decarbonization investments during the green transition. This is a specific form of CfD where price guarantees are granted for future CO_2 pricing levels, e.g. in the European Emissions Trading Scheme, thereby ensuring a crucial component of the returns on switching to a new technology. Public risk absorption within CCfDs can be further enhanced by allowing adjustments to the contractual CO_2 prices in response to changes in the prices of production inputs such as energy.[27]

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[25] Küster, A., Meister, A., Poli, E., Warhem, V., Wolf, A. (2023). Catalyzing the EU's Green Industrial Transformation. cepInput No.5/2023.
[26] Wolf, A. (2023). A Bank to Boost Renewable Hydrogen. cepInput No.13/2023.
[27] Wolf, A. (2023). Market Instruments for a Climate-neutral Industry. cepInput No.7/2023.

The range of policy instruments designed to reduce the risks faced by renewable technologies is even broader, but also more difficult to define. One reason for this is that, unlike risk absorption, the impact of risk reduction measures usually only becomes apparent gradually over long periods of time. Another difference is that they do not target market outcomes and thus intervene in the allocation of goods; rather, they operate at a pre-market level. Their main task is to eliminate barriers to future market exchange. Broadly speaking, their function is therefore to reduce transaction costs rather than correct transaction outcomes. One way to categorize these measures is by the stage of a greenfield renewables project on which they focus. Regarding the first stage of project planning, this concerns public support for capacity building in network infrastructure. For electricity-based technologies, for example, this can involve public investment in grid capacity. While this can initially entail some degree of public risk absorption, it reduces the risk of investments in renewables in the long term. Physical bottlenecks in access to renewable energy are reduced, thus lowering exposure to supply disruptions and capacity-induced market price fluctuations. Such measures can play an especially important role in developing economies, where infrastructure investments tend to face severe chicken-and-egg problems (see Section 3.2).

Measures targeting the project approval phase aim to reduce the costs and uncertainty of administrative approval procedures. In particular for projects requiring complex environmental impact assessments, administrative approval can heavily affect the lead times to operation (i.e. the time span between completed project planning and the start of operation).[28] Longer lead times result in delayed cash flows, thereby reducing the financial value of a project. Policy measures to mitigate these administrative risks include legally defining binding time limits for such procedures, which could be associated with automatic approval if the deadline is exceeded. Other measures aim to speed up administrative processes by improving bureaucratic efficiency and streamlining the variety of necessary administrative steps, as well as establishing single points of contact (one-stop shops) for project developers.

Finally, in the operational phase of projects, measures establishing or harmonizing market rules for the goods produced perform an important function. Transparent market rules lower the information costs and help to establish a level playing field between technology solutions, which in turn raises the efficiency of market outcomes. Harmonization of rules across country borders expands the market potential for a fast scaling of new technologies, thus reducing initial technological risks. At the same time, it helps to diversify revenue sources, which mitigates the role of country-specific risks. Again, such measures do exhibit a particular significance for supporting projects in developing economies. A model where direct investment support is complemented by a process of regulatory cooperation and convergence at the political level is much more likely to create a sustainable market environment for projects in countries with institutional deficiencies.[29] Moreover, from the perspective of a developing economy, it promises positive spillovers from regulatory learning beyond the direct economic impact of the project.

[28] Longoria, G., Lynch, M., Farrell, N., & Curtis, J. (2024). The impact of extended decision times in planning and regulatory processes for energy infrastructure. Utilities Policy, 91, 101824.

[29] Hebous, S., Kher, P., & Tran, T. T. (2020). Regulatory risk and FDI. 2019/2020 Global Investment Competitiveness Report: Rebuilding Investor Confidence in Times of Uncertainty.

