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Wilfried
Martens Centre
for European Studies

The 7Ds for Sustainability – Decarbonisation Extended

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Table of abbreviations

ACER	Agency for the Cooperation of Energy Regulators
CBAM	Carbon Border Adjustment Mechanism
CfD	Contract for Difference
CRM	Critical Raw Materials
CRMA	Critical Raw Materials Act
EIB	European Investment Bank
EMD	Electricity Market Design
ESG	Environmental, Social and Governance
GDIP	Green Deal Industrial Plan
MFF	Multiannual Financial Framework
NZIA	Net Zero Industry Act
PPA	Power Purchase Agreement
R&D	Research and Development
REE	Rare-Earth Element
RES	Renewable Energy System
SME	Small and Medium-Sized Enterprise
UNEP	United Nations Environment Programme
WTO	World Trade Organisation

Introduction

by Peter Hefele

With its 2019 Green Deal and the goal of carbon neutrality by 2050, the EU aims to become the most influential global actor when it comes to advancing the international agenda on decarbonisation and the fight against climate change. Geopolitical conflicts have increasingly shifted political priorities and resources, making the commitments pledged in the previous decade even more challenging to achieve. At the same time, resilience and economic security have become key criteria for the future transformation.

Through its domestic and external relationships, the EU has to be able to ensure a sufficient and reliable supply of materials, fuels, technologies and skills, while meeting the energy demand of its citizens and industries in a secure, flexible and efficient manner. The benefits of the transformation project must be balanced with the need for social acceptance. Openness towards manifold innovation patterns is as important as political and regulatory predictability.

Given the gigantic financial resources needed to transform the existing fossil-based economies, the role of the private sector is crucial to making this happen faster and in a more cost-efficient manner. The volume of private investment in technology and infrastructure must be scaled up massively, as public sources will be less available due to the already high levels of debt. Due to the existing regulatory framework, financial instruments are still not sufficiently accessible for a large part of the corporate sector. In particular, small and medium-sized enterprises (SMEs) lack access to bond market investors and various sophisticated products.

For too long, issues linked to the green transition have been separated from those related to the security of raw materials. But this ignores the ways in which both kinds of issues are inextricably bound up with each. This is because some of these raw materials are components essential to digitalisation, and the green transition and digitalisation are inseparably linked with each other. Ensuring a stable and affordable raw material supply chain without getting into new import dependencies, with all their geopolitical implications, requires a strategic reorientation of European politics.

The EU has to regain lost ground in the design and production of innovative clean technology. Most of the progress in this area is being made in North America and Asia, and it is there that most large-scale production is also taking place. State subsidies have distorted the level playing field and given rise to daunting challenges for European companies.



Wielding Decarbonisation to Swell Energy Security and Energy Resilience in the EU

by Bernd Weber and Sam Williams

Summary

This paper outlines strategies for enhancing energy security and resilience in the EU amidst geopolitical upheavals and the protectionist and interventionist industrial policies adopted by global competitors. Focusing on technological innovation and green business models, this paper suggests a change of paradigm, positioning decarbonisation as the catalyst to reach EU energy security, energy resilience and economic growth. Key recommendations include implementing a future-proof electricity market, diversifying energy supply chains, supporting small and medium-sized enterprises and cleantech startups, and creating polycentric energy and climate partnerships.

The paper also emphasises the importance of integrating the EU's energy markets to increase supply and decrease energy costs. By fostering a single market for innovation, offering financial incentives and leveraging international cooperation, the EU can mitigate import vulnerabilities and drive the green transition, while avoiding short-sighted, isolationist strategic autonomy approaches that run the risk of stifling innovation and growth.

Keywords EU energy security – Energy resilience – Decarbonisation

Introduction

Recent geopolitical disruptions and increasingly protectionist and interventionist competition from global powers have exposed vulnerabilities in the EU's energy supply chains, necessitating a comprehensive re-evaluation of industrial and energy security strategies. The EU's heavy reliance on a few third countries for energy imports and specific parts of the value chain with regard to renewable energy¹ and clean technologies² has highlighted the urgent need for a resilient and sustainable energy policy approach. This paper explores the current state of the EU's energy resilience, taking a look at the electricity market, cleantech and the industrial decarbonisation race, and international partnerships, and provides concrete policy recommendations for strengthening energy resilience through innovation and international cooperation.

State of play

Geopolitical tensions, such as Russia's war on Ukraine, have underscored the risks for the EU associated with relying on only a few energy sources from a limited number of third countries, as disruptions to supply could have severe economic and social consequences. Simultaneously, increased competition in cleantech manufacturing and the procurement of raw materials on the global stage by actors such as the US and China is challenging the EU and highlighting the risks of accepting the status quo,³ which would effectively mean falling behind in terms of wealth creation and innovation.

Defined as 'the ability to shield the energy system from internal and external shocks', energy resilience must

¹ European Commission, 'Energy Statistics – An Overview' (2022), 1.

² For example, solar panels; B. McWilliams et al., 'Smarter European Union Industrial Policy for Solar Panels', *Bruegel* (2024), 2.

³ For example, with regard to lithium-ion batteries: Cleantech for Europe, *EU Cleantech Quarterly Briefing* (Brussels, 2024).

increasingly be understood as a synonym for energy security and energy transition.⁴ A holistic approach to ensuring energy resilience is needed, as energy resilience and an industrial agenda geared towards climate change are mutually dependent and mutually reinforcing. This approach needs to reflect the role energy systems play and the services they provide with regard to two elements. First, it should ensure the sufficient and reliable supply of the materials, fuels, technologies and skills needed to maintain the pace and scope of the planned transformation of the energy systems. Second, it should provide for the ability to meet the projected primary energy demand, and enable the system to produce (affordable and clean) energy for industries and households to use in a secure, flexible and efficient manner, at all times.

The US has initiated substantial investments in climate-friendly technology through the Inflation Reduction Act, focusing on building a future energy economy and manufacturing industry, while countries in Asia have also made strides in supporting the domestic production of climate-friendly technologies. China leads in solar and wind energy, while Japan, Korea and India are all enhancing the incentives to produce cleantech.⁵

The EU has responded by focusing on integrating climate policies into its trade and economic strategies. It has also, to some extent, been working on enhancing its energy infrastructure and fostering cross-border integration to support the sustainable energy transition. Despite still being in ‘the driving seat of global decarbonisation’ thanks to the European Green Deal,⁶ Europe faces several challenges to fully integrating its climate policies into a cohesive economic, industrial and trade strategy, starting with issues with its internal electricity market.⁷ Additionally, the EU’s strategy on energy security dates from 2014, calling for a prompt and contextualised update.

Following the recent reforms to the electricity market design (EMD),⁸ the EU’s electricity market needs further mid- and long-term adjustments, focusing on integration and evolution to lower procurement costs and provide investment and innovation incentives. The main issues include insufficient price signals, lack of flexibility, limited system integration of renewable energy sources (RES) and market fragmentation across member states. With the inherently intermittent nature of RES, enhancing flexibility and storage capacity is crucial to maintaining a stable and reliable energy supply.

If not tackled, these challenges will hinder the market’s efficiency, stability and ability to adapt to evolving energy demands and decarbonisation goals.⁹ The European Commission has highlighted the need for investment in grid infrastructure to accommodate growing RES and electrification demands. The Grid Action Plan emphasises the importance of anticipatory investments and faster permitting procedures for efficient grid expansion and modernisation. Additionally, the EU has stressed the need to create a regulatory framework that incentivises grid operators to invest in these necessary upgrades while managing consumer electricity costs fairly.¹⁰

The Net Zero Industry Act (NZIA) suggests the use of various instruments and measures to bring EU industries to net zero. These include promoting carbon capture and storage technologies to address emissions from hard-to-abate sectors. It also recommends the use of energy regulatory sandboxes that could be effective for scaling new and currently less-developed technologies, for instance, innovative storage solutions. The NZIA emphasises the importance of the development of ‘hydrogen valleys’ for industrial use, accelerating the

⁴ B. Weber et al., ‘An Industrial Agenda to Increase Germany’s Energy Resilience’, *EPICO Klimainnovation* (2024), 4.

⁵ M. Pieper and B. Weber, ‘One Year on, Europe Is Still Missing a Business Case for Industrial Decarbonisation’, *Euractiv*, 16 August 2023.

⁶ Ibid.

⁷ EPICO Klimainnovation, *Accelerating EU Industry Competitiveness: Paving the Way for the Next Policy Cycle* (Brussels, 2024).

⁸ European Parliament and Council Regulation amending Regulations (EU) 2019/942 and (EU) 2019/943 as regards improving the Union’s electricity market design (Text with EEA relevance), OJ L2024 (13 June 2024), 1747.

⁹ B. Weber et al., *Where to Go? Assessment of Market Design Options for the European Electricity and Gas Market*, EPICO and Aurora Energy Research (Berlin, 2022), 11.

¹⁰ European Commission, *Grids, the Missing Link – An EU Action Plan for Grids*, Communication, COM (2023) 757 final (28 November 2023).

deployment of hydrogen technologies across borders. Reducing regulatory burdens and supporting industrial symbiosis in ‘net-zero acceleration valleys’ are highlighted as strategies to enhance the competitiveness of EU industries in the green transition. The Act also insists on additional investments in renewable energy technologies, such as wind and solar, as well as energy-efficiency improvements such as smart grids.¹¹

However, several issues remain, including the strongly selective, top-down approach that limits innovation; limited consideration of broader challenges, such as investment barriers; and coordination of EU green policy. An EU-level funding strategy is also missing, making cleantech deployment dependent on fragmented national policies.¹²

The NZIA rightly encourages leveraging existing EU funding instruments, such as the Innovation Fund, and emphasises the need to de-risk investments through the use of financial tools such as guarantees to attract private capital to cleantech development and deployment. However, as is noted more generally in the Draghi Report on competitiveness,¹³ too much focus remains on the public sector: the EU should not deploy an extra €800 billion or take on massive public debt annually. To develop and scale cleantech, funders, startups and developers encounter high costs. Addressing this funding shortage requires the creation of an EU-wide harmonised legislative framework to develop coherent cross-border funding strategies to promote innovation. These strategies should provide investors and developers with a clearer understanding of the financial markets and access to de-risking tools such as guarantees to attract capital, and should streamline financial and industrial regulations for high-value investments to support the scaling of cleantech startups.

The single market also requires strengthening in order to effectively deploy strategic net-zero technologies and to facilitate direct and indirect electrification, which is essential for achieving climate goals.¹⁴ A report on the single market authored by Enrico Letta found that a ‘fifth freedom’, focused on research, innovation and education, could promote knowledge sharing and drive technological advancements.¹⁵ The Draghi Report suggests improving competitiveness across the EU by securing natural gas supplies, increasing interconnection infrastructure financing to strengthen European power systems, lowering energy taxation and earmarking more Emissions Trading System revenues for energy-intensive industries. It also highlights that cleantech is an area where the EU can hold its own vis-à-vis other regions, provided that it takes decisive action, such as via the accelerated implementation of the NZIA.¹⁶ Yet, the EU still needs to carry out significant work to fill these gaps.

In parallel, dependence on a limited number of third countries for energy imports, renewable energy deployment and manufacturing is becoming an increasing liability. Energy-intensive industries need to diversify their energy supply chains; adopt sustainable business models, including circularity; and prioritise efficiency and innovation.

While the overall dependency on energy imports is expected to decrease, there will still be a need to import certain energy carriers, particularly renewable hydrogen. This is the case for Germany, which plans to increase the deployment of RES by at least 70% by 2045 compared to total energy imports from non-renewable sources.¹⁷ Given its importance to reaching net zero, hydrogen stands out as an area in which EU energy diplomacy should be improved in order to deal with competition for an initially scarce resource and a much-

¹¹ European Parliament and Council Regulation on establishing a framework of measures for strengthening Europe's net-zero technology products manufacturing ecosystem and amending Regulation (EU) 2018/1724 (Text with EEA relevance), OJ L2024 (13 June 2024), 1735.

¹² S. Tagliapietra et al., *Rebooting the European Union's Net Zero Industry Act*, Bruegel (2023), 7.

¹³ M. Draghi, *The Future of European Competitiveness*, European Commission (Brussels, 2024), 59.

¹⁴ B. Weber et al., *An Industrial Agenda to Increase Germany's Energy Resilience*, EPICO Klimainnovation (2024), 5.

¹⁵ E. Letta, *Much More than a Market*, European Council (Brussels, 2024), 7.

¹⁶ Draghi, *The Future of European Competitiveness*, 43.

¹⁷ S. Samadi and J. Lechtenböhmer, *Climate Neutrality by 2045: Comparison of Developments in the Energy System in Current Scenarios for Germany* (2022).

needed global ramp-up at the same time. The international hydrogen market faces several key issues: high production costs, significant infrastructure investment needs and intense global competition. The focus on renewable hydrogen is crucial for meeting climate goals, but achieving cost parity with fossil hydrogen remains challenging. Stable prices and strategic investments are an essential missing piece of the puzzle to support growth and competitiveness.¹⁸

The EU member states encounter common issues in hydrogen diplomacy. The challenge of aligning regulatory and sustainability standards across different regions needs to be addressed, while the geopolitical tensions arising from regional conflicts and dependencies are complicating diplomatic and economic partnerships. There are also legitimate socio-ecological justice concerns, including the fair and equitable treatment of local communities and the environment in partner regions, and the risk of environmental degradation due to large-scale energy projects that could harm ecosystems and biodiversity.¹⁹

Policy recommendations

Shifting the paradigm to leverage decarbonisation goals and catalyse energy security and resilience means that the EU must adopt a holistic and forward-looking approach. The following recommendations provide a roadmap for achieving these objectives. More concretely, the EU must increasingly focus on accelerating technological advancements and innovative and scalable green business models, and integrating these into the energy system.

