LUISS

Institute for European
Analysis and Policy

Hub for New Industrial Policy
& Economic Governance

An EU energy policy for the challenges of the twin transition of industry and open strategic autonomy

Alexandre Marin

LUHNIP Working Paper Series 5/2025

March 14, 2025

An EU energy policy for the challenges of the twin transition of industry and open strategic autonomy

Alexandre Marin[1]

Executive Summary

This working paper explores the evolving landscape of the EU's energy policy, focusing on the challenges of the twin transition and ensuring strategic autonomy amid increasing geopolitical pressures. While energy policy has focused on market integration and functioning, the current framework must simultaneously secure energy supplies and decarbonize European industries while maintaining their competitiveness.

The first section examines the EU's efforts to transition to a low-carbon economy, highlighting progress in increasing renewable energy through solar, wind, and hydrogen. Support mechanisms and contracts like CfDs and PPAs are now expected to play a role in the ramp-up of these technologies and the evolution of the energy mix.

The second section addresses the structural vulnerabilities in the EU's energy policy, particularly its heavy dependence on imported natural gas, exacerbated by the war in Ukraine. Despite diversification efforts, such as tapping into LNG and forging new partnerships, the EU remains exposed to volatile global gas markets. This is in stark contrast to the United States, which has benefited from its domestic shale gas, and China, which has leveraged its proximity to Russian gas and control of critical raw materials to boost its competitiveness in clean technologies.

The third section critically assesses the EU electricity market design, particularly the marginalist pricing system. Despite renewable generation accounting for a growing share of electricity production, fossil fuel technologies will continue to disproportionately influence wholesale market prices in the coming years. This leads to higher electricity costs, which undermine industrial competitiveness and place additional strain on energy-intensive industries (EIIs), just when they need to accelerate their electrification efforts.

The working paper concludes with policy recommendations, emphasizing the need for an EII-specific approach beyond horizontal reforms. Key recommendations include better coordination of national energy policies, expanding nuclear and renewable capacities, and shielding energy-intensive industries from rising network costs and energy taxes. A comprehensive review of energy cost differentials is also necessary. Targeted interventions are proposed to ensure that EIIs have access to electricity at production costs, at least for part of their consumption, while leveraging existing instruments like CfDs and PPAs. New flexibility instruments tailored to industrial constraints and over longer time horizons ('multi-days') are also explored.

Finally, the working paper advises caution when considering the outsourcing of EIIs based on price differentials, as this could lead to increased carbon imports and substantial Carbon Border Adjustment Trade Mechanism (CBAM) costs, undermining both environmental and economic goals.

[1] Head of European Affairs, RIVA Group, Alexandre.Marin@rivagroup.com. All opinions expressed in this article are solely those of the author and do not reflect the views or positions of RIVA Group, Eurofer, or any other affiliated organization.

1. Introduction

In a June 2024 speech presenting the conclusions of his report on European economic competitiveness, Mario Draghi highlighted energy costs as a critical factor for the EU, citing the lack of resources, dependence on natural gas, insufficient decoupling of gas and electricity prices, and the urgent need for investments in clean energy generation and grid infrastructure (Draghi, 2024). This challenge is now being addressed by the new European Commission through upcoming initiatives under the Clean Industry Deal, presented on 26 February 2025, which will likely determine the success or failure of the twin transition and the decarbonisation of the European economy and industry. This working paper examines key aspects of these energy policies, focusing on the challenges hindering industrial decarbonization within an increasingly complex international and geopolitical environment.

Although the history of the European Communities began with the integration of energy, with the ECSC for the coal industry and EURATOM for the civil nuclear industry, it was not until the building of a Single market for energy in the 1990s that an EU energy policy actually came about (Petrini, 2019). The electricity and gas markets were then reinforced by the introduction of a legal basis for EU energy policy (Article 194 TFEU) in the Treaty of Lisbon, which enshrined this competence while carefully delimiting it. Under the terms of the TFEU, the Union's energy policy aims to ensure the functioning of the energy markets, the security of the Union's energy supply, promote energy efficiency and the development of renewable forms of energy as well as network interconnections.[2] However, Member States retain the right to determine the general structure of their energy supply and their choice between different energy sources.[3]