5 Risk management in EU Green Deal policies

5.1 Risk-absorbing policies

Since its announcement in 2019, measures to overcome barriers to green instruments have been a cornerstone of the European Green Deal strategy.[30] Beside instruments in the area of investment signaling like the Green Taxonomy[31], this has involved the introduction of new mechanisms to redistribute financial risks. A key vehicle for this is the InvestEU Programme. It has emerged from the European Fund for Strategic Investments (EFSI) and pursues the goal to boost investments in areas of strategic interest and high importance for long-term economic growth. The InvestEU Fund administers an EU budget guarantee of 26.2 billion EUR plus voluntary contributions by Member States. Guarantees are used to back financial support in the form of loans, grants and equity instruments provided by InvestEU implementing partners to public and private investors, focusing on supporting investments in key areas including decarbonization.[32] In 2021, this was complemented by the temporary Recovery and Resilience Facility (RRF), providing loans and grants to Member States to finance investments and reforms over the period 2021-2026. According to its mid-term evaluation in 2024, 24.85 billion EUR of RRF funds were allocated to projects in the area of the green transition.[33] Moreover, the Commission has gradually made the conditions under which Member States are allowed to provide state aid to de-risk green investments more flexible. Its most recent sign is the adoption of the Clean Industrial Deal State Aid Framework, focused on enabling financial assistance to investments in clean energy, industrial decarbonization and the manufacturing of green technologies.[34]

With the announcement of the Global Gateway Initiative, risk-absorbing investment support by the EU has taken an external dimension. Unveiled in December 2021[35], Global Gateway intends to boost the European green agenda, support infrastructure development worldwide and enhance connectivity in various fields including digital technology, climate and energy, transportation, health, education, and research. Its first milestone was an Africa-Europe Investment Package, providing 150 billion EUR for cooperation with African partners.[36] In total, it aims to mobilize 300 billion EUR in investments worldwide. By now, it has defined a total of 218 flagship projects, including a large number of projects in the investment area of climate and energy.[37]

Recently, the EU has complemented this finance-related support with product-related risk absorption. Their strategy is to target the demand side. Firstly, this takes the form of measures aiming to stimulate public demand through new public procurement rules. The Net-Zero Industry Act (NZIA) foresees the introduction of mandatory non-price criteria in the public procurement of net-zero technologies as

30 European Commission (2019). The European Green Deal. Communication to the European Parliament, the Council, the European Economic and Social Committee, the Committee of the Regions. COM/2019/640 final.

31 European Union (2020). Regulation (EU) 2020/852 of the European Parliament and of the Council of 18 June 2020 on the establishment of a framework to facilitate sustainable investment, and amending Regulation (EU) 2019/2088.

32 European Union (2025). InvestEU Programme.

33 European Commission (2024). Recovery and Resilience Facility – Mid-term evaluation.

34 European Commission (2025). Framework for State Aid measures to support the Clean Industrial Deal. Communication from the Commission. C(2025) 7600 final.

35 European Commission (2021). The Global Gateway. Joint Communication to the European Parliament, the Council, the European Economic and Social Committee, the Committee of the Regions and the European Investment Bank. JOIN(2021) 30 final.

36 European Commission (2024). EU-Africa: Global Gateway Investment Package.

37 European Commission (2025). Global Gateway flagship projects – Infographics.

well as in renewable energy support auctions.[38] Similarly, the Ecodesign for Sustainable Products (ESPR) Regulation empowers the Commission to define mandatory green requirements for pre-qualification and award criteria of public tenders involving the wide range of products covered by the ESPR.[39] In these cases, risks are shifted to public households at the national, regional and local levels. Secondly, legal initiatives have started to shift risks to private downstream demand. Its current focus is on promoting investments in recycling capacities. Most prominently, for the time after 2030, the EU Battery Regulation provides for a mandatory minimum share of recycled raw materials to be used in the production of industrial (capacity > 2 kWh), starter and traction batteries. This is determined on a raw-material-specific basis and is initially 16% for cobalt, 85% for lead, 6% for lithium and 6% for nickel.[40] The Critical Raw Materials Act (CRMA) has mandated the Commission to implement a similar minimum quota requirement for the use of raw materials in the production of permanent magnets.[41] Finally, a recent example for an EU policy absorbing very specific contractual risks in marketizing green technologies is the Pilot Programme to support Power Purchase Agreements (PPAs). It will provide counter-guarantees to corporate PPAs, backing parts of the usual offtaker payment obligations. This facilitates direct access to green energy for small- to medium sized enterprises and for those that lack a strong credit rating.[42]