Implementing a future-proof electricity market

Electricity will become increasingly important for our overall energy system, boosting its resilience. However, the electricity market needs to be fit for purpose, particularly in terms of adapting to an ever-increasing share of renewables. Making the electricity market future-proof will also require close cooperation between member states and the European level.

First, there is a need to speed up the market-driven expansion of RES. The new European EMD sets out the broad strategy for this. For example, it calls upon member states to implement guarantees to scale market-driven private agreements through the use of direct contracts between suppliers and industrial consumers in the form of power purchase agreements (PPAs). These should also be made available for small and medium-sized enterprises (SMEs). Furthermore, the EMD determines that public support for renewables expansion should be ensured by member states by using two-way contracts for difference (CfD)²⁰ when directly financing RES build-outs. The EU should provide Union-wide guidelines for both smart CfDs and PPAs to help to create a more competitive and dynamic energy market. The Agency for the Cooperation of Energy Regulators (ACER) has acquired additional competences, for example, with regard to an EU-wide PPA platform, and this should lower barriers for access to these contracts for manufacturing companies. If member states were to

¹⁸ B. Lotz et al., 'Design Options for a European Hydrogen Bank', *EPICO Klimainnovation, Konrad-Adenauer-Stiftung and Guidehouse* (Brussels, 2023).

¹⁹ S. Schäfer et al., *EU Hydrogen Diplomacy in Africa and the Middle East: A Just Regional Energy Transition*, EPICO Klimainnovation and the Iberdrola Energy and Climate Chair of the College of Europe (Brussels, 2023). For example, Kazakhstan, with its abundant renewable resources, has potential as a green hydrogen producer and exporter. Increased cooperation with other similar countries has the potential to result in the development of green hydrogen supply chains. Yet, challenges such as a lack of decarbonisation incentives, limited local research and development, inadequate transport infrastructure and water scarcity remain significant barriers to fully realising this potential. See EPICO Klimainnovation, *EU-Kazakhstan Green Hydrogen Partnership: Mapping Barriers and Establishing a Roadmap* (Brussels 2023).

²⁰ A two-way CfD is a contract signed between an electricity generator and the state, which sets a strike price, usually by competitive tender. The generator sells the electricity in the market but then settles the difference between the market price and the strike price with the state. This allows the generator to receive a stable revenue for the electricity it produces, while providing limiting revenue for generators when market prices are high. In a two-way CfD, if the market price is below the strike price, the generator receives the difference; if the market price is above the strike price, the generator pays back the difference.

act too slowly with regard to the aforementioned PPA guarantees, the EU might also consider stepping in, for instance, via the European Investment Bank (EIB). The goal of such guarantees would be to enhance the bankability of projects by reducing off-taker risks. Guarantees would also help SMEs and cleantech startups, that is, companies that might otherwise pay a higher risk premium, gain access to PPAs.

Second, an ever-increasing share of RES in our electricity mix means that flexibility becomes paramount. This is necessary both to keep system costs in check, but also to ensure competitive power prices for households and industry. This flexibility could consist of demand-side adjustments in the household sector, for example, by shifting the times at which electric vehicles are charged; flexibility on the industrial side; or storage solutions which could help to increase adaptability. In the EMD, member states are called upon to assess the current flexibility in their respective markets and to identify targets for improving it. These flexibility strategies are to be based on a common methodology, developed by ACER at the European level. Both the methodology and an exchange on the best policy instruments should become the nucleus of an EU-wide flexibility strategy.²¹

There is also a strong need to implement alternative financing methods for grid expansion and to focus on cross-border integrated grid planning to maintain competitive electricity prices. Expanding transmission capacities between countries will reduce costs and volatility, and a focus on renewable energy will ensure competitiveness and resilience.

The EU should improve the long-term visibility of infrastructure planning and underpin it with binding political commitments that encourage financial investment in supply chains. Greater coordination of gas and hydrogen supplies and infrastructure actors should be prioritised. With the necessary infrastructure, the EU can support the deployment of renewable energy technologies and enhance energy resilience. The report on EU competitiveness by Mario Draghi proposes making public guarantees regarding the financing of EU interconnections. This would leave ample room for member states to come up with proposals on how to finance the purely domestic parts of energy infrastructure.²²

A blueprint for developing cross-border cooperation could come from the North Sea, an area which is key to achieving energy security. This region includes a lot of offshore wind potential, which could be pivotal for Europe's electrification and production of hydrogen. The European Network of Network Operators for Hydrogen, the European Network of Transmission System Operators and the European Network of Transmission System Operators for Gas should work together to establish clear and ambitious offshore hydrogen production targets, favouring innovative financing models such as tax incentives, public guarantees and hydrogen purchase agreements. Together, these could significantly boost investment and mitigate financial risks. Encouraging public-private partnerships and utilising advanced technologies will foster cost-efficient development. Infrastructure that integrates hydrogen production with existing energy systems and industrial hubs should be promoted to optimise space and resources, ensuring a resilient and efficient transition to a hydrogen-based economy.²³

Boosting cleantech and industrial decarbonisation

To drive the green transition, the EU must establish innovation incentives that support startups while also signalling the temporary nature of certain financial instruments, offering predictability to companies, investors and the public sector. By providing clear and consistent support for innovation, the EU can foster the development of new technologies and business models that contribute to industrial decarbonisation and energy resilience.

²¹ EPICO and Aurora Energy Research, *Accelerating a Technology-Neutral Flexibility Strategy for the German Power Market* (Berlin, 2024).

²² Draghi, *The Future of European Competitiveness*, 59.

²³ S. Williams et al., *Connecting Borders Through Offshore Hydrogen: Infrastructure and Financing in the North Sea*, EPICO Klimainnovation (Brussels, 2024), 5.

Strengthening the single market will also entail creating a conducive environment for innovation, hence providing increased support for SMEs and cleantech startups. It is crucial to enhance regulatory harmonisation and simplify bureaucracy, thus reducing compliance costs and barriers for businesses. In contrast to mere subsidies, greater integration can foster competition and leverage economies of scale. Tax incentives, grants and public guarantees are all tools that could enhance the bankability of smaller companies, and should therefore be further developed and implemented.

The EIB should thus expand the rollout of public guarantee products to support cleantech manufacturing and reinforce EU competitiveness. Enhancing guarantees for manufacturing and loans, supporting long-tenure investments and facilitating access to green capital markets could all aid this much-needed innovation. The EIB should also provide guarantees to reduce risk and increase private investment, ensuring European manufacturers can scale production and maintain market leadership in the global green energy transition.²⁴ Creating a single market for innovation that prioritises these agents of change, rather than solely the incumbents, will harness the EU's domestic potential.

The NZIA recommends the use of energy regulatory sandboxes,²⁵ and these should be swiftly implemented to expedite the adoption of new and less-developed technologies and to streamline regulatory frameworks for fostering innovation across the member states. Developing such sandboxes could provide the ability to test new technologies, market mechanisms and business models in key areas such as demand-response, energy-storage and smart-grid technologies in a controlled environment. This would enable critical issues to be identified and resolved, enhancing Europe's energy system flexibility. One such issue relates to market barriers, predominantly the diverse compensations that aggregators have to pay to suppliers in some member states.²⁶ Policymakers should therefore systematically establish sandboxes across the EU in a speedy and coordinated way to enable the exchange of information and the identification of common obstacles.

Forming polycentric energy and climate partnerships

Bilateral partnerships should complement multilateral ones, with the EU Global Gateway enhancing cooperation with third countries through investments and additional funding to better mitigate the risks associated with energy import dependencies and to ensure a stable supply of essential resources.

For example, EU hydrogen diplomacy in the Middle East and Africa should focus on partnerships with local communities, enhancing sustainability standards and boosting financial support for renewable hydrogen projects. This would ensure local stakeholders are involved and benefit from hydrogen initiatives, promoting socio-economic development. Two key parallel approaches are also needed. First, establishing enhanced sustainability standards is key to minimising environmental impacts, for example, ensuring water use is managed responsibly and biodiversity is protected. Second, the international part of the European Hydrogen Bank needs to overcome investment barriers and scale up projects.²⁷

Whereas the domestic pillar of the hydrogen bank is already underway, with two auction rounds having taken place, the structure of the international pillar still needs to be developed. This could be done in three complementary ways. The first would be to combine default guarantees with supply-side auctions to reduce investment risks and incentivise renewable hydrogen production by covering the gap between production

²⁴ B. Weber, *An Industrial Agenda to Increase Germany's Energy Resilience*; Cleantech for Europe, 'The EIB's Strategic Roadmap 2024–2027 Should Stimulate More Public Guarantees to Unlock the EU's Cleantech Competitiveness' (Brussels, 2024).

²⁵ Energy regulatory sandboxes are controlled environments where innovative energy technologies or business models can be tested under relaxed regulations to foster development without regulatory risks.

²⁶ G. Sgaravatti, 'Electricity Tariffs Dashboard', *Bruegel* (Brussels, May 2024).

²⁷ EPICO Klimainnovation and the Iberdrola Energy and Climate Chair of the College of Europe, *EU Hydrogen Diplomacy in Africa and the Middle East*.

costs and market prices. The second would be to develop a robust infrastructure, including pipelines and terminals, to support hydrogen imports and create a stable market. The third would be to implement import prioritisation benchmarks, ensuring alignment with sustainability goals and supporting global energy transition targets. For example, the European Hydrogen Bank should facilitate matchmaking between hydrogen producers and consumers to bridge supply and demand gaps, thereby fostering efficient transactions and maximising the limited molecules available.²⁸

Going forward, EU policy should focus on stronger climate diplomacy. The Climate Club, which was launched at the Conference of the Parties 28 in 2023, offers another framework for establishing partnerships outside of bilateral and multilateral relationships in emission-intensive industrial sectors (e.g. steel and cement), and its potential should be harnessed for future industrial policy in the EU. By following a sectoral model, it could foster knowledge exchange and enhance climate finance mechanisms. Cooperation should focus on upstream areas (e.g. green iron ore, renewable hydrogen and scrap) and downstream areas (e.g. markets for climate-friendly steel products).²⁹

The EU should also decouple discussions on the Carbon Border Adjustment Mechanism from the Climate Club to avoid contentious debates and missed opportunities for cooperation. For example, in the steel sector, the priority should be to seize ‘quick wins’ by promoting green steel and the use of renewable hydrogen, and to lead in the markets for intermediate and finished products through promoting green public procurement. Additionally, the EU should provide financial and technical support for green steel projects and create a conducive environment for dialogue to build trust among member countries, which could enable cooperation on more challenging decarbonisation issues in the future.³⁰

Conclusion

Ongoing challenges predominantly stem from the discrepancies between the EU’s decarbonisation goals, the involvement of energy-just international energy partnerships and the need for economic growth. This calls for a stark paradigm shift in EU energy and climate policymaking.

The EU stands at a critical juncture. By strengthening both its single market and the electricity market, supporting innovation and enhancing international cooperation, the EU can build a resilient and sustainable energy framework. Taking these measures will mitigate the risks associated with geopolitical tensions and ensure a reliable supply of energy, fostering a secure and prosperous future.

EU energy security and resilience could be significantly enhanced through a combination of strategic policy interventions and international cooperation. By focusing on technological innovation, supporting SMEs and cleantech startups, and fostering diversified partnerships, the EU can reduce its dependency on external sources and build a more resilient energy system. This will require a concerted effort, but will achieve a secure, resilient and net-zero energy future that benefits all citizens and industry.

²⁸ B. Lotz et al., ‘Design Options for a European Hydrogen Bank’.

²⁹ P. Kumar, *Piloting the Climate Club in the Steel Sector*, EPICO Klimainnovation (Berlin, 2023).

³⁰ Ibid.

	Programme 1	Programme 2	Programme 3
	Implementing a future-proof electricity market	Boosting cleantech and industrial decarbonisation	Forming polycentric energy and climate partnerships
Project 1	Shift subsidies from fossil fuels to guarantees of PPAs for SMEs to boost market-driven renewable-energy expansion. Provide EU-wide guidelines for complementary two-way CfDs that incentivise innovation and efficiency. Develop an EU-wide storage and flexibility strategy on the demand side. Ensure EU compatibility of capacity mechanisms, complementing hydrogen-ready gas or nuclear power plants.	Establish innovation incentives to support startups and signal that European carbon CfDs are temporary, offering predictability to companies, investors and the public sector. Carbon CfDs should be linked to the EU Emissions Trading System, initially have a term of 10 years, and be focused on applications where they provide clear added value in terms of resilience.	Couple hydrogen diplomacy with EU climate diplomacy. Support third countries in developing a voluntary certification scheme for green hydrogen and its derivatives that is aligned with EU requirements. The European Commission should identify key regions that are only taking the first steps in the hydrogen economy and provide concrete support to them on the formulation of standards and certification.
Project 2	Improve the long-term visibility of infrastructure planning and underpin it with binding political commitments that encourage financial investment to ramp up supply chains. Grid capacity bottlenecks cannot cope with an ambitious RES expansion.	The EIB should pursue its rollout of guarantees, focusing on scaling manufacturers of clean technologies through coverage of up to 80% of the risk. Such guarantees should aim to make cleantech bankable in the long term. The European Commission should schedule related funding for the next Multiannual Financial Framework.	Boost the energy pillar of the Global Gateway with projects aimed at mobilising additional funding to import hydrogen derivatives, through guarantees and support for off-takers. Priority should be given to sectors with the highest potential for carbon emissions abatement.
Project 3	ACER, INNOH, the European Network of Transmission System Operators and the European Network of Transmission System Operators for Gas should further detail hydrogen infrastructure planning. The first step should be to develop an integrated offshore and onshore hydrogen infrastructure plan for the North Sea as a blueprint to be replicated in other key areas in the EU.	Simplify, standardise and speed up the application process for permits and licences. To this end, energy regulatory sandboxes should be swiftly further detailed on a sector-by-sector basis, with the eventual aim of enabling regulators to assess the effectiveness of different regulatory approaches and their impacts on the EU's energy system.	Strengthen the EU's role in the Climate Club established by the G7, particularly in cooperation on sectoral strategies for industrial decarbonisation. The Climate Club offers a framework for establishing partnerships outside of bilateral and multilateral relationships in hard-to-abate industrial sectors. It could play a crucial role in enhancing the international dimension of the EU's climate resilience.