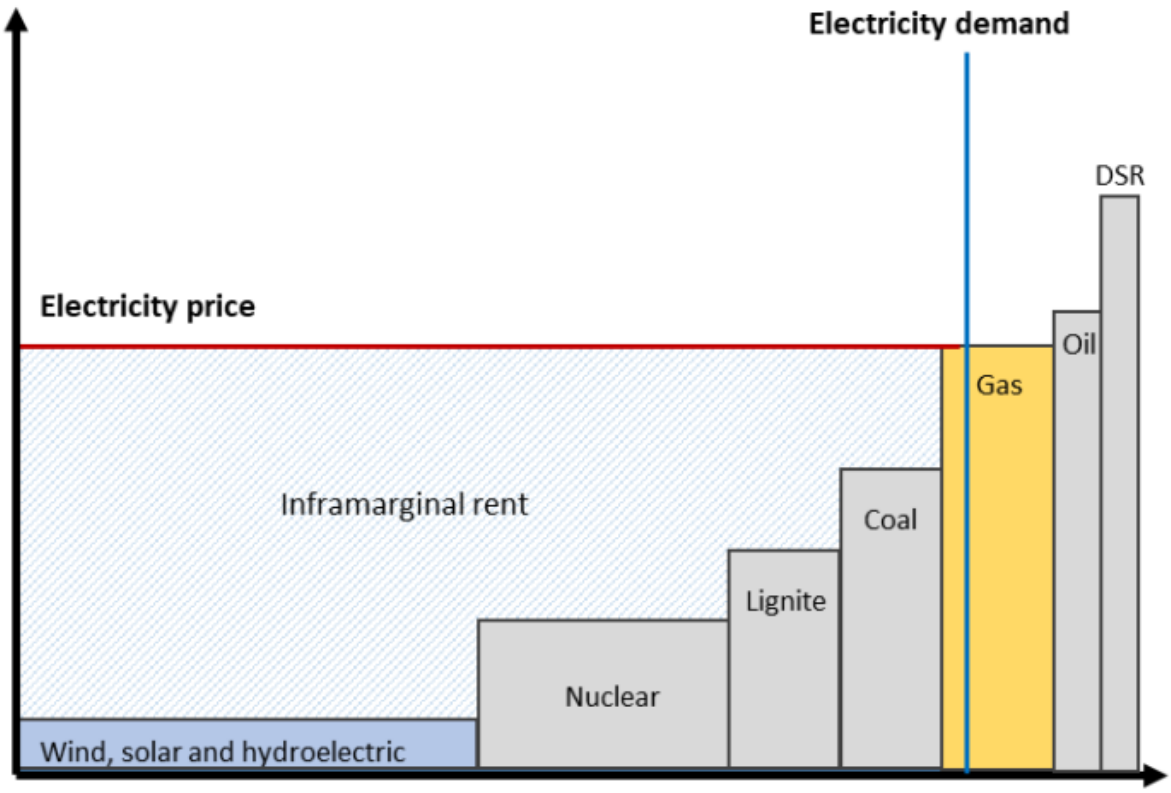
While preserving national sovereignty over energy mixes, the EU has successfully integrated the structure of its energy policy and system at multiple levels in recent years (Meeus, 2019). At the EU level, the governance of the Energy Union was established in 2015, aligning it with the bloc's climate policy.[4] This strategy requires MSs to develop integrated national energy and climate plans. At the network level, Transmission System Operators (TSOs) and Distribution System Operators (DSOs) work together through European bodies such as ENTSO-E (for electricity), ENTSO-G (for gas), and with ENNOH for hydrogen, established in 2025. These organisations coordinate ten-year network development plans (TYNDP) and promote interconnections. Finally, national regulators play an increasingly coordinated role through the Agency for the Cooperation of Energy Regulators (ACER), established in 2011 and whose mandate has since been expanded.

The energy markets for electricity and gas in the EU have been liberalized, with network activities regulated and other market segments opened to competition. In this model, wholesale market prices

[2] TFEU, https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A12012E%2FTXT.
[3] TFEU, https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A12012E%2FTXT.
[4] European Commission (2015), Communication *A Framework Strategy for a Resilient Energy Union with a Forward-Looking Climate Change Policy*, COM/2015/080 final, 25.0.2015.

are determined transparently through exchanges like EPEX, NordPool, GME, and OMIE. Every day, the EUPHEMIA algorithm[5] enables the matching of supply and demand across all bidding zones on the short-term market, operating within the principles of microeconomic theory. This system is supposed to ensure a competitive, transparent, and efficient price-setting mechanism across Europe.