5.2 Risk-reducing policies

In the field of risk-reducing policies, the EU has likewise demonstrated increased regulatory activity in recent times. Several pieces of legislation target the efficiency of public approval procedures for green projects. The main risk-reducing instrument is the definition of concrete time limits for such procedures, with exceptions to ensure compliance with general quality standards. The most recent version of the Renewable Energy Directive (RED III) sets requirements for Member States to speed up approval procedures for renewable energy pro-jects. For projects in dedicated acceleration areas, concrete time limits for approval procedures are imposed. This includes projects involving co-located energy storage, for whose approval the time limit is set at six months (offshore: 12 months).[43] The CRMA defines specific time limits for recognized strategic projects in the fields of extracting, processing and recycling strategic raw materials. Extraction permits should be decided within 27 months, while processing and recycling permits must be decided within 15 months. A similar approach is followed by the NZIA for projects creating domestic manufacturing capacities for net-zero technologies.

Through its budget allocation, the EU also provides direct financial assistance to the construction and expansion of cross-country network infrastructure, thus supporting the diversification of market risks. This also concerns infrastructure of particular relevance for renewable energy projects. The Trans-

[38] European Union (2024). Regulation (EU) 2024/1735 of the European Parliament and of the Council of 13 June 2024 on establishing a framework of measures for strengthening Europe's net-zero technology manufacturing ecosystem and amending Regulation (EU) 2018/1724.

[39] European Union (2024). Regulation (EU) 2024/1781 of the European Parliament and of the Council of 13 June 2024 establishing a framework for the setting of ecodesign requirements for sustainable products, amending Directive (EU) 2020/1828 and Regulation (EU) 2023/1542 and repealing Directive 2009/125/EC.

[40] European Union (2023). Regulation of the European Parliament and of the Council concerning batteries and waste batteries, amending Directive 2008/98/EC and Regulation (EU) 2019/1020 and repealing Directive 2006/66/EC.

[41] European Union (2024). Regulation (EU) 2024/1252 of the European Parliament and of the Council of 11 April 2024 establishing a framework for ensuring a secure and sustainable supply of critical raw materials and amending Regulations (EU) No 168/2013, (EU) 2018/858, (EU) 2018/1724 and (EU) 2019/1020.

[42] Synertics (2025). How the EU's Clean Industrial Deal is Making PPAs More Accessible for Businesses.

[43] European Union (2023). Directive (EU) 2023/2413 of the European Parliament and of the Council of 18 October 2023 amending Directive (EU) 2018/2001, Regulation (EU) 2018/1999 and Directive 98/70/EC as regards the promotion of energy from renewable sources, and repealing Council Directive (EU) 2015/652.

European Energy Networks (TEN-E) framework provides the EU with an instrument for promoting the expansion of cross-border energy networks.[44] It defines specific corridors in which the energy network is to be strengthened. Infrastructure projects that contribute to this can obtain the status of a Project of Common Interest (PCI). These can apply for funding from the Connecting Europe Facility (CEF), the EU fund for promoting cross-border infrastructure.[45] State aid for cross-border energy networks can also be granted under the Important Projects of Common European Interest (IPCEIs) instrument.[46] These are investment projects financially supported by several Member States, which are expected to make a sustainable contribution to securing economic growth and industrial competitiveness in the EU. IPCEIs recognized by the European Commission are considered compatible with the principles of the internal market and European state aid rules. This gives Member States greater scope for infrastructure state aid compared to purely national projects.