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Supporting EU Clean Technologies

by Artur Patuleia and Domien Vangenechten

Summary

The recently announced Clean Industry Deal presents an opportunity to realise the EU's ambitions for leadership in clean technologies in a challenging geo-economic context. If implemented correctly, it has the potential to be the overarching initiative that aligns markets, incentives and institutions with the need to foster investment in industrial decarbonisation and scale up the manufacturing of EU clean technologies. To stay competitive, the EU must be able to create new market opportunities, address infrastructure gaps, simplify administrative processes, and put in place time-limited and targeted financing instruments to support its investment needs. The EU will also be required to pursue mutually beneficial international partnerships that create local added value, going beyond access to critical raw materials, if Europe is to thrive in the new geopolitical reality. The Union's institutional setting should also be addressed to enable it to capitalise on regional strengths and be ready to coordinate the implementation of instruments at the regional and national levels.

Keywords Industrial strategy – Clean technologies – Competitiveness

Introduction

In the European Green Deal the EU has found a guiding compass in times of crisis, putting a green recovery at the heart of its Covid-19 response¹ and accelerating the energy transition as the means to combat the spiralling energy prices caused by Russia's invasion of Ukraine.² In the first seven months after Russia's invasion, the EU saved €99 billion in gas imports thanks to renewable energy generation.³

The EU is currently facing a polycrisis. Geopolitical tensions are rising, with two wars raging in its backyard. Europe's sluggish economy has been battered by an energy crisis, inflation, surging capital costs and a trade shock resulting from new Chinese competition in key European sectors, such as the automobile industry,⁴ while also dealing with ever-intensifying climate impacts.⁵ This situation has raised fundamental concerns about the resilience of the European economy, especially its manufacturing sector. As with any guiding compass, the European Green Deal will need to continuously adapt to these new circumstances to function effectively.

As questions around the future of Europe's industrial base and the bloc's relevance in strategic value chains, including the production of semiconductors, advanced artificial intelligence, biotech and clean technologies, are dominating the EU political debate, boosting the EU's manufacturing base is going to be a key political priority for the next five years.

With the announcement of a Clean Industrial Deal as part of her successful re-election bid,⁶ Ursula von der Leyen firmly embedded her response to these questions in the European Green Deal. The Clean Industrial Deal seeks to boost Europe's business case for clean manufacturing as it charts a pathway to achieving an emissions reduction of at least 90% by 2040, and climate neutrality by 2050. The coming years will be key to delivering this agenda.

¹ European Commission, *Europe's Moment: Repair and Prepare for the Next Generation*, Communication, COM (2020) 456 final (27 May 2020), 6–8.

² European Commission, *REPowerEU Plan*, Communication, COM (2022) 230 final (18 May 2022), 1.

³ P. de Pous et al., 'More Renewables, Less Inflation – Restoring EU Economic Stability Through Investment in Renewables', *E3G and Ember*, 17 October 2022, 4–5.

⁴ A. Al-Haschimi et al., 'Why Competition With China is Getting Tougher Than Ever', *The ECB Blog*, 3 September 2024.

⁵ European Environmental Agency, *European Climate Risk Assessment*, Report no. 1/2024 (11 March 2024), 61–72.

⁶ U. von der Leyen, *Europe's Choice. Political Guidelines for the Next European Commission 2024–2029*, European Commission (18 July 2024), 6.

Clean industry for Europe's prosperity

The case for clean industrial manufacturing has never been stronger

In recent years, we have seen evidence that sustained investment in decarbonisation will make Europe's economy more resilient and competitive, while also generating economic growth. Nearly one-third of the bloc's economic growth already results from the deployment and manufacturing of clean technologies.⁷ To meet decarbonisation efforts, investments in clean-energy manufacturing more than doubled between 2022 and 2023. Climate policies have also set the conditions for the EU to be a leader in critical clean technologies—such as electrolyzers, heat pumps and wind—and to host global-level flagship industrial decarbonisation initiatives—as is the case for green steel and cement.

A thriving European industry with a strong presence in net-zero value chains built on solid competitiveness fundamentals will be a strong lever to create more and better jobs—up to 1.6 million by 2035 and 2 million by 2040, according to some estimates.⁸ This will contribute to making the EU economy more productive and add to the fundamentals of global knowledge and innovation leadership.

Competition from China and the US is fierce

The benefits of having a strong presence in strategic clean-industry value chains have been driving a global race to secure technological leadership and manufacturing capacity. This has led to strong competition for the EU's own global position in these new industries. China's active industrial policies have created new players, in some cases making innovative products in critical technologies, that are competing for an increased market share globally, including in the EU. China's leadership in lithium iron phosphate battery technology is already affecting decisions about investments in new battery plants by European manufacturers.⁹ The Inflation Reduction Act in the US has introduced a mix of tax incentives, grants and loan guarantees¹⁰ to promote clean-technology manufacturing, leverage innovation and decarbonise existing industrial capacity, causing some manufacturers to rethink investments in the EU.¹¹

But whilst China and the US have been rolling out policies aimed at driving massive public and private investment to scale up the manufacturing capacity of strategic clean technologies, the EU has not been able to follow suit in this area of climate policy. Rather, the Union has largely relied on the expectation that the demand resulting from economy-wide climate targets and incentives would be a sufficient driver for local manufacturing investment, and that the necessary economic shifts would not require decisive industrial policy action. While this might have worked a few decades ago, today's world is different, and far-sighted and strategic industrial policy—predominantly in China—has been able to anticipate and capture these emerging markets.¹²

With the benefit of hindsight, one can conclude that the EU's policy framework has not met expectations, but has opened up its market to competitors. The imperative to course-correct has become even more pressing since recent crises have exposed Europe's vulnerabilities to supply-chain disruptions and external fossil-fuel supply shocks, raising fears of social instability and deindustrialisation. The increase in the gap in GDP between the EU and the US, in purchasing power parity terms,¹³ has further fuelled these fears, increasing the pressure on the EU to focus more on investing in new sources of growth.

⁷ L. Cozzi et al., 'Clean Energy Is Boosting Economic Growth', *IEA*, 18 April 2024.

⁸ L. Kalcher and N. Makaroff, *Forging Economic Security and Cohesion in the EU*, Strategic Perspectives (Brussels, 11 April 2024), 25.

⁹ H. Dempsey et al., 'Europe's Battery Industry Hit by EV Slowdown', *Financial Times*, 8 July 2024.

¹⁰ J. Badlam et al., 'The Inflation Reduction Act: Here's What's in It', *McKinsey & Company*, 24 October 2022.

¹¹ J. Smyth and P. Nilsson, 'German Companies Flock to US With Record Pledges of Capital Investment', *Financial Times*, 19 February 2024.

¹² A. Bentley and J. Nahm, 'Strategies of Green Industrial Policy: How States Position Firms in Global Supply Chains', *American Political Science Review* (2024), 2–3.

¹³ M. Draghi, *The Future of European Competitiveness – A Competitiveness Strategy for Europe*, European Commission (9 September 2024), 8.

To prosper, Europe needs to adapt

Although the EU recognises the need to adapt to a new global context, its flagship policy package—the Green Deal Industrial Plan (GDIP)—has disappointed many observers.¹⁴ The Plan mainly relies on national policy instruments and state aid support, does not sufficiently address the challenges of heavy industry, and is not backed by the financial, regulatory and coordinating capacity necessary to foster innovation and strengthen European unity. Most of all, due to the lack of a concrete vision and strategy for the future of Europe’s industry rooted in an analytical assessment of its strengths and leadership opportunities, the GDIP tries to support too many objectives with too few means, while also causing concerns about the integrity of the internal market through its relaxation of state aid rules.¹⁵

Ultimately, the emerging fragmented approach is jeopardising the integrity of the internal market, and there is a risk that the lack of concrete action to support EU clean technologies will be compensated for by defensive trade measures intended to protect against foreign competition—an area in which the EU does have clear competences, in contrast to fiscal and industrial policy. The current approach will likely fail to raise the necessary investments to scale up manufacturing capacity, negatively affect Europe’s stance among key trading partners, and make the transition more expensive for households and businesses.

The hope of EU technological leadership in tomorrow’s net-zero economy may fade away, with businesses delaying investment decisions to transform production or to scale up clean-technology manufacturing, while key competitors cement their dominant positions in the clean-technology markets, as has already been seen with regard to China’s dominance in electric vehicles and the battery value chain.¹⁶

Priorities for boosting EU clean technologies

The current approach to industrial policy—characterised by untargeted action, uncoordinated national incentives, the reshuffling of existing EU funds, defensive trade measures and sometimes unstable regulatory signals—will not enable Europe to compete in today’s world.

The recently announced Clean Industrial Deal presents an opportunity to hit the reset button. It needs to ensure that the EU acts strategically and in unity, focusing on regulation that enables innovation and scales up markets, driving investments supported by time-limited and targeted financial support, and forging mutually beneficial partnerships to build resilient supply chains.

If successful, it would mean securing strategic industrial capacity and capturing market share in the fast-growing clean-technology market, which already represents 10% of global GDP growth.¹⁷ As a key enabling condition, the decarbonisation of the power system by 2035 would lead to a further reduction in fossil-fuel use, improving energy security and increasing resilience to fossil-fuel supply shocks—achieving a 90% emissions reduction could save up to €856 billion in gas, oil and coal imports.¹⁸ A more efficient and productive industry would create high-quality jobs generating higher added value.

¹⁴ S. Tagliapietra, R. Veugelers and J. Zettelmeyer, *Rebooting the European Union’s Net Zero Industry Act*, Bruegel (22 June 2023), 5–8; N. Re-deker, ‘Chasing Shadows: What the Net Zero Industry Act Teaches Us About EU Industrial Policy’, *Hertie School Jacques Delors Centre* (1 March 2024), 2–3; A. Waliszewska et al., *How to Make the Best of the Green Deal Industrial Plan: Pragmatic Recommendations for Policy Makers*, E3G (22 May 2023), 3.

¹⁵ S. Ferraro, G. Cannas and K. van de Castele, ‘The Use of Crisis State Aid Measures in Response to the Russian Invasion of Ukraine (Until End-June 2023)’, *Competition State Aid Brief 1/2024* (February 2024), 1–9.

¹⁶ Dempsey et al., ‘Europe’s Battery Industry Hit by EV Slowdown’.

¹⁷ Cozzi et al., ‘Clean Energy Is Boosting Economic Growth’.

¹⁸ Kalcher and Makaroff, ‘Forging Economic Security and Cohesion in the EU’, 14–15.

For this, three interlinked priorities need to be considered.

Creating an inducive environment for the scaling up of clean manufacturing

1. *Effective regulation.* Long-term demand targets, standards and public procurement instruments would improve market visibility, supporting businesses in their investment decisions and transition plans. They would also leverage research and development investment and strengthen the business case for net-zero technologies. These instruments are key to de-risking and scaling up manufacturing expansion, driving an increased global market share.
2. *Skills.* The electrification of industrial processes and the manufacture of high-added-value technologies would increase productivity and create more and better-paid jobs. This will require local upskilling and reskilling. Better jobs—unionised, secure and well paid—are a cornerstone of the broader societal benefits of a clean-industry agenda.
3. *Clean transition partnerships.* Balanced and fair partnerships with emerging economies would ensure long-term supply-chain resilience for EU clean industries. These partnerships need to drive local added value and support the transition, thereby constituting a relevant lever for development and improving the EU's geopolitical position.

Making clean power a cornerstone of Europe's energy security and competitiveness

1. *Decarbonised power by 2035.* Abundant renewable energy would ensure that businesses have access to affordable power, could improve efficiency and would be less exposed to external fossil-fuel supply shocks. This is reflected in demands by European businesses to have access to clean energy. Clarity on a target of 2035 for power-sector decarbonisation would improve grid investment planning and delivery, accelerating renewable energy integration and the electrification of industrial processes—other major economies, such as the UK and the US, have already followed this pathway.¹⁹ The benefits of accessing clean energy can be maximised by taking decisive action to electrify the EU's industrial base, spurring productivity and efficiency.
2. *Digital grids.* Local flexibility markets are critical to integrating increased electricity demand and renewable-energy generation. They enable efficient energy system development and ensure consumer access to the cheapest costs. For this, the priority should lie in deploying digital infrastructure (e.g. smart meters) and setting the standards for the rapid and harmonised implementation of local flexibility markets.
3. *Strengthening the energy infrastructure planning framework.* The manufacturing of clean technologies, such as batteries, requires a lot of energy. This will come on top of increased demand for clean energy—electricity in particular—from sectors that need to decarbonise, such as industry. To avoid infrastructure bottlenecks jeopardising the viability of projects, energy system operators need to understand where, when and how much future demand to anticipate—as demonstrated by the situation in the Netherlands, where grid connection constraints are affecting business investment.²⁰ The EU needs to adapt infrastructure governance structures to ensure timely and cost-effective delivery. This will require fully independent systems operators and cross-vector energy system planning to create the strategic spatial energy plan that is required.