Figure 1: Simplified merit order supply demand stack and marginal pricing principle in the current electricity market design



Source: EC JRC (Gasparella et al., 2023).

The recent goals of achieving the twin transition—industrial decarbonization and digitalization—alongside EU open strategic autonomy in response to rising geopolitical challenges (Defraigne et al., 2022; Guerrieri and Padoan, 2024) have prompted the EU to revise key legislations under the Green Deal. In 2024, this led to significant revision in both the gas (gas package[6]) and electricity framework (electricity regulation[7]). These changes reflect the central concerns of EU energy and industrial

[5] The public description of the EUPHEMIA Single Price Coupling Algorithm is available on the NEMO Committee website.
[6] Composed of the directive (EU) 2024/1788 and the regulation (EU) 2024/1789 adopted in May 2024.
[7] Regulation (EU) 2024/1747 of the European Parliament and of the Council of 13 June 2024 amending Regulations (EU) 2019/942 and (EU) 2019/943 as regards improving the Union's electricity market design.

policies: first, ensuring the security of supply and energy resilience within the Union, and second, establishing a regulatory framework that promotes the decarbonization of European industry while safeguarding its global competitiveness.

In this policy working paper, we aim to first describe the recent initiatives aimed at increasing the share of renewable energy and phasing out fossil fuels and the challenges that still face the EU in this way and second, we analyse the structural problems of the energy policy compared to its main competitors but also from the industrial point of view, with special attention to the impacts of the electricity market design on industry competitiveness. Finally, we aim to outline some further steps and policy proposals to reform EU energy policy to meet the objectives set by the EU in the Clean Industry Deal.

Specifically on energy, this initiative consists mainly of the Affordable Energy Action Plan, published in February[8], and the Clean Industry State Aid Framework (CISAF), which is subject to consultation from March 2025.[9] In addition to these two pillars, other elements affecting energy competitiveness, such as the CBAM and LNG market and geopolitical developments, deserve a dedicated in-depth analysis.

2. The role of energy policy for the twin transition of industry and open strategic autonomy

Decarbonising the EU economy across sectors like transport, construction, and industry will require significant efforts in both direct and indirect electrification. Ensuring access to affordable renewable or low-carbon energy sources has been a central goal of recent reforms aimed at achieving carbon neutrality. Since the early 2000s and particularly following the adoption of the first Renewable Energy Directive (RED) in 2009, the EU has implemented various policies to increase the share of renewables in its energy mix. Renewable energy targets, set at both EU and national levels, have been revised upward over time. The latest revision, RED III (2023/2413), sets the 2030 target at 42.5%, with an ambition to reach 45%.

2.1 Renewables in electricity generation

In recent years, several technologies have received dedicated strategies at the EU level to support the decarbonisation of energy production. These include solar energy (2022) – with a target of 600 GW of new capacity in 2030 –, wind energy – 37 GW/year new capacity required to reach the 2030 target (Action Plan 2023) –, marine renewable energies – offshore, wave and tidal – (2020, 2023), and the

[8] https://energy.ec.europa.eu/publications/action-plan-affordable-energy-unlocking-true-value-our-energy-union-secure-affordable-efficient-and_en

[9] https://ec.europa.eu/commission/presscorner/detail/en/ip_25_652

Council adopted last December conclusions to promote geothermal energy[10]. The European Commission's actions to promote these technologies focus on speeding up and streamlining permitting procedures – identified as one of the main obstacles,[11] and improving access to public funding and guarantees (e.g. through the European Investment Bank), and, more recently, making better use of trade defence instruments (TDIs) to protect European sectors from unfair competition amid growing geopolitical rivalry in clean technologies.[12].

Nuclear energy has long been a contentious issue among MSs, particularly in recent years regarding its inclusion in the EU Taxonomy, its role in producing clean hydrogen, and the support mechanisms it may qualify for. Despite these debates, nuclear power's potential for decarbonization (as a low-carbon energy source) and its advantages for grid management (centralized and on-demand generation) are increasingly recognized by the EU at the highest levels (including by Ursula von der Leyen in August 2024[13]). It is expected to play a role through various technologies, such as small modular reactors (SMRs) – which are the subject of a new alliance[14] — fission (eligible for CfDs) and other technologies considered net-zero technologies under the NZIA (2024/1735).