The EU has also stepped up its ambitions to harmonize national market rules in the field of energy technologies. The most comprehensive recent initiative has been the electricity market reform in 2024, consisting of a Regulation[47] and a Directive[48]. It includes a range of new prescriptions on trading rules in national electricity wholesale markets, price-based support schemes for renewables and the design of electricity contracts in retail markets. Of utmost importance for establishing a cross-border transport infrastructure for hydrogen is the Internal Gas Market Directive likewise adopted in 2024.[49] It includes EU requirements for the transport, supply and storage of hydrogen. It also sets out rules for the gradual establishment of an EU-wide hydrogen network. This will enhance the long-term flexibility of the electricity system and increase opportunities to sell renewable hydrogen across borders.

Measures that aim to reduce the risks of EU-external investments have recently gained strategic attention. Again, the Global Gateway Initiative (see above) is a prominent example. Among its flagship projects to be financed, many deal with supporting a local infrastructure essential for the green transition, such as electricity grids and ICT networks.[50] Its function is thus not only to absorb private project risks, but also to reduce risks for future green supply chains through promoting connectivity. Moreover, attempts for long-term risk reduction are increasingly organized through the instrument of bilateral strategic economic partnerships with third countries. Such partnerships are designed to focus on specific areas relevant for the green transition like energy, raw materials or net-zero manufacturing technologies. In addition to creating platforms for the joint financing of investments, partnership agreements also foresee the creation of joint education and research networks, as well as regulatory cooperation.[51] Hence, in the long-term, these partnerships can play a vital role in reducing various risks associated with joint green supply chains.

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44 European Union (2022). Regulation (EU) 2022/869 of the European Parliament and of the Council of 30 May 2022 on guidelines for trans-European energy infrastructure, amending Regulations (EC) No 715/2009, (EU) 2019/942 and (EU) 2019/943 and Directives 2009/73/EC and (EU) 2019/944, and repealing Regulation (EU) No 347/2013.

45 European Commission (2025a). CEF Energy - Supporting sustainable energy infrastructure projects.

46 European Commission (2025b). Practical information for Important Projects of Common European Interest (IPCEI).

47 European Union (2024). Regulation (EU) 2024/1747 of the European Parliament and of the Council of 13 June 2024 amending Regulations (EU) 2019/942 and (EU) 2019/943 as regards improving the Union's electricity market design.

48 European Union (2024). Directive (EU) 2024/1711 of the European Parliament and of the Council of 13 June 2024 amending Directives (EU) 2018/2001 and (EU) 2019/944 as regards improving the Union's electricity market design.

49 European Union (2024). Directive (EU) 2024/1788 of the European Parliament and of the Council of 13 June 2024 on common rules for the internal markets for renewable gas, natural gas and hydrogen, amending Directive (EU) 2023/1791 and repealing Directive 2009/73/EC (recast).

50 European Council (2024). Global Gateway: Council endorses flagship project list for 2025. Press release, Dec 2 2024.

51 Wolf, A. (2025). Clean Trade and Investment Partnerships. cepInput No.10/2025.

6 Case study: Renewable hydrogen imports

Given domestic space limitations and unfavorable climatic conditions, Europe will have to satisfy a significant share of its future renewable energy needs by imports. In the foreseeable future, this energy will be mainly transported in the form of renewable hydrogen (i.e. electrolytically produced hydrogen using electricity from renewable sources) and its derivatives (green ammonia, green methanol). Hydrogen performs an important complementary function in the green transformation, serving to decarbonize processes where direct electrification is too expensive or technologically infeasible.[52] For these reasons, investments in overseas production capacities for renewable hydrogen are a good example case to demonstrate how current financing risks impede progress of the green transition.

Recently, the competitiveness of European hydrogen imports from different world regions has been subject of a range of studies. They expect a significant reduction of hydrogen transport costs through scaling and learning effects. The analysts disagree on whether this is sufficient to make intercontinental hydrogen transport competitive in the foreseeable future. While Aurora (2023)[53] considers price competitiveness of hydrogen from Chile and Australia transported to Europe by ship to be achieved as early as 2030, Galimova et al. (2023)[54] predict that long-distance transport to Europe can still not compete with domestic production by 2050. Fraunhofer CENIS (2023)[55] identify a business case for hydrogen imports from the MENA region by 2030, provided that the bulk of transport volumes is handled by pipelines. The limitations of these studies are that costs are purely assessed from a technological perspective. Local conditions for renewable energy generation and spatial distance to the EU are the determining factors in their cost comparisons. They do not consider the political and regulatory distance, and its impact on financing costs. Indeed, technoeconomic studies tend to operate with globally homogeneous discount rates for future cash flows, thus ignoring country- or region-specific risks.