¹⁹ UK Department for Business, Energy and Industrial Strategy and K. Kwarteng, 'Plans Unveiled to Decarbonise UK Power System by 2035' (7 October 2021); The White House, 'Factsheet: President Biden Sets 2030 Greenhouse Gas Pollution Reduction Target Aimed at Creating Good-Paying Union Jobs and Securing U.S. Leadership on Clean Energy Technologies' (22 April 2021).

²⁰ T. Sterling, 'Dutch Employers Warn Electric Grid Problems Are Harming Investment', *Reuters*, 22 January 2024.

Setting up EU institutions to deliver support for clean technologies through joint industrial policy

1. *An industrial strategy to leverage common strengths.* Many of Europe's strengths are regional, such as the established industrial bases, skills, and access to low-cost renewables and critical raw materials in south-western Europe. Being able to tap into the low-cost clean energy that is available in some European regions would strengthen the viability of retaining the energy-intensive parts of value chains within the EU.²¹ An EU industrial strategy should identify priority industries, and locational strengths and value chains, and then seek to grant support through competitive bidding processes to ensure efficient resource allocation.
2. *A dedicated governance and coordination structure.* Better coordination in developing EU net-zero value chains, considering priority industries and locational factors, would lead to the more efficient allocation of public and private capital and better mobilisation of labour resources. Coordination also needs to deliver administrative simplicity for businesses to enable them to participate in EU net-zero value chains.
3. *Well-resourced administration for fast and responsive decision-making.* Reducing the asymmetric delivery of the European Green Deal would ensure businesses across the bloc have similar opportunities to improve their competitiveness and participate in EU net-zero value chains. It is therefore critical to enhance national administrative capacities and make sure that independent expert advice is integrated into the infrastructure planning framework.

Conclusion

The EU is facing a moment of truth with regard to securing its future economic prosperity. With the global economy quickly moving to net zero and competition heating up, bold action to scale up clean-technology manufacturing and invest in cutting-edge innovation is essential for the EU's relevance in tomorrow's economy.

Clean technologies are becoming increasingly strategic assets for international influence and delivering socio-economic growth and stability. They represent a fast-growing market sustained by advanced technologies and will increasingly shape global supply chains and trade balances. The benefits of capturing a relevant market share of these new technologies have been driving strong competition from China and the US, with these players putting in place assertive industrial policies which are creating uncertainty in the EU.

Although the EU is starting from a solid leading position, its industrial policy framework needs to be made fit for a global economy that is going through a fundamental transformation, where the dynamics of competition are changing. The publication of the GDIP shows that there is a risk of creating ineffective responses that do not address fundamental shortcomings.

The recently announced Clean Industrial Deal is Europe's opportunity to get things right. This flagship initiative should leverage market creation signals and combine this with decisive action to scale up manufacturing, transform existing industrial capacity and invest in groundbreaking innovation. The initiative should learn from the recent crisis responses and prioritise coordinated EU-level action supported by a strong governance framework that taps into Europe's regional comparative advantages and ensures the effective use of public funds. The stakes are high, and only united action can set the structural conditions for the EU's future competitiveness and prosperity.

²¹ S. Gokbekir et al., 'The Future of Energy-Intensive Industry in Northwestern Europe: A Balancing Act', *PwC*, 24 April 2024, 4–5.

	Programme 1	Programme 2	Programme 3
	Creating an inductive environment for the scaling up of clean manufacturing	Making clean power the cornerstone of Europe's energy security and competitiveness	Setting up EU institutions to deliver support for clean technologies through joint industrial policy
Project 1	Ensure long-term clarity for clean manufacturing by delivering stable policy and demand signals. Regulatory instability is the Achilles heel of nascent industries—the EU should set transparent long-term objectives supported by the rollout of demand–pull instruments such as those relating to standards or public procurement.	Launch the necessary initiatives on key enabling technologies (e.g. non-fossil flexibility, smart grids, labour shortages) to put the EU on track to be a decarbonised power system by 2035. This would enable European businesses to have access to cheap and abundant renewables and would reduce exposure to future fossil price and supply shocks.	Develop a coherent EU industrial strategy which leverages the EU's collective strengths and the single market. This requires identifying strategic industries and their value chains; considering the added value of EU cooperation; and building on the existing skills, manufacturing hubs and competitive advantages of diverse geographical areas.
Project 2	Make job attractiveness a priority and ensure upskilling delivers locally and inclusively. To be attractive to workers, new clean industries must deliver quality jobs: unionised, secure, well-paid, safe and socially well-respected. Incentives such as financial breaks should be designed to reskill and employ locally, enhance foundational skills and target those in precarious employment.	Invest in the digitalisation of grids to enable the implementation of demand-side management solutions and the faster rollout of clean technologies such as batteries, heat pumps and electric vehicles, and to reduce the exposure of electricity prices to gas markets. This will also strengthen the EU's market-leading position in clean-technology solutions and manufacturing.	Set up a dedicated governance and coordination structure for EU industrial policy with sufficient analytical capacity and competences to identify and support projects across the value chain of (strategic, clean) industries. It should also explore the possibility of a European funding approach that offers a structural and long-term financing solution to complement national investments.
Project 3	Develop strategic and mutually beneficial clean transition partnership models with emerging economies to build resilient supply chains, while supporting partner countries to navigate the global energy transition. Secure diversified, long-term access to critical supplies and contribute to economic development in partner countries.	Move forward with independent and integrated infrastructure planning to manage energy system costs. Coordination is needed to achieve mass electrification, the uptake of hydrogen, and the deployment of carbon capture and storage solutions—all while decommissioning chunks of the existing gas grid in a cost-effective way.	Support the enhancement of national, regional and local administrative capabilities to coordinate strategic planning and infrastructure development, as well as to streamline permitting. Regional comparative advantages (e.g. in the form of skills or natural resources) risk remaining under-exploited due to uneven capacities to develop and deliver policies to attract or scale up clean-technology investments.

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Securing Europe's Independence in Critical Raw Materials and Technological Components

by Frank Umbach

Summary

The paper analyses the EU's present import dependence for critical raw materials (CRMs)—particularly on China—and its efforts to 'de-risk' this through various countermeasures in the EU's raw material policies. It reviews such policies since 2008 (with a focus on the EU's Green Deal and its Critical Raw Materials Act), the challenges for the EU considering the rapidly rising global demand for CRMs, the implications for its foreign raw material policies and the inherent conflicts of competing strategic objectives. It concludes by making the following three major recommendations, and providing details of the concrete measures to be taken: (1) expanding domestic mining and stockpiling with sustained political, public and financial support; (2) strengthening the EU's foreign raw-materials policy; and (3) promoting the 'de-risking' of the supply chain for CRMs and disruptive technologies (components).

Keywords Critical raw materials – Energy transition – Green technologies – Supply chains – Import diversification – Refining – Stockpiling – De-risking

Introduction

The global energy transition and climate-change targets (i.e. limiting global warming to 1.5°C) are becoming ever more dependent on the critical raw materials (CRMs) which are required for green technologies.¹ Alongside the increasing geopolitical rivalries, China's control of many CRMs has also become a major concern for Western arms industries and in terms of the resilience of CRM supply chains in major crises or conflicts with China.² A US analysis warned last May: 'The countries that are able to secure their own supply chains for critical technologies will be in the position to write the rules of global economic governance for years to come'.³

China is the world's largest producer of green technologies such as solar cells, wind turbines and electric vehicles (with a 60% share of the global market). It has benefited from its strong position in raw-materials extraction and processing for green technologies and electromobility from the outset, and uses its strategically dominant position in mining, metallurgy and materials science to its advantage. New developments in its supply chains are not constrained to increasing mining, but complete the process by adding refining, reprocessing, recycling and manufacturing systems.

In contrast to China, the EU is heavily dependent on imports of CRMs from abroad (100% for primary metals)—and thus on access to foreign mines and the availability of their products on the international commodity markets. Currently, China supplies 98% of the EU's rare-earth elements (REEs) and around 62% of the 34

¹ See also F. Umbach, *Energy Security in a Digitalized World and Its Geostrategic Implications*, Konrad Adenauer Foundation (Hong Kong, September 2018); F. Umbach, *The New 'Rare Metal Age'. New Challenges and Implications of Critical Raw Materials' Supply Security in the 21st Century*, S. Rajaratnam School of International Studies and Nanyang Technological University, Working Paper no. 329 (Singapore, 27 April 2020); F. Umbach, *Strengthening Energy Security and Building Resilience in the Asia-Pacific*, UN Economic and Social Committee in Asia and Pacific (Bangkok, 2021).

² G. Wischer, 'The U.S. Military and NATO Face Serious Risks of Mineral Shortages', *Carnegie Endowment*, 12 February 2024; J. Emont, 'America's War Machine Runs on Rare Earth Magnets. China Owns That Market', *Wall Street Journal*, 4 May 2024; M. Bazilian and G. Wischer, 'The West Needs to Produce More Critical Minerals. Here's How the Pentagon Should Help', *Defenseone.com*, 30 May 2024; L. Zhen and S. Hyeon Choi, 'The US Wants to Decouple Its Military Supplies From China – But Can It?', *South China Morning Post*, 18 June 2024; F. Umbach, 'Rare Earth Minerals Return to the U.S. Security Agenda', *Geopolitical Intelligence Service* (1 August 2019).

³ R. C. Berg, H. Ziemer and E. Polo Anaya, 'Mineral Demands for Resilient Semiconductor Supply Chains. The Role of Western Hemisphere', *CSIS Briefs*, Washington, DC (May 2024), 1.

CRMs defined as such by the EU in 2023.

REEs are just one example of how China dominates the global supply of CRMs, the country being responsible for nearly 80% of global production of the 17 REEs and more than 90% of their refining processes. Currently, Chinese companies also control about 80% of global refined cobalt production, more than 60% of global lithium-ion production capacity and 75% of all lithium-ion battery production. China is the only superpower to have positioned itself so dominantly in the entire clean-tech supply chain and the mining, metallurgy and materials science fields.

In a move comparable to Russia's gas-export policies, China weaponised its production and export monopoly of REEs as early as 2010. This was the result of an escalating maritime territorial and resource conflict with Japan, which led to the imposition of an export ban on REEs to Japan without any prior notice. At that time China controlled some 97% of the global production of REEs, despite having less than 40% of the world's reserves and only 57% of global resources. Towards the end of the 38-day diplomatic conflict between China and Japan in autumn 2010, the US and the EU were also drawn in when Japan began importing Chinese REEs from them, thus circumventing the direct export ban.⁴

New disruptive technology developments, such as batteries for electromobility, are having a lasting impact on geopolitical dynamics regionally and globally. They require new supply chains, trade routes and strategic partnerships, including to secure the supply of CRMs. This is leading to the forging of new geopolitical alliances and geo-economic rivalries that need to be anticipated in the EU's economic, trade, foreign and security policies.

In 2017 a World Bank study explicitly warned that the global energy transition and climate-protection policies would demand significantly greater use of CRMs. The warning was confirmed by a report from the UN Environment Programme (UNEP) in the same year: the envisaged 2°C limit to global warming would require around 600 million tons more metallic raw materials than a 6°C target by 2050. The International Energy Agency has forecast that the global demand for CRMs could rise to 40 times the 2020 level by 2040. According to industry forecasts, global demand for the REEs used in magnets could increase fivefold by 2040.⁵ Given the rocketing demand for copper for achieving net-zero targets, as much new copper will be required as the world has produced in all recorded history.⁶

Generally speaking, there are no acute geological restrictions on the availability of CRMs, including REEs. However, there are concrete limitations to extraction, processing and recycling due to geopolitical and geo-economic risks, as well as domestic constraints in the producing and exporting countries (restrictive environmental regulations, lack of good governance, resource nationalism, lack of local public acceptance etc.). Hence, the global supply of many CRMs is limited to coming from a few, often politically unstable, countries. Furthermore, global competition for access to these CRMs will further intensify due to the needs of the global energy transition, electromobility, the digitisation of all industrial sectors and our private lives, and the development of artificial intelligence.

⁴ See also Umbach, *Energy Security in a Digitalized World and its Geostrategic Implications*, 50.

⁵ See also World Bank Group, *The Growing Role of Minerals and Metals for a Low Carbon Future*, (Washington, DC, June 2017); UNEP, *Sustainable Trade in Resources: Global Material Flows, Circularity and Trade* (Nairobi, 14 May 2020); UNEP, *Mineral Resource Governance in the 21st Century. Gearing Extractive Industries Towards Sustainable Development* (Nairobi, 2020); OECD, *Global Material Resources Outlook to 2060* (Paris, 2020); D. Gielen, *Critical Minerals for the Energy Transition*, International Renewable Energy Agency, Technical Paper 5/2021 (2021); International Energy Agency, *The Role of Critical Minerals in Clean Energy Transitions* (Paris, 2021); International Energy Agency, *Global Critical Minerals Outlook 2024* (Paris, May 2024); World Bank Group, *Minerals for Climate Action: The Mineral Intensity of the Clean Energy Transition* (Washington, DC, 2020)

⁶ See V. Beiser, 'The Green Economy Is Hungry for Copper – and People Are Stealing, Fighting, and Dying to Feed it', *Wired.com*, 22 August 2024.

Against this backdrop of growing dependence on the import of CRMs, particularly from China, Western mining projects and plants often have to cope with exploding investment needs and budgets, delays, missed production goals and insufficient commercial profitability. They all have to compete with low and subsidised Chinese prices. The involvement of any Western project will ultimately increase the price of the final product—be it renewables or already expensive high-tech Western weaponry. Rare-earth magnets produced in the US, for instance, are around 50% more expensive than Chinese ones. Moreover, even new Western reprocessing projects have to rely on Chinese technology, which China could cut off access to. Last year, it banned exports of REE-processing technologies.