2.2 Renewables in the gas market

The decarbonization of European gas consumption is set to occur through the use of biogas and renewable fuels of non-biological origin (RFNBOs), particularly hydrogen (Conti et al., 2024). Hydrogen has been identified as a key solution for hard-to-abate industrial sectors, such as iron ore reduction, fertilizers, and the chemical industry. Both the EU[15] and individual MSs (e.g., France, Germany) have adopted strategies and policies to promote hydrogen, and the recent revision of the gas regulatory framework (the gas package) aims to create an entirely new hydrogen market and ecosystem to cover the needs for the transition.

One of the central aspects of this legislation is the definition of clean hydrogen, which, in Europe, will be produced through electrolysis. This process must comply with the stringent requirements of additionality (ensuring the creation of new renewable electricity capacity), and temporal and geographical correlation for the electricity used in the process, set by a delegated act adopted in

[10] https://data.consilium.europa.eu/doc/document/ST-16939-2024-INIT/en/pdf
[11] European Commission (2022), Recommendation on speeding up permit-granting procedures for renewable energy projects and facilitating Power Purchase Agreements, C/2022/3219 final, 18.5.2022.
[12] European Commission (2023), Commission Staff Working Document, Reform of Electricity Market Design, SWD(2023) 58 final, Strasbourg, 14.3.2023
[13] Keynote speech by President von der Leyen at the GLOBSEC Forum 2024, Prague, 30 August 2024.
[14] European Commission (2024), Commission to ally with industry on Small Modular Reactors, European Commission website, February 9th 2024; European Commission (2024), News announcement. DG ENER. Commission to ally with industry on Small Modular Reactors, 9.02.2024.
[15] European Commission (2020), *A Hydrogen Strategy for a Climate-Neutral Europe*, COM(2020) 301 final, 08.07.2020.

February 2023.[16] The definition of low-carbon hydrogen is still pending adoption[17] and, for this policy to succeed, a robust hydrogen transport infrastructure must be swiftly developed, which the creation of a European Network of Network Operators for Hydrogen (ENNOH) in 2025 might help.

In light of these challenges, a recent report by the European Court of Auditors (ECA, 2024), and an increasing number of suspended or uncertain projects raises questions about whether the EU's hydrogen consumption targets are too ambitious, despite the Commission's efforts and the creation of a Hydrogen Bank in 2022 to help finance projects. Beyond the "chicken-and-egg" issue of supply and demand to enable the sector to truly take off, hydrogen illustrates the critical role of internationally competitive electricity prices (Compass Lexecon, 2024). It also underscores the importance of timely and effective support mechanisms, as is demonstrated by the comparison with the U.S. Inflation Reduction Act (IRA), even though several U.S. projects are now seriously into question under the new Trump administration.

2.3 Support mechanisms

The state aid guidelines for supporting new renewable production capacity, originally established in 2014, were revised in 2022, with some aspects codified by the latest revision of the Electricity Market Design (EMD) in 2024 (Jérémie and Baudinet, 2024). Contracts for difference (CfDs), particularly two-way CfDs (for details on their design, see Kitzing et al., 2024), are intended to be the primary support mechanism. They are meant to complement the current market structure by providing the long-term price signals necessary for the development of new capacity, especially for capital-intensive technologies such as nuclear power and their prolongation.[18] Under the CID, new guidance is expected from the Commission to help Member States design these instruments effectively.

Significant expectations have been placed on the growing use of PPAs, long-term contracts directly concluded between electricity – or biogas – producers and consumers (Hancher and Dezorby, 2024; see also CREG, 2024). PPAs are expected to play a critical role in advancing the integration of renewable energy into the overall energy mix, while also enabling large consumers to hedge a portion of their energy supply over extended periods. However, contrary to what is frequently suggested in official documents,[19] PPAs do not automatically guarantee *per se* competitive prices for EIIs. To fully understand their impact, it is essential to consider the consumer side's perspective and constraints, as will be discussed in the last section.