An exception to this is Egli et al. (2025).[56] This study maps the costs of European hydrogen imports from African countries. For several reasons, Africa has the potential to become a major hydrogen supplier for Europe. Due to the climatic conditions, it offers high production potential for electricity from wind and sun, needed as an input in electrolysis. There also significantly less space limitations in capacity-building. Moreover, the relative spatial proximity to Europe allows to limit transport costs. In contrast to preceding studies, Egli et al. (2025) consider typical risk premiums associated with the source countries by drawing on recent financial market data. Precisely, in computing the capital costs of hydrogen projects in a country, the risk spread is decomposed into a technology-related and a country-specific component. The country-specific component is obtained from Damodaran (2023), who estimates current risk spreads for countries worldwide by correlating country discrepancies in interest rates of national treasury bonds with the results of sovereign ratings.[57] In doing so, Egli et al. (2025) estimate for hydrogen projects in all African countries Weighted Average Costs of Capital (WACC) of more than 10%, assuming a purely commercial scenario without political support (see Figure 3). In

52 IEA (2019). The future of hydrogen. International Energy Agency. Study.

53 Aurora (2023). Renewable hydrogen imports could compete with EU production by 2030. January 23, Aurora Energy Research.

54 Galimova, T., Fasihi, M., Bogdanov, D., & Breyer, C. (2023). Impact of international transportation chains on cost of green e-hydrogen: Global cost of hydrogen and consequences for Germany and Finland. Applied Energy, 347, 121369.

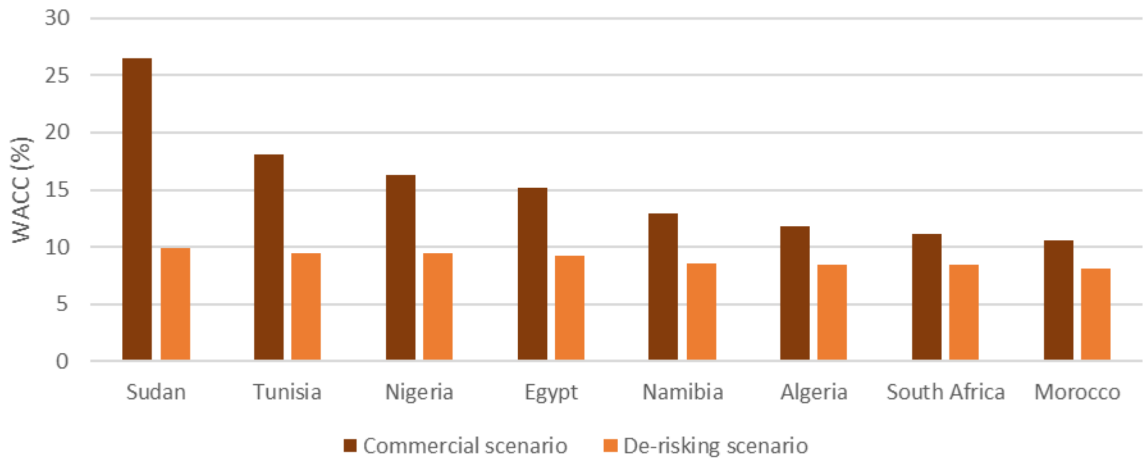
55 Fraunhofer CINES (2023). Clean hydrogen deployment in the Europe-MENA region from 2030 to 2050 - A technical and socio-economic assessment. Fraunhofer Cluster of Excellence “Integrierte Energiesysteme”.