Beijing is seeking to control key technology and value chains to further its strategy of asymmetric interdependence. In 2024 it ordered its state-owned companies to increase annual REE production by almost 13%, up to 135,000 tons. Its deliberate overproduction—on top of lower demand growth than expected—has already dropped prices to a three-year low, hampering Western counter-strategies for building up alternative REE supply chains.⁷ Beijing has also curbed the export of antimony, another CRM vital to the Western defence industry. China has also reportedly discovered a large potential reserve of REEs in the Himalayas, where it has a long-standing violent territorial conflict with India. Together with its increased mining of CRMs in Afghanistan and its huge CRM reserves, this discovery could further strengthen its dominant global market position.⁸

EU raw-materials policies and strategies since 2008

European awareness of supply-chain issues has changed in recent years due to the EU's pandemic experience with critical-supply disruptions and the concerns arising from the geopolitical overdependence of Western supply chains on China. China is no longer seen just as an economic partner and competitor, but also as a 'systemic (geopolitical) rival'.⁹ As early as 2018, Vice-President of the European Commission Maros Sefcovic warned that CRMs could become the 'new oil'.¹⁰

Although the European Commission introduced a common raw-materials policy in 2008, it was not until 2017 that the Commission, Germany and some other member states began to push ahead with appropriate industrial strategies to meet the challenges of raw-material supply for electromobility and the construction of European battery gigafactories. Currently, the EU27 can only cover 9% of the EU's total raw material needs. Europe accounted for only 5% of the world's mining in 2020 and is the only region in the world with a declining mining industry. Global demand for lithium could increase eighteen-fold, cobalt by fifteen-fold by 2030 and by sixty-fold by 2050. Demand for REEs could increase tenfold by 2050.¹¹

Both Germany's and the EU's raw-materials policies have promoted a 'three-pillar strategy' since 2010. These pillars comprise: (1) using domestic raw materials; (2) importing primary raw materials not available in

⁷ C. Lu, 'China's Antimony Curbs Expose U.S. Critical Mineral Supply Chain Vulnerabilities', *Foreign Policy*, 23 August 2024; *Economist*, 'China Controls the Supply of Crucial War Minerals', 13 July 2023; E. White, 'China's Overseas Investment in Metals and Mining Set to Hit Record', *Financial Times*, 31 July 2023; C. Cytera, 'China, Gallium, and Germanium – the Minerals of the Chip War', *Cepa.org*, 8 August 2023; P. Andersson, *The Growing Secrecy Around China's Mineral Resource Planning, Implications for the EU*, Swedish National China Centre, Commentary 2/2024 (2024); C. Lu, 'Beijing Tightens Its Grip on Critical Mineral, Rare-Earth Supply Chains', *Foreign Policy*, 7 November 2023; J. Emont, 'China Is Winning the Minerals War', *Wall Street Journal*, 21 May 2024; H. Dempsey, 'Western Graphite Producers' Shares Soar After Beijing Announces Export Curbs', *Financial Times*, 23 October 2023; K. Johnson and E. Groll, 'China Raises Threat of Rare-Earths Cutoff to U.S.', *Foreign Policy*, 21 May 2019; C. Lu, 'Beijing Tightens Its Grip on the Critical Minerals Sector', *Foreign Policy*, 7 November 2023; E. Morina, 'Rare-Earth Prices Are in the Doldrums. China Wants to Keep Them That Way', *Wall Street Journal*, 15 July 2024; M. Wilowski, 'China Restricts Exports of Graphite, Key Mineral Used for Making EV Batteries', *Investopedia.com*, 20 October 2023.

⁸ See also F. Umbach, 'Chinas Interesse an Afghanistans Rohstoffreichtum. Implikationen für die EU-Versorgungssicherheit bei kritischen Rohstoffen', *Europäische Sicherheit und Technik* (July 2022); F. Umbach, 'Scenarios for Afghanistan's Critical Raw Materials', *Geopolitical Intelligence Service* (18 October 2021); S. Chen, 'Chinese Scientists Turn to Artificial Intelligence as Potential 1,000km Seam of Rare Earth Found in Himalayas', *South China Morning Post*, 21 June 2023.

⁹ See F. Umbach, 'EU-China Relations at a Crossroads: Decoupling or a European "Sinatra Doctrine"?', *East Asian Policy* 13 (Spring 2021).

¹⁰ F. Simon, 'EU's Sefcovic: Real Risk That 'Raw Materials Become the New Oil'', *Euractiv*, 20 November 2018.

¹¹ See footnote 5.

Europe; and (3) reducing dependence on primary raw materials through recycling, substitution and increasing resource efficiency.¹²

The growing concern about and geo-economic importance of the EU's current and future raw-material supply security is also reflected in the European Commission's list of defined CRMs: the number has risen steadily from 14 in 2011 to 34 in 2023. The latest list was produced after assessing 70 raw materials and minerals, comprising 67 individual materials and 3 material groups: 10 heavy REEs, 5 light REEs and 5 platinum group metals. Copper and nickel did not meet the CRM thresholds but have been included on the list of 'strategic raw materials'.

The EU's Green Deal and Critical Raw Materials Act

With the Critical Raw Materials Act (CRMA) presented in March 2022, the EU has provided a comprehensive conceptual approach to the numerous challenges to the security of the future raw-material supply for its electromobility and battery industries. The EU wants to limit and reduce demand growth for its CRMs in the medium term by introducing a circular economy with much higher recycling and reuse levels, to diversify its imports and to expand its domestic mining in Europe. The following are the goals up to 2030:

- at least 10% of annual consumption to be covered by the EU's own raw-material extraction;
- at least 40% of annual consumption to be generated by EU-based processing (instead of between 0% and 20% as before);
- at least 15% of annual consumption to be ensured through recycling; and
- a maximum of 65% of annual consumption for each CRM at all stages of processing to be imported from a single third country.¹³

The CRMA also aims to reduce administrative burdens and shorten permitting procedures for CRM projects in the EU, while still ensuring a high level of social and environmental protection. In addition, selected strategic projects will receive financial support (in Spain, Portugal, Sweden and Norway) and have shorter approval periods (27 months for extraction permits and 15 months for processing and recycling permits).

The EU and the European Bank for Reconstruction and Development have also set up a new facility under the InvestEU umbrella, providing equity investments for CRM exploration. The facility aims to mobilise €100 million in investments that will support the EU's CRMA and REPowerEU.

The EU has also contemplated the idea of buying more than 30 CRMs on the global markets as a collective buyer (following the model of the gas joint-buying platform). However, mining executive managers have remained sceptical of buying CRMs collectively.¹⁴

¹² See also F. Umbach, 'Neue Herausforderungen für die deutsche Rohstoffversorgungssicherheit', *Energiewirtschaftliche Tagesfragen* 1/2 (2020); European Commission, *Tackling the Challenges in Commodity Markets and Raw Materials*, Communication, COM (2011) 25 final (2 February 2011).

¹³ European Commission, *A Secure and Sustainable Supply of Critical Raw Materials in Support of the Twin Transition*, Communication, COM (2023) 165 final (16 March 2023).

¹⁴ A. Hancock and T. Wilson, 'Mining Industry Sceptical of EU Joint Purchasing Plan for Critical Minerals', *Financial Times*, 21 May 2024.

Challenges and policy recommendations

Despite having developed a coherent, sustainable and comprehensive strategy for CRM supply security, the implementation of the CRMA is hampered by manifold uncertainties with regard to increasing European production and expanding its processing capacities. These include cost competitiveness, bureaucratic overregulation, local failures of acceptance due to environmental and other objections, and potential Chinese counter-strategies on the global supply market.

Medium-sized industries face even greater problems with the future supply of raw materials, because they do not have direct access to international mining projects (with no shares in mining projects they have to rely on intermediary suppliers) and therefore to sufficient raw materials on the world markets, compared to large Chinese, Russian and other competitors with their own mining projects. The European extractive industry is currently not in a position to extract from new or old mines without large subsidies from the EU or its member states as these mines are barely financially competitive—especially against Chinese state-owned companies. For this reason, the EU's raw-materials policy aims to improve the framework conditions for the extraction of raw materials both from imports and domestically. As the EU has made only limited progress in diversifying its global supply chains for CRMs and disruptive technologies in recent years, the following recommendations intend to enhance the EU's security of supply for CRMs.

Expanding domestic mining and stockpiling with sustained political, public and financial support

So far, the European Commission has had much less authority over and strategic influence on the raw-materials policies of its member states than their energy and gas policies. In many cases, the policies are ineffective as the member states (rather than the European Commission) have overlooked or marginalised the inherent risks of European CRM import dependencies—particularly with regard to China. These dependencies are much higher than the former 40% dependence on Russia for European gas imports.

To cope with the ever-increasing demand for CRMs, which form the basis of the most important and disruptive technology supply chains (e.g. in the energy and defence sectors), the EU should develop enhanced and resilient CRM policies that give more authority to the European Commission in cooperation with the member states. This would allow better Europe-wide management and avoid the duplication of efforts or rivalries developing within the EU. The Commission does not so much have a problem with a lack of strategic thinking and concepts as with the timely and coherent implementation of its policies and concepts by the member states.

While full strategic autonomy is neither realistic nor desirable, diversification of the supply and import of CRMs is necessary. Strengthening the resilience of the raw-material supply chain includes expanding domestic mining, processing and refining capacities in Europe to reduce imports and undesirable geopolitical dependencies, as well as global climate emissions. Alongside political leadership, appropriate political support and public communication strategies regarding the European mining of CRMs are urgently needed to achieve these strategic goals. In the best-case scenario, the EU could produce around 30% of its raw-material demand domestically in the future. However, this is highly unlikely, even though the EU is providing significantly more financial support for extractive projects in Europe. This is due to the lack of social and local acceptance in densely populated member states such as Germany.¹⁵

¹⁵ See also F. Umbach, 'Critical Raw Materials for the Energy Transition: Europe Must Start Mining Again', *Energypost.eu*, 10 January 2022; F. Umbach, 'Geopolitical Dimensions of the EU's Future Supply of Critical Raw Materials', *Euractiv*, 1 June 2021.

Furthermore, domestic mining in Europe needs to factor in responsible sourcing and environmental regulations. This has already further increased the price difference with Chinese mining production costs and decreased the EU's global competitiveness. Therefore, simplifying EU permitting procedures as part of less bureaucratic regulations for all member states is essential to shorten the time frames for new CRM mining and refining, as well as recycling projects and supply chains.

However, many environmental groups are opposed not only to fossil-fuel mining, but also to raw-material mining, believing that future recycling and reuse of CRMs alone can offset the need for it and replace the estimated growth in demand. This seems highly unrealistic, at least in the next decade, as recycling and reuse, as well as other alternatives to reduce the demand for and import growth of CRMs also face numerous challenges and limitations. In addition, the replacement of larger quantities of batteries, solar panels and wind turbines will not occur until after 2030, meaning the resources within them will not be available for reuse until then. While the introduction of a circular economy is of paramount importance for both climatic and industrial reasons as well as for supply security, it alone will not be a 'silver bullet' for the rapidly growing European demand for CRMs and the associated security of supply risks in the next decade.

This poses a strategic dilemma in the form of a *conflict of goals and objectives*, which green parties and environmental non-governmental organisations try to avoid discussing publicly or stifle discussions on with the argument of the supposed silver bullet solution of recycling as the central component of a circular economy. As is currently the case with wind-power projects, green parties and non-governmental organisations have to choose between local environmental protection and global climate protection. Hence, local environmental standards may have to take a back seat in favour of national and international climate protection policies and agreed goals. For the latter, European raw-material mines are more necessary than ever, for two reasons. First, because they are a prerequisite for the faster implementation of electromobility and the massive expansion of renewable energies and energy storage. Second, because the existence of European raw-material mines would significantly lower CO₂ emissions due to the stricter EU environmental protection regulations and shorter transport routes involved than if the EU remained dependent on significant raw-materials imports from Latin America, Africa and Asia (China).¹⁶

The EU currently has no REE mining. Sweden's Norra Karr REE mining project, which could supply a large share of Europe's demand, has been delayed for 10 years due to environmental opposition. However, in Romania, Europe has restarted magnesium mining for the first time in more than a decade as a way to decrease its dependence on China after Beijing curbed and temporarily stopped magnesium exports in 2021.

Any efforts to reduce the dependency on Chinese REEs have also been hampered by the fact that key European REE companies have long had operations in China or joint ventures with Chinese companies. They are dependent on Chinese technologies for REE mining and refining. In addition, all European and Western countries will have to address the shrinking size of the mining workforce, including mining engineers, due to the increasing number of workers who will reach retirement age in the coming years. The best efforts to attract the next generation from universities are complicated by the industry's 'dirty' reputation, which conflates mineral mining with coal mining.

In addition to education and efforts to change stereotypes about the mining and refining industries, the EU needs to promote the creation of raw-material stockpiles of its 34 CRMs, both at the centralised EU level and among companies (by offering tax breaks and credits). Thus, it is useful to consider recent US experiences:

¹⁶ See also F. Umbach, 'Unpopular, but Strategically Necessary: Why Europe Needs Domestic Resource Extraction', *Sustainable Supply Chains*, 11 March 2024.

the US's current national defence industry stockpile is considered insufficient as it still only covers 40% of the military's needs for a one-year conflict followed by three years of recovery and replenishment.¹⁷ Thus, the capacities of the various stockpiles need to be based on clearly defined strategic needs and objectives.

Strengthening the EU's foreign raw-materials policy

According to industry analyses, around 300 new raw-material mines will have to start operating by 2035 to meet the expected demand for CRMs such as lithium, nickel, cobalt and REEs. However, since the average global lead time from the planning to the commissioning of raw-material mines takes an average of 7 years (in Western democracies, more like 10–15 years), there is the threat of a global supply bottleneck for CRMs. This makes the accelerated decarbonisation of global industry to achieve the 1.5°C target highly challenging.

As a late-moving actor, the EU is also facing problems with its mineral foreign policy. Africa plays an increasingly important role in coping with the rapidly rising global demand for CRMs, not only for China, but also for the US, Japan and the EU. Western interest in Africa can be explained not just by the continent's vast reserves of raw materials, but also by the more positive economic development, successful political reforms, greater political stability and improved investment opportunities for foreign investors in several African countries in recent years. The African continent accounts for 60% of the world's diamond deposits, 50% of cobalt reserves, 40% of phosphate (used in fertiliser) and almost 90% of the precious metal platinum, as well as huge deposits of bauxite (for aluminium) and numerous other industrial metals. It is therefore hardly surprising that most direct investment in the continent flows into Africa's extractive sector—including from China.

When considering its raw material foreign policies, the EU should consider the approach of the US, which currently has just one free-trade agreement (out of 20) with an African country (Morocco, which has the world's largest phosphate reserves). While the EU's commodity partnerships with African and Latin-American countries are certainly useful and necessary to diversify import dependencies, as are long-term contracts, neither of these provides any real guarantee, especially in times of crisis with changing framework conditions. Such partnerships and contracts could, under certain circumstances, also lull politicians and industry into a false sense of security regarding the stability of supply of raw materials if they are not part of a comprehensive and strategically defined raw-materials strategy.

The US and the EU may already be too late to work with some African countries. The example of the Lobito Corridor project (reviving a 100-year-old railway line to connect the Republic of Congo in central Africa with the Angolan port of Lobito in western Africa) for transporting CRMs to the US and the EU highlights this, as most of the African supply of such materials has already been locked in by China.¹⁸ Therefore, the following concrete recommendations should be considered:

- Expand and deepen partnership agreements for CRM cooperation and common mining and refining projects, particularly with like-minded democratic countries with market economies (e.g. Norway, Canada, Australia and others, including those—if possible—in Africa and Latin America).
- Promote and financially support friend-shoring projects for CRM mining/refining/processing in strategic partnership countries (e.g. Norway).

¹⁷ G. Wischer and M. Bazilian, 'The US Government Should Build a Resilient Resource Reserve for Wartime and Peacetime', *Atlantic Council*, 29 August 2024.

¹⁸ See A. Schipani, 'The US-Backed Railway Sparking a Battle for African Copper', *Financial Times*, 21 August 2024; W. Schneidman and V. Songwe, 'Biden's IRA Shuts Africa out of Critical Minerals Supply Chains', *Foreign Policy*, 3 August 2023; K. Bartlett, 'US, China Compete for Africa's Rare Earth Minerals', *Voa News*, 10 February 2023; *RANE Worldview*, 'What Africa's Largest Mining Project Means for Guinea, China and the World', 16 July 2024.

- Become a more active partner of the US in its Minerals Security Partnership and deepen transatlantic partnership projects in Africa, Latin America and Asia.¹⁹
- Develop similar rules to those of the US on 'Foreign Entities of Concern' to work with partner countries to reduce their dependence on China. These US rules mandate that companies qualify for tax credits from the Inflation Reduction Act if Chinese state-owned companies do not control more than 25% of the operation in partner countries. Such investment limits help to reduce Chinese profits and the country's interest in new investment projects.
- Develop new global regulatory frameworks for CRM mining and refining by adjusting environmental, climate and technology standards as part of transatlantic and G7 policies in the UN and other international organisations.

Promoting the 'de-risking' of the supply chain for CRMs and disruptive technology (components)

The global environment is rapidly changing, with critical supply chains becoming more fragmented due to rising competition and conflicts between Western democracies and autocratic-dictatorial systems in Russia, China and the Global South. Beijing seeks to control the most important global supply chains for new disruptive technologies (e.g. clean energy, batteries, chips and semiconductors, artificial intelligence and quantum computing). It has also enhanced its 'civil-military fusion' policy, which subordinates all economic and civilian technology policies to meeting China's military needs and its arms build-up.

A simplistic, unbalanced and naive liberalisation of the markets has weakened the national security of Western democracies because of their non-diversified import dependencies—in areas ranging from energy supply to medical equipment, medicines, semiconductors, telecommunications and CRMs—which are open to exploitation for geo-economic and geopolitical leverage. The EU needs to develop new economic security strategies as not just politicians, but even businesses and companies often have little understanding of their own supply-chain vulnerabilities and the potential cascading impacts of these on other sectors and national economic security. Geopolitical resilience has become a competitive advantage for companies operating in the unstable international environment. With its newly developed comprehensive Economic Security Strategy, published in June 2023, the European Commission seeks to reconcile the imperatives of economic growth and technological innovation with the needs of (geo-economic) security.²⁰ In this complex and rapidly changing geopolitical and geo-economic international landscape, the following actions will help to develop more resilient European supply chains:

Prioritise projects within a strategy that balances supply security with incentives for free and fair bilateral trade and which also operates within global competition rules (without decoupling and unfair provisions of

¹⁹ For transatlantic cooperation perspectives, see SAFE, *A Global Race to the Top. Using Transparency to Secure Critical Mineral Supply Chains* (Washington, DC, 2023); M. Moschella, 'Potential for EU-US Coordination on Diversification and Resilience of Supply Security', IAI Papers 24/24 (September 2024); J. Smyth, M. McCormick and H. Dempsey, 'Western Nations Join Forces to Break China's Grip on Critical Minerals', *Financial Times*, 23 September 2024; J. A. Rupp, 'How the US Can Confront China's Critical Mineral Challenge', *Financial Times*, 10 October 2023; C. S. Hendrix, 'The US Strategy on Critical Minerals Needs Clearer Priorities', *Piie.com*, 1 August 2023; K. Lebedur and E. Weinthal, 'Can South American Lithium Power Biden's Battery Plans?', *Foreign Policy*, 12 April 2023; R. Blakemore and P. Ryan, 'One Year After the IRA, the Hard Work to Build Resilient Mineral Supply Chains Is Only Beginning', *Atlantic Council*, 16 August 2023; S. Finizio, 'Climate Action, Geopolitical Risks and Strategic Policy: The Western Race to Secure Critical Raw Materials', IAI Commentaries 23/53 (October 2023).

²⁰ This strategy is based on three pillars: (1) promotion of the economic base and its competitiveness, (2) protection against risks, and (3) partnerships with countries that share common concerns and interests. It also identifies four areas that require continuous risk assessment: (1) resilience of supply chains, including energy security; (2) physical and cybersecurity of critical infrastructure; (3) technology safety and leakage; (4) weapons of economic dependency and coercion. European Commission, *European Economic Security Strategy*, Communication, JOIN (2023) 20 final (20 June 2023).

protectionism). The balancing of competing strategic objectives needs strong EU and political leadership with clearly defined strategic priorities.

Prioritise financial support for friend-shoring projects by introducing tax breaks and credits for the development and production of disruptive technologies and critical technology components.

Increase information exchange and best practices for disruptive technologies and critical technology components among the G7 and the US Minerals Security Partnership, as well as with other strategic partner countries.

	Programme 1	Programme 2	Programme 3
	Enhancing supply security of CRMs	Implementing a CRM foreign policy	Promoting the ‘de-risking’ of the supply chain for CRMs and disruptive technology (components)
Project 1	Expand European projects to increase mining, refining and processing capacities.	Expand CRM partnership agreements and common projects with like-minded democratic countries with market economies (such as Norway, Canada and Australia).	Prioritise projects within a strategy that balances supply security with incentives for free and fair bilateral trade and which operates within the global rules of competition (without decoupling and unfair provisions of protectionism).
Project 2	Promote raw material stockpiling.	Promote and financially support friend-shoring projects in CRM mining/refining/processing.	Prioritise financial support for friend-shoring for the development and production of disruptive technologies and critical technology components.
Project 3	Transfer more national authority for CRM supply security to the European Commission, as happened with the EU’s gas policies.	Develop new global regulatory frameworks for CRM mining by adjusting environmental, climate and technology standards.	Increase information exchange and best practices for disruptive technologies and critical technology components among the G7, as well as with other strategic partner countries.

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The EU's Path to Global Leadership in Decarbonisation

by Jaroslaw Pietras

Summary

The EU faces the challenge of balancing sustainability and competitiveness as it seeks to lead global decarbonisation efforts. To achieve these goals, the Union must carry out a profound economic transformation, invest significantly in new technologies and harmonise environmental priorities with economic growth. As a global leader in climate policy, the EU must confront competition from economies with less ambitious climate actions. As the Union implements climate measures, their stringency seriously impacts the competitiveness of European industries. Therefore, providing greater clarity about obligations and simplifying compliance rules are vital for the EU's own enterprises and those in other countries.

For the EU to influence others, particularly in the Global South, it must demonstrate that its own strategies are successful. This would involve tangible proof that its measures deliver positive outcomes for climate, the environment and the economy. Without clear results, global economic partners may oppose the EU's approach. This includes the Carbon Border Adjustment Mechanism, which aims to prevent carbon leakage. The EU must pursue active climate diplomacy, offering technical assistance and financial support, and engaging in international trade reforms, such as greening the World Trade Organization. Success in these efforts will position the EU as a global leader in sustainability and economic transformation.

Keywords Decarbonisation – Sustainability – Carbon Border Adjustment Mechanism (CBAM) – WTO – Climate diplomacy

Introduction

The urgency of preventing climate change and seeking to decarbonise economic processes cannot be overstated. The Intergovernmental Panel on Climate Change has consistently warned that limiting global warming to 1.5°C above pre-industrial levels requires a drastic reduction in greenhouse gas emissions. The EU has responded to this challenge with the European Green Deal, a comprehensive strategy to make Europe the first climate-neutral continent by 2050. This ambitious plan sets the stage for the EU to lead by example, demonstrating that economic growth and environmental sustainability need not be mutually exclusive, but can be mutually reinforcing. This is no easy task, as the EU faces the challenge of maintaining the global competitiveness of its economy as a whole and its industries in particular. This was well documented in Mario Draghi's recent report on European competitiveness.¹ It is becoming clear that the only way to ensure that the EU can drive global decarbonisation while maintaining its competitiveness is through an active trade policy coordinated with the EU's domestic economic policies. The EU has long been an advocate of open, rules-based trade and must now use this position to promote sustainable practices around the world. Greening trade involves ensuring that trade agreements and policies encourage low-carbon technologies, reduce carbon footprints and support the global transition to a sustainable economy. It also means that trade rules and the World Trade Organization (WTO) system must be able to take climate and sustainability issues into account and make them widely accepted.

¹ European Commission, *The Future of European Competitiveness: Part A – A Competitiveness Strategy for Europe* (Brussels, 2024).

Balancing policies of sustainability and competitiveness

The EU has been very active for years in the climate negotiations leading up to the Paris Agreement on climate change. It has become clear that progress on climate targets will not be achieved unless it is accompanied by consistent efforts by all emitters in both developed and developing countries. While the EU has made significant progress in reducing its own emissions, global climate targets cannot be achieved without the active participation of other large emitters, including emerging economies, which are expected to account for the majority of future emissions growth. The EU should seek to ensure that the Paris Agreement targets are met through the actions of all the parties and that other countries increase their nationally determined contributions over time. In this context, the EU's own climate commitments are crucial to maintaining its credibility as a global leader. The EU's commitment to reducing greenhouse gas emissions by at least 55% by 2030 compared to 1990 levels and to achieve net-zero emissions by 2050 sets a high standard for others.

The EU, undertaking ambitious measures in climate policy, confronts international trade competition from economies with modest climate actions. In the long run, as the EU implements more and more stringent climate policies, such a situation could seriously impact the competitiveness of European industries. To achieve global climate goals, other countries should be incentivised to take significant steps to mitigate climate change.

A central pillar of the EU's strategy to green international trade is the introduction of the Carbon Border Adjustment Mechanism (CBAM). This mechanism seeks to level the playing field for European industries by imposing a carbon price on imports from countries with less stringent climate policies. By doing so, CBAM aims to prevent carbon leakage—when companies move production to countries with laxer environmental regulations—and tries to ensure that European industries are not disadvantaged by their commitment to sustainability.² Furthermore, there is hope that CBAM will encourage other countries to adopt similar carbon pricing mechanisms, thus driving global efforts to reduce emissions. However, the success of CBAM depends on careful implementation and international cooperation.³ The EU must engage in dialogue with its trading partners to ensure that CBAM is seen not as protectionism but as a necessary step toward global climate action.

Another pillar affecting EU trade relations is legislation requiring the greening of its supply chains, particularly in sectors that are heavily reliant on imported raw materials and components. By setting sustainability standards for imports and promoting the use of recycled materials, the EU tries to reduce the carbon footprint of its own industries and encourage global suppliers to adopt more sustainable practices. Additionally, it is done via trade agreements which include provisions that promote environmental protection and ensure that partner countries commit to implementing international environmental agreements, such as the Paris Agreement. However, that this measure is not anchored in international agreements, even being fully legitimised, provokes negative reactions from countries and companies coping with compliance. Like CBAM, it requires significant documentation and paperwork, involving additional costs in export and import transactions.

An additional piece of similar legislation tries to prevent deforestation in other countries by requiring proof that in the process of production, regardless of the region and the supplier, there is no negative impact on existing forests. As it does with the requirements in the area of supply chains, it obliges EU importers to ensure documentation covering production sites beyond the EU territory. It extends obligations to producers and suppliers, particularly of developing countries, to provide detailed and credible proof of the lack of negative impact of production on the condition of the forests involved. Other legislation heads in the same direction,

² J. Pietras, *Navigating the Carbon Border Adjustment Mechanism: The Dangers of Non-compliance and Circumvention* (Brussels, Wilfried Martens Centre for European Studies, 2022).