56 Egli, F., Schneider, F., Leonard, A., Halloran, C., Salmon, N., Schmidt, T., & Hirmer, S. (2025). Mapping the cost competitiveness of African green hydrogen imports to Europe. Nature Energy, 1-12.

57 Damodaran, A. (2025). Country default spreads and risk premiums.

some countries, the WACC even reach extreme values of more than 15%, including the high-potential Northern African countries Egypt and Tunisia. As a consequence, estimated hydrogen supply costs from African countries exhibit a median of about 11 EUR/kg H_2 even when assuming low general interest rates, which lies way above estimated domestic production costs in Europe's most suitable regions.[58]

Figure 3: Estimated costs of capital for renewable hydrogen projects in selected African countries



Source: Egli et al. (2025).

As a remedy, Egli et al. (2025) discuss targeted de-risking policies in the form of an alternative simulation scenario. The scenario assumes a de-risking approach consisting of a combination of hydrogen offtake guarantees by Western European countries (mimicking Germany's H2Global instrument[59]) and the provision of project insurance against war and expropriation risks by the World Bank Group's Multilateral Investment Guarantee Agency (MIGA). This combination is assumed to neutralize the excess risk of producing renewable hydrogen in Africa instead of in Western Europe. Therefore, capital costs are adjusted by replacing African country risk premiums by an average of risk premiums for Western Europe countries and adding the expected costs of the MIGA insurance. As a consequence, the overall WACC are expected to fall drastically for all African countries, especially for those with highest idiosyncratic risk. They consistently exhibit values of less than 10%. This is reflected in a similarly significant decline of hydrogen supply costs, now exhibiting a median of only about 8 EUR/kg H_2. The most competitive African countries could even export renewable hydrogen to Europe at costs of less than 4°EUR/kg H_2 under these circumstances, which is projected to outperform potential future European production hubs like Rotterdam.[60]

This demonstrates that European de-risking support to third country projects can result in economic gains that materialize in lower energy import costs for Europe. At the same time, the reduction of risks for project investors does not come for free in welfare terms. While overall financial risk indeed can shrink due to the superior ability of public institutions to diversify risks across a wide range of sources, de-risking will always involve the uptake of certain elements of private risks by public budgets. In the case of hydrogen offtake agreements, this primarily concerns domestic demand uncertainty, i.e. the

58 Agora Industry (2024). EU map of hydrogen production costs.
59 H2Global Stiftung (2023). Shaping the global energy transition.
60 See Egli et al. (2025).

ability to resell the centrally purchased hydrogen on domestic markets. Too generous offtake guarantees will result in large spreads between import and domestic prices, which will have to be covered by taxpayers' money. Hence, relying solely on measures of public risk adoption is certainly not a sustainable risk management strategy for the green transformation. What is needed instead is a multi-level strategy that combines risk transfer with risk reduction efforts, ensuring a smooth transition from urgent short-term investment impulses to long-term market stability. Below, we set out our own proposal for a suitable strategic framework.

7 A multi-level risk management framework

The fate of the energy transition and the model of green growth in Europe hinges on our ability to undertake substantial long-term investments over the next few years. In this situation, a myriad of risks (some of which overlap) causes investors to hesitate. Given the vulnerability of the European economy during this transition period, a lack of investment could not only delay, but also prevent a successful green transformation. In this context, decarbonization policies must primarily be understood as risk management policies.

Both economic theory and practical experience suggest that a single policy measure cannot tackle the variety of risk sources. Instead, a strategic framework is needed that develops a consistent mix of tailor-made measures. Firstly, such a framework should recognize the complementarity of risk-absorbing and risk-reducing instruments. If designed intelligently, the partial absorption of investor risk can quickly and effectively unlock private resources without creating new incentive problems. However, to limit the long-term risks to public budgets and the rest of the economy, these measures must be coupled with long-term policies to eliminate risk sources. From a technological perspective, there is a further argument for such complementarity. By speeding up the deployment of new green technologies, risk-absorbing instruments help to gain experience with technology-specific risks. This facilitates the design of, and increases the impact of, risk-reducing measures.