³ S. Weko et al., *The Global Impacts of an EU Carbon Border Adjustment Mechanism*, IASS Policy Brief no. 6/2020 (Potsdam, 2020).

such as the taxonomy indicating which investments conform to the requirements of sustainability.⁴ Because international trade rules do not cover such measures, and the EU is merely permitted to have the taxonomy in place, the impact on trade might be significant.

The need to integrate sustainability with the WTO

All of these measures affecting exporters to the Union put a significant burden on those trading with the EU. While convincingly justified, they are not yet fully integrated within international trade rules. Very often they are seen as contradicting the principles on which the trading rules are based. They might be challenged as not fully conforming to the most basic principles enshrined in the WTO system. China and India have already made formal claims in the WTO Dispute Settlement system that CBAM is not compliant with some WTO provisions. Other countries may join in. Even if it is unlikely that these claims will lead to any meaningful outcome, the situation attests to the growing concerns that there is no agreement on climate-motivated trade measures.

Some EU trading partners, especially originating in the Global South, protest the unilateralism of the EU approach, which adopts measures without engaging in a comprehensive agreement on how they are constructed and implemented to minimise their negative impact without compromising the aims of these measures. The multitude of EU environmental and climate policies results in an aggravated impact in countries of the Global South still coping with the need to ensure economic growth and the enhancement of capacity while implementing the complex requirements for their industry.⁵ The poorer countries also face a disproportionately excessive administrative burden on their institutions in coping with formal requirements and are not prepared financially to provide sufficient support to help the institutions complete required paperwork.

The paradox lies in the combination of the undisputed justification of climate change mitigation and the contested trade burdens on the EU. These measures fall within the scope of trade rules but are not explicitly covered by existing multilateral trade agreements. It is not only exporting countries that complain, but also EU companies and importers, especially small ones. For them, the cost of compliance is often more burdensome than the actual CBAM payments. To alleviate legitimate concerns, the EU should engage in building a common understanding of implementation requirements. For example, there are many different approaches to calculating emissions, including those developed by the International Organization for Standardization. These methods lead to substantially different results. To avoid inconsistencies, CBAM refers to the European approach. This creates problems for many manufacturers around the world, who may have to use different methods depending on who they trade with. It calls for negotiations to begin to establish the most widely accepted approach possible.

There are many similar practical issues related to the requirements for providing internationally accepted data for due diligence on the sustainability of supply chains or deforestation.⁶ There is also an issue of the verification methods and how they are applied in practice. To minimise the negative reactions of trading partners and engage them in shaping global climate instruments, the EU should try hard to find solutions via dialogue and negotiations with its trading partners. The effectiveness and acceptability of the EU measures depend on the scale of involvement of other countries to create a set of rules covering these types of issues.

⁴ It is necessary to consider the trade impact of several pieces of EU legislation besides the CBAM Regulation. These include, *inter alia*, the Corporate Sustainability Reporting Directive; the Taxonomy Regulation, notably with its 'do no significant harm' assessment; the Sustainable Finance Disclosure Regulation; the Corporate Sustainability Due Diligence Directive; the Eco-design for Sustainable Products Regulation; the Industrial Emissions Directive; the Emissions Trading System; and also REACH.

⁵ It should be taken into account that the perception of climate actions and other environmental measures taken by the EU and particularly their impact might be considered as a prolongation of the long-lasting policies of exploitation of the Global South. See, for example, M. Lang, M. A. Manahan and B. Bringel (eds.), *The Geopolitics of Green Colonialism: Global Justice and Ecosocial Transitions* (London: Pluto Press, 2024).

⁶ B. Li et al., *Unpacking the EU Deforestation Regulation's Legal Production Requirement*, World Resources Institute (June 2024).

Therefore, the EU should promote the reform of the WTO aiming at the unequivocal inclusion of green measures in trading rules.⁷ Elements to be considered in such a reform include the facilitation of trade in green products, focused on eliminating tariffs and other trade barriers, as well as the greening of international trade in services, and particularly low-carbon international transport, resulting in the reduction of the climate footprint related to international trade. In particular, the sustainability aspect in global value chains can help to identify problems which should be considered when reforming the WTO.

International agreement is also needed on another aspect of climate and environment policies having an impact on trade. The EU and many other countries use subsidies to accelerate decarbonisation and green transformation. The amounts in question are large, and their potential collision with trade rules is imminent. It is not only the issue of their size but also the conditions, circumstances and terms of their application. The EU has relaxed its policy in relation to green subsidies, which means that other countries could follow suit, weakening the subsidies' contribution to the green transformation and distorting their impact on trade.

Reforming the WTO along such lines would help to create a global green marketplace, which could be based on common environmental standards, methods of verification of emissions, subsidies and the development of climate-friendly technologies, and embedding circularity concepts into international trade. The creation of such a green global marketplace should be a guiding principle of the reform of the WTO. Tackling these issues in the WTO would help to alleviate some of the negative perceptions of the EU climate measures. But agreeing on them internationally would also be welcomed by European companies. It must be remembered that many formal, technical and practical difficulties in the implementation of CBAM—due diligence in supply chains, deforestation legislation and so on—pose significant problems not only for exporters in other countries but also the EU's own trading companies. Small and medium-sized companies, in particular, have great difficulty overcoming the complexities of compliance.⁸ For them, the costs of compliance often outweigh the climate benefits many times over. Greater clarity and simplification would facilitate the unobtrusive implementation of sustainability legislation in the EU. Thus, it would contribute to maintaining the competitiveness of European companies.

EU international decarbonisation actions and diplomacy

For the EU to lead the global decarbonisation effort, it must engage in proactive climate diplomacy, building alliances and fostering international cooperation on climate action. This involves not only advocating for stronger climate commitments from other countries but also providing the necessary support to help them achieve these commitments. This requires climate diplomacy to become more intense and concrete. It can involve offering preferential trade terms to countries that meet certain environmental criteria or providing financial assistance for green initiatives in partner countries.

The EU should engage with all other countries through climate diplomacy, offering technical assistance, technology transfer and financial support to help them transition to low-carbon economies. This engagement should be based on mutual benefit, with the EU helping emerging economies develop their green industries, which in turn can create new markets for European products and services.

Achieving global leadership in decarbonisation will require unprecedented levels of investment in green technologies, infrastructure and innovation. The EU must mobilise both public and private finance to support sustainable

⁷ The EU is already strongly engaged in the debates concerning WTO reforms. See European Commission, *Reforming the WTO. Towards a Sustainable and Effective Multilateral System* (Brussels, 2021). But the EU should be clearer on including its own climate measures in trading rules to avoid the criticism of green unilateralism.

⁸ T. Delille, V. Giovannini and G. Messent, 'EU CBAM Reporting Obligations and Obligated Entities: Understanding the Complexity of a New System', Squire Patton Boggs (Washington, DC, 2024).

development, ensuring that the transition to a low-carbon economy is inclusive and equitable. The European Green Deal Investment Plan, which aims to mobilise at least €1 trillion in sustainable investments over the next decade, is a step in the right direction. Private sector investment should be complemented by public funding, with financial instruments tailored to support the commercialisation of innovative solutions. Mechanisms such as Carbon Contracts for Difference can help de-risk investments in emerging technologies by providing price stability, encouraging companies to invest in low-carbon solutions. However, this will require robust governance mechanisms to ensure that funds are allocated efficiently, and that they deliver measurable climate benefits while avoiding any weakening of EU competitiveness or distortion of international trade. The EU's Global Gateway initiative, which aims to mobilise €300 billion in investments for sustainable infrastructure worldwide, can play a crucial role in this effort. The Union's industrial strategy should prioritise investments in key technologies where Europe has a competitive advantage or strategic interest. By helping developing countries build sustainable infrastructure, the EU can promote global climate action while also creating new opportunities for European businesses.

The European Investment Bank has positioned itself as the EU's climate bank, with a commitment to align all its activities with the goals of the Paris Agreement by 2021. The bank can play a crucial role in financing the green transition by providing low-interest loans, guarantees and other financial instruments to support renewable energy projects, energy efficiency improvements and sustainable infrastructure development. Additionally, the European Investment Bank should focus on de-risking private sector investments in green technologies, encouraging more private capital to flow into sustainable projects.

The private sector is indispensable in financing the green transition. The EU must create a conducive environment for private investment in sustainable development through clear regulatory frameworks, incentives and the establishment of green finance standards. Moreover, the EU should support the development of green bonds and other financial products that allow investors to fund climate-friendly projects. The green transformation in Europe, as well as globally, requires large additional financial resources.

Conclusion

The EU has long been a key player in international climate negotiations, and it must continue to push for more ambitious global climate action. The EU's pledge to reduce greenhouse gas emissions by at least 55% by 2030 compared to 1990 levels, and to achieve net-zero emissions by 2050, sets a high standard for others to follow. But the EU should also be able to demonstrate that this ambition can be beneficial to economic prosperity and growth.

The EU's industrial sectors, particularly those that are energy-intensive, will need to undergo significant transformation to align with the Green Deal's goals. This includes the adoption of near-zero emissions technologies in steel, cement and chemicals production, as well as the electrification of industrial processes. The EU should ensure that European manufacturers remain competitive in the global markets for low-carbon products.

The EU has a unique opportunity to lead the global decarbonisation effort, setting the standard for how economies can transition to sustainability while maintaining competitiveness. By reforming WTO and greening trade rules, agreeing on green subsidies and the financing of sustainable development, and engaging in proactive climate diplomacy, the EU can drive global climate action and create new economic opportunities for its industries. However, achieving these goals will require a comprehensive, coordinated approach that involves all levels of government, the private sector and civil society. The EU's leadership on climate change is not just about meeting emissions targets; it is about demonstrating that sustainable policies are necessary for prosperity. The key to success lies in the EU's ability to integrate its climate goals with broader economic and strategic interests, demonstrating that environmental leadership and economic prosperity can go hand in hand.

	Programme 1	Programme 2	Programme 3
	Greening of international trade between the EU and its trading partners	Ensuring international cooperation on climate and intensifying climate diplomacy	Mobilising private finance to leverage sustainable development aid
Project 1	Engage in WTO negotiations to facilitate trade in green goods and services. Support the reform of WTO rules that would make them indisputably consistent with climate objectives. Revitalise the Dispute Settlement Body.	Fully apply Europe's normative—soft—power to promote international climate actions through dedicated coordination between EU Representations and EU members' embassies. Create synergy between hard and soft external policy instruments in use by the EU Commission and the European External Action Service.	Ensure sustainable and environmentally responsible conduct from European companies investing abroad via the implementation of the Corporate Sustainability Due Diligence Directive. Strengthen cooperation on critical raw materials through targeted use of EU development funds.
Project 2	Urgently initiate measures to promote European export of products affected by CBAM. Review and analyse compliance requirements for involved companies. Use the 'CBAM international effect' on trading partners by enhancing relations with countries introducing a carbon price.	Facilitate the development of the G7 Climate Club with the positive agenda of cooperation in climate actions between club members. Initiate dialogue and negotiations to prevent the labelling of EU climate policies as 'green unilateralism'.	Finance the international just transition with available resources from European development assistance. Blend EU official development aid with private financial sources to ensure additional financing.
Project 3	Expand the networks of the EU free trade agreements with likeminded countries.	Find common ground in European climate diplomacy facing the divergent climate actions of the US, China, India and others by initiating comparisons of decarbonisation outcomes, and negotiate common standards and methodologies for measuring carbon emissions.	Green European development aid by focusing on the European Fund for Sustainable Development Plus. Make sure that the Global Gateway includes major climate components supported by EU funds.

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Financing the Sustainability Agenda

by Markus Demary and Adriana Neligan

Summary

Financing the necessary innovations and investments for a successful decarbonisation in the EU is challenging. The main reasons are tighter banking regulations, increased bureaucracy for loan applications and portfolio reallocations away from carbon-intensive industries. In addition, there is the risk that government and corporate debt levels might become unsustainable. The EU has already put forward a green bond framework to finance decarbonisation. Yet a large part of the corporate sector, particularly the small and medium-sized enterprise sector, has no access to this financial instrument. The EU therefore still needs the right mixture of reforms to both unlock private lending and investment and ensure that they stay financially sustainable so that risks do not build up in the financial sector. This paper offers several recommendations for reforms to enhance the financing of such investments by strengthening and auditing EU funds, reinforcing incentives for the transformation and supporting European small and medium-sized enterprises.

Keywords Climate-neutral industry – Decarbonisation – Transition finance

Introduction

The EU has set legally binding targets for climate neutrality by 2050. To succeed in the transition to a low-carbon economy, companies need to continuously develop new and improved climate-friendly technologies and adopt or move towards low-carbon business models. This will require investments in digital technologies, automation and AI, as well as stable supply chains, all of which will need to be consistent with the EU taxonomy for sustainable activities. To succeed in decarbonising the economy, we estimate, based on a meta-analysis, that the EU will have to invest between €758 and €1,055 billion per year until 2050 in the industry, energy, transportation and building sectors.¹

For channelling the capital flows into environmental and climate protection investments, a key pillar of the EU Green Deal is the promotion of sustainable finance. The EU has adopted new regulations on sustainability reporting, most importantly the EU taxonomy defining sustainable activities, the EU Corporate Sustainability Reporting Directive and the EU Sustainable Finance Disclosure Regulation, which is tailored to financial companies. The main aim is to increase comparability and transparency regarding the inclusion of sustainability criteria.²

Small and medium-sized enterprises (SMEs) face several challenges

Financing the necessary innovations and investment volumes is challenging for the corporate sector due to tighter banking regulations, increased bureaucracy for loan applications and portfolio reallocations away from carbon-intensive industries, as well as government and corporate debt levels that might become unsustainable. How these immense volumes of investment are financed is particularly relevant to the successful mastering of the needed structural changes.