Undeniably, the EU has recently placed greater emphasis on investment barriers in its Green Deal initiatives (see Section 5). However, it still lacks a framework to manage the variety of inconsistent de-risking approaches. We propose a simple and intuitive framework (see Figure 4). This framework differentiates between targeted measures with a short-term or long-term horizon, implemented in a political environment governed by clear principles. The first of these premises is a commitment to long-term stability in the regulatory approach of the Green Deal, which provides investors with planning security. Specifically, this means that the EU should continue to rely consistently on CO_2 pricing as a central steering signal for private decarbonization investments. Based on this macro-level stability, de-risking policies should target the non-diversifiable investment risks inherent to the green transition.

Foremost, this concerns the risks specific to investments outside the EU. As achieving self-sufficiency is unrealistic for Europe, strengthening resilience in the green transition will depend on increasing investment in third countries with high resource potential and/or strong market growth prospects. The EU should expand its toolset for de-risking internal investments to include external engagement. To this end, we recommend amending the EU's Global Gateway Initiative's strategic approach. Rather than defining a limited set of (often opaque) flagship projects, the approach should be decentralized and focus on developing innovative support instruments.

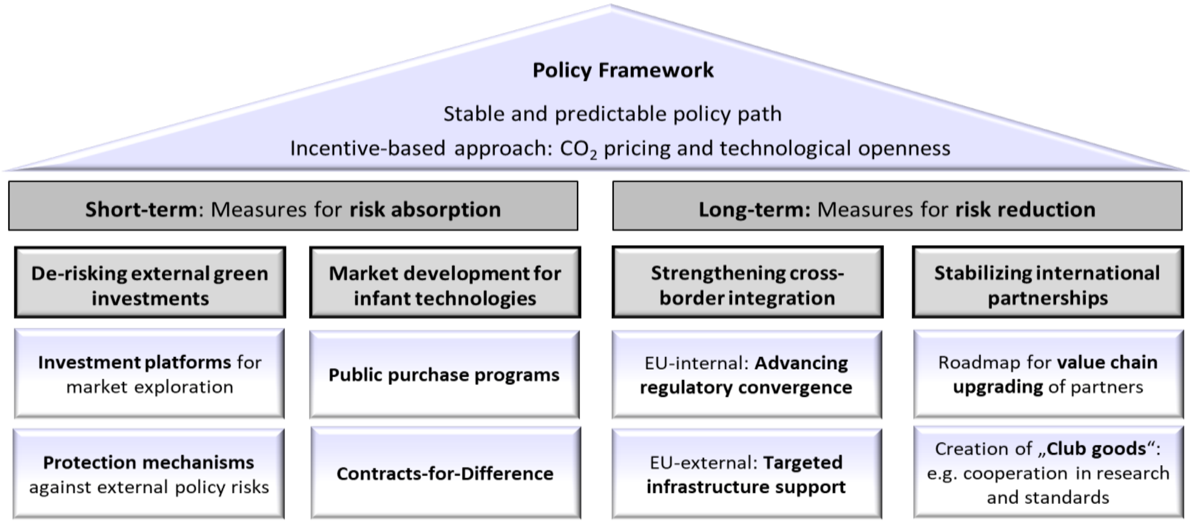
For instance, it would be worthwhile testing the creation of platforms to coordinate investments in future so far unexplored markets in developing economies. Building on the established model of public-private partnerships, providing public equity capital as a risk buffer could attract private investors. Such platforms could be organized as project companies, collecting capital not only from institutional investors and large industrial companies, but also from small and medium-sized enterprises. The role of the platform would be to unlock the specific potential of an investment region. Designing platforms for different world regions could also contribute to the goal of diversifying Europe's future green supply chains. However, this engagement must not come at the expense of purely private external investment initiatives. Therefore, targeted mechanisms must be in place to protect investors against the most critical country- or region-specific downside scenarios. For example, the EU could collaborate with organizations such as the World Bank to increase the availability of publicly backed insurance against expropriation or the collapse of local institutions (see Section 6).

This should be complemented by measures that address demand-side risks and focus on promoting domestic market development for new green technologies. Temporary public purchase programs for such technologies, as are currently being implemented for renewable hydrogen, are effective in creating a stable demand base. However, they necessitate the establishment of new institutions and pose risks to the public. Therefore, they should only be applied in the initial stages of scaling a new technology. Another direct way to reduce the market risks faced by technological frontrunners is to use CfDs, which are economically intelligent instruments. CfDs insure project developers against fluctuations in critical investment parameters, thus reducing financing costs. In many cases, this will be the carbon price. When allocated through competitive tenders, they can stabilize the CO_2 price signal without distorting the merit order of CO_2 mitigation costs.

Alongside these risk absorption measures, the EU should put the aim of eliminating risks in green supply chains at the center of its long-term growth strategy. A key priority should be to increase demand for green technologies by removing market barriers. This has both an internal and external dimension within the EU. Internally, efforts must be intensified to advance regulatory convergence among Member States in areas crucial for the deployment of new green technologies. Specifically, this involves creating a consistent environment for the cross-border transportation of energy carriers such as electricity, hydrogen, and biomethane, as well as CO_2. Externally, the EU should continue to engage in promoting basic infrastructure in developing economies worldwide to set the stage for joint supply chains.

Finally, to stabilize long-term cooperation with new economic partners, the EU should make more targeted use of its strategic partnership instruments. In partnerships with developing economies, this primarily involves including steps to upgrade the value chain in future cooperation roadmaps. Partner countries should be given the opportunity to expand their role within joint value chains to include downstream processing steps over time, thus advancing their industrial development while benefiting from internal knowledge and innovation. To achieve this, joint infrastructure and research projects should be designed with specific downstream applications in mind. Additionally, intra-club trade integration should be made as conditional as possible. Providing 'club goods' such as continuous cooperation in research and development of standards can reduce the risk of partner countries turning away from the EU.

Figure 4: Proposal for a multi-level risk management framework



Source: own illustration

8 Conclusion

External turbulence and internal pressure are forcing the EU to reconsider its decarbonization strategy. It is becoming increasingly clear that a highly regulated environment with detailed macro-level targets and central policy tools alone is insufficient to create a favorable investment climate. When calibrating policies according to economy-wide climate indicators, it is easy to forget that these indicators are the result of numerous individual investment decisions, each of which is subject to a multitude of risks. The EU has recognized this shortcoming, as is evident from its recent initiatives. However, it still lacks a consistent strategy to ensure that de-risking is targeted and does not result in disincentives or excessive public risk-taking.

This cepInput outlines the key components of such a strategic framework. It argues that a central distinction between risk-absorbing and complementary risk-reducing policies must be made. Risk-absorbing instruments are useful for shielding investors against non-diversifiable risks inherent to green technologies. However, they also involve the redistribution of individual investment uncertainty to the public or other market stakeholders. Even when properly designed, therefore, risk-absorbing instruments always entail an economic burden. However, this must be considered alongside the long-term societal costs of inaction, particularly given the current critical phase of high transformative investment needs. Risk-reducing measures aim to eliminate the sources of risk and the need for burden sharing. By their very nature, the impact of these measures only becomes apparent gradually over the long term, which suggests combining them with measures that provide immediate risk absorption.

An EU risk management framework should specifically focus on external investments. Given the EU's continued reliance on imports of green technology and the need to diversify current supply routes, priority should be given to designing new measures to reduce the risk of European investment in third countries. This will require a combination of risk-absorbing and risk-reducing policy instruments. Alongside the willingness to publicly hedge existing country risks, the EU must increase its efforts to implement economic partnerships with third countries. This requires diplomatic activity and the willingness to engage in deepened regulatory cooperation and knowledge exchange. This should include joint roadmaps and supply chain strategies that align with the partners' development interests.

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