¹ M. Demary, *Wie hoch sind die Investitionsbedarfe in die klimaneutrale und digitale Transformation in NRW?*, Fin.Connect.Kompakt 01, Institut der deutschen Wirtschaft (Cologne, 2024).

² A. Neligan, T. Schaefer and E. Schmitz, *Nachhaltigkeitsbericht: ja, aber wie?*, Institut der deutschen Wirtschaft, IW Brief Report no. 38, (Cologne, 2024).

While the EU has developed a green bond framework for financing decarbonisation, a large part of the corporate sector has no access to this financial instrument. SMEs lack access to bond market investors since the needed issuing limits are too large for these businesses and bond investors are not interested in investing in small lot sizes. SMEs therefore depend on bank financing. However, bank financing will become more restrictive, as banks have to raise their equity capital to meet the requirements of the newest bank regulation package, namely, the Capital Requirements Regulation III and the Capital Requirements Directive VI. Schneider et al. estimate that banks will require €120 billion in additional capital to be ready for the implementation of the new bank regulations,³ while we estimate that EU banks will need to expand their capital base by a further €276 to €384 billion until 2030 to finance the above-mentioned needed investments in decarbonisation. Thus, bank capital can become a limiting factor for the financing of decarbonisation, and freeing up bank equity capital for new SME loans is as important as capital market investors embracing SME finance.

Since SMEs normally do not tap securities markets for financing but rely on bank loans instead, banks might have a hard time allocating their equity capital to finance the decarbonisation of the SME sector. Banks must expand their balance sheet during the financing of the transformation of the corporate sector. From a regulatory viewpoint, the denominator in banks' equity capital ratio is rising, and when the capital ratio declines like this, it risks becoming too low and banks having to expand their equity capital base to hold their regulatory equity capital ratio above the threshold value demanded by financial regulation during the financing of the transformation. Since bank equity capital is an important buffer against unexpected credit defaults, the efficient use of the existing bank capital is crucial for financing the transformation. However, banks can free up their equity capital by the securitisation of their loan portfolios and the placement of asset-backed securities in capital markets. Through these measures, SME finance can be linked to capital market investors. Promoting securitisations for financing the transformation of the SME sector is, however, crucial to avoid financing gaps for SMEs. Enabling securitisation will not only help to finance the transformation, but it will also strengthen the European Capital Markets Union by bridging the gap between bank finance and capital market finance.

Banks' loan supply between climate risks and transformation risks

Banks begin to decouple from customers whose credit risks have increased due to climate-related risks or the risk that their business model will become obsolete due to decarbonisation. Moreover, banks have to monitor the transformation risks of their customers, which could result from the unsuccessful transformation of business models and a lack of transformation towards climate neutrality. Thus, banks need more information from their customers, which increases the administrative burdens for SMEs when applying for finance. For example, the additional administrative costs for the first reporting according to the European Sustainability Reporting Standard to comply with the Corporate Sustainability Reporting Directive are estimated for large companies at around €1.7 billion in initial costs and €1.9 billion annually in recurring costs. The costs of the verification of reports by an external auditor result in up to €4 billion in additional annual costs and will increase in the future.⁴ Hence, SMEs might postpone necessary climate-relevant investments.

Banks and investment companies have already started to decarbonise their loan and asset portfolios by reallocating these portfolios away from carbon-intensive sectors. This could lead to financing problems for carbon-intensive SMEs that would like to invest in climate-friendly technologies but that might not be 'green' enough yet. For a successful structural change that promotes the decarbonisation of companies from hard-to-abate carbon-intensive sectors and that prevents SMEs in these sectors from having to leave the market,

³ Schneider et al., *Basel 'IV': What's Next for Banks?*, McKinsey & Company, Global Risk Practice (Munich, 2017).

⁴ EFRAG, *Draft European Sustainability Reporting Standards*, Centre for European Policy Studies and Milieu (Brussels, 2022).

the ability to match SMEs with appropriate funding has to be preserved during the transition. Therefore, the right framework conditions are needed for the financial sector and the real economy so that investments and innovations can be financed. Keeping corporate and government debt at sustainable levels is important during the decarbonisation process since a large volume of the needed investments will have to be financed by debt instruments.

Decarbonisation creates a dilemma for companies because the transformation of their business model can be a risky venture. At the same time, not transforming their business model is risky, too, since the future demand for their traditional product will vanish. This risk is especially prevalent for the makers of intermediate goods for combustion car production. Thus, not only climate risks affect the financial sector, but also the risks of the structural change in the corporate sector, which the financial sector supports. Corporate indebtedness could thus be a side effect of the transformation. The measurement and monitoring of these risks is as important as reducing financing gaps for the corporate sector.

Recommendations for financing the transformation better

The EU should focus on reforms for strengthening the incentives for investments in decarbonisation in the corporate sector, especially in SMEs, and for ensuring the smooth financing of these investments. We suggest the following reforms and measures.

Strengthening and auditing EU funds supporting the transformation

First, to finance the transformation and unlock private funds for that purpose, EU funds must be used to mobilise private capital through risk reduction or to set incentives to invest. This includes the use of revenues from the Carbon Border Adjustment Mechanism—for example, in the form of a transformation fund administered by the European Investment Bank (EIB). These funds must be used efficiently to set the right incentives to decarbonise and to fulfil the EU's objectives. Thus, central to the process is auditing EU funds and rethinking how they can be allocated to support innovations and investments in decarbonisation by better matching companies, banks and investors.

Second, the EIB plays a significant role in mobilising private capital. Strengthening the EIB to finance the transformation is therefore key. For example, the EIB can be an important anchor investor for infrastructure investment funds or initial public offerings connected to investments in climate neutrality.

Third, the EU should also implement a special investment fund targeted at financing carbon capture companies, carbon transportation and carbon-storage infrastructure since these investments might be too risky for private investors, especially at the development stage of the projects. Development grants and venture capital can be useful instruments in this context.

Strengthening incentives for the transformation

First, it is crucial to reform the EU energy tax and subsidy system to align with EU climate and energy objectives. The fossil fuel industry is still subsidised, with some of the subsidies being used for renaturation and others for investments in climate neutrality. Subsidies that do not set incentives for the transformation should be gradually reduced. Incentives could be strengthened further by a reformation of the EU Emissions Trading System and the EU Energy Taxation Directive so that tax rates fall in line with climate objectives and set the incentives to invest in climate-friendly alternatives. In addition, the consistency of the EU Emissions Trading System with other regulations must be ensured. Since many low-carbon technologies and carbon-removing technologies need to be developed, tax incentives for research and development (R&D) in low-

carbon technologies can foster the development of these technologies and ensure that companies gain competitiveness through technological progress.

Second, since much of the machinery and equipment currently used must be replaced by low-carbon alternatives before depreciation, companies must be made aware of the accelerated depreciation of carbon-intensive equipment, and incentives should be set for them to start their investments in decarbonisation early. However, the EU taxonomy can have a negative effect on the basic materials industry and defence industry, which needs to be addressed. Exemptions for these hard-to-abate sectors should be possible since, at the same time, CO₂ can be taken from the atmosphere by carbon capture and storage technologies. These technologies should be promoted to reach climate neutrality while also preserving sectors which are both carbon intensive and of strategic importance to the EU.

Third, supervisory agencies must analyse whether the risk from transformation falls into the existing risk categories, such as credit default risks and liquidity risks, or whether new risk categories must be developed. These supervisory bodies must be integrated into frameworks for measuring climate risks and the transformational risks of companies and oversee the incorporation of these risk factors into banks' risk management systems. Moreover, supervisory agencies must monitor the financing of the transformation and the resulting risk factors at the macroprudential level—that is, not only from the viewpoint of individual banks but within the banking system as a whole. Macroprudential risks can emerge from concentrated exposure to carbon-intensive sectors or non-performing loans due to company indebtedness during the transformation. It is important to address these risks before banks get into trouble, since banks react to risks by reducing lending and this could be counterproductive to a smooth financing of the transformation of the corporate sector.

Supporting European SMEs

First, bureaucratic costs for SMEs due to increased non-financial information requirements need to be reduced. Different standards apply to companies for reporting non-financial information and also to banks for measuring environmental, social and governance (ESG) conformity in their loan portfolios. As a result, an SME that tries to compare lending conditions between banks must supply many different ESG reports to the individual banks, which increases the costs of comparing lending conditions. The standardisation of ESG key performance indicators for SMEs' reporting to banks and customers can reduce costs for SMEs and increase transparency and thereby competition in the lending sector. The development of data-sharing services or data ecosystems for SMEs for reporting standardised ESG key performance indicators could increase the efficiency of the reporting, since the SMEs would only have to provide the information once per year to the data ecosystem, where banks and customers could retrieve it.

Second, financial obstacles for SMEs which arise because of banks' limited regulatory equity capital must be eliminated during the transformation given SMEs' high dependence on bank loans. Bank equity capital for the transformation could be freed up by the securitisation of loan portfolios and the placement of these in capital markets. Smaller and medium-sized banks, however, lack the personnel and organisational resources for securitisation transactions. In addition, their loan portfolios do not achieve the lot sizes that attract capital market investors. However, securitisation platforms for smaller banks could enable these banks to use this mechanism. The standardisation of loans and processes could reduce the costs and burdens for smaller banks, and would allow the smaller banks to pool their loans to achieve lot sizes that are worthwhile for capital market investors. The auditing and reforming of bank regulations that hinder the financing of SMEs would be a good starting point, together with initiatives that promote securitisation platforms for smaller banks in times of transformation.

Third, local investment funds should be promoted, and backed by EU funds. SMEs need silent-participation equity capital for financing the transition, to hold their debt at a sustainable level while investing in their carbon-neutral transformation. The risk structure of these funds should be managed so that investors with a higher risk tolerance can invest in the development of new ideas and disruptive business models while risk-averse retail investors can invest in more incremental innovations made by existing SMEs with stable cash flows.

Conclusion

The smooth functioning of financing climate-friendly investments is crucial for successful decarbonisation. This success can be hindered by lending policies that are too restrictive as well as by lending conditions that are too easy, which can lead to the build-up of credit default risks on banks' balance sheets and subsequent problems. The EU should therefore find a framework that unlocks private lending and investment and at the same time ensures that lending and investment stay financially sustainable so that risks do not build up in the financial sector. To this end, the EU should find the right mixture of reforming both regulations that hinder the financing of companies and regulations that prevent the financial sector from allowing risks on the balance sheet of financial institutions during the financing of the transformation. While the EU should promote private financing of the investments that lead to private profits, it should offer financing for the infrastructure and ground-breaking technologies with high social returns needed for climate neutrality; these are typically too risky for private companies and investors since the returns are widely dispersed and benefit competitors as well as initial investors. While risk-sharing between states and companies can enable the development of technologies for decarbonisation, tax incentives for R&D are a technology-neutral and competition-neutral way of encouraging private companies to develop the technologies needed for decarbonisation.

	Programme 1	Programme 2	Programme 3
	Strengthening and auditing EU funds	Strengthening incentives for the transformation	Supporting European SMEs
Project 1	<p>Improve the matching between companies, banks and investors by auditing EU funds and rethinking how they can be allocated for supporting innovations and investments in decarbonisation (e.g. guarantees for the securitisation of SME loans and investment funds). Use the EU's own resources (e.g. the Carbon Border Adjustment Mechanism) for the transformation by allocating these to the EIB.</p>	<p>Reform the EU energy tax and subsidy system, aligning it with EU climate and renewable energy objectives. Ensure a level playing field within the EU by gradually phasing out fossil fuel subsidies, including CO₂ content, and strengthening tax incentives for R&D in low-carbon technologies and the accelerated depreciation of carbon-intensive equipment. Ensure the consistency of the EU Emissions Trading System with other regulations.</p>	<p>Reduce bureaucratic costs for SMEs due to non-financial information requirements by standardising ESG key performance indicators that such companies must report to banks and customers (e.g. taxonomy-eligible turnover or taxonomy-aligned turnover). Develop data-sharing standards (a data ecosystem) for SMEs for the reporting of ESG data which can be accessed by banks and customers.</p>
Project 2	<p>Strengthen the EIB's ability to finance the transformation. Risks for investors can be reduced with the EIB as the anchor investor for infrastructure investment funds or initial public offerings.</p>	<p>Assess the impact of the EU taxonomy on the basic materials industry as an enabling activity for other industries and its impact on the defence industry to reform the taxonomy in case of conflicts with other policy goals, for example, defence and security.</p>	<p>Eliminate financing obstacles for innovative SMEs during their transformation and during the innovation life cycle by freeing up bank equity capital through promoting platforms for the securitisation of SME loans for smaller banks. Audit and reform bank regulations that hinder the financing of SMEs in times of transformation (e.g. capital requirements for unrated companies).</p>
Project 3	<p>Develop a special investment fund targeting the financing of carbon capture companies. Overcome market failures at the various stages of the innovation cycle by using instruments such as development grants, early- and later-stage venture capital.</p>	<p>Enable the monitoring of risks from climate change and transformation by developing frameworks for supervisory agencies on how to measure these risks for companies at the macroprudential level (e.g. concentrated exposure to carbon-intensive sectors, non-performing loans due to company indebtedness during the transition).</p>	<p>Promote local investment funds for SMEs backed by EU funds. SMEs need silent-participation equity capital for financing the transformation to hold their debt at a sustainable level while investing in their carbon-neutral transformation. Structure these funds so that investors with a higher risk tolerance can invest in the development of new ideas and business models while risk-averse retail investors can invest in the more incremental innovations of existing SMEs.</p>

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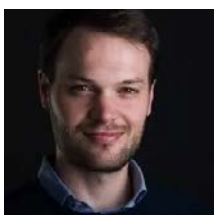
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