[16] Delegated Regulation (EU) 2023/1184 of 10 February 2023 establishing a Union methodology setting out detailed rules for the production of renewable liquid and gaseous transport fuels of non-biological origin.

[17] A consultation was conducted in September 2024 : https://energy.ec.europa.eu/news/commission-launches-consultation-draft-methodology-low-carbon-hydrogen-2024-09-27_en?utm_source=chatgpt.com

[18] The construction of new Czech and French reactors will resort to CfDs support schemes. So should the prolongation of French and Belgian existing ones (See the Invitation to submit comments published the 8th august 2024 by the Commission – State aid SA.106107 (2024/N) – Lifetime extension of two nuclear reactors – Doel 4 and Tihange 3).

[19] European Commission (2022), *EU Solar Energy Strategy*, COM(2022) 221 final, 18.05.2022.

2.4 The next challenge: increase flexibility and upgrade the grid and infrastructure

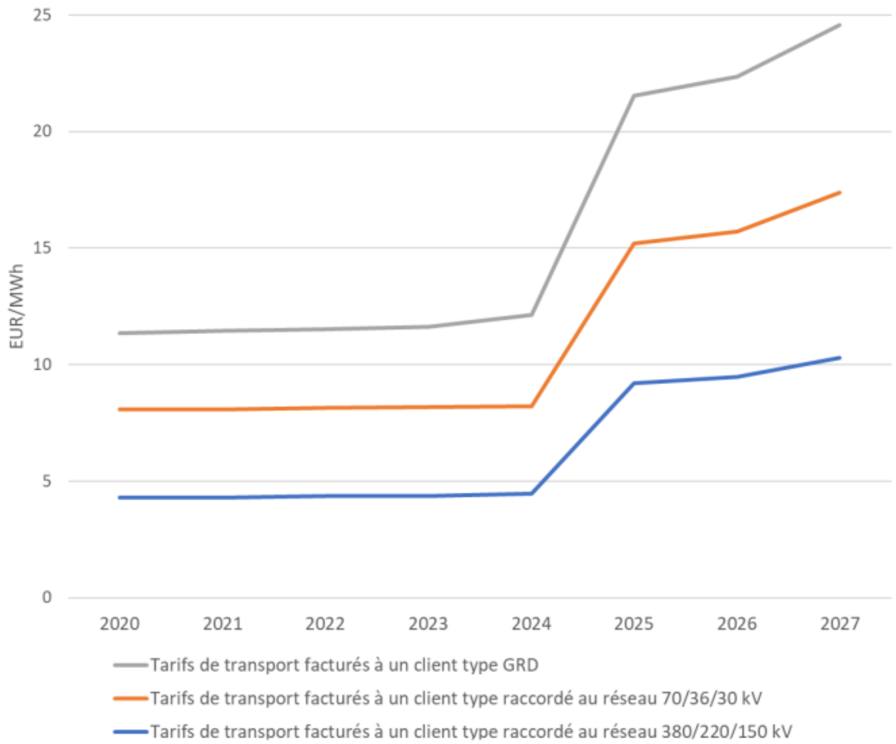
Two interconnected challenges arise from the EU's energy mix choices and they can be seen as the logical next steps following the policies already laid out (ACER-CEER, 2024).

The first challenge is the increasing need for flexibility in the electrical system. As the energy mix increasingly relies on intermittent sources, maintaining balance between electricity production and consumption at all time will become more challenging. While some stability can still be provided through production adjustments and storage (e.g., pumped-storage hydroelectricity, batteries), the majority of the effort will shift to demand-side response (DSR), where consumers adjust their consumption based on price signals. While retail flexibility holds promise, industrial flexibility is already well-established, with many sectors utilizing DSR mechanisms to which the EU is committed to removing remaining regulatory obstacles (ACER, 2023). But for the transition to succeed without straining the system, though, the focus should shift from simply assessing how industry electrification can support grid flexibility (Boldrini and Koolen, 2024) to creating/adapting mechanisms that enable industrial consumers to maximize their flexibility potential, taking into account their commercial, organizational, social, and technical constraints. New schemes that extend beyond current timeframes to manage multi-day or weekly periods—that batteries alone cannot fully address—should for example be explored.

The second major challenge is the upgrade of the electricity grid, as highlighted in the recent Grid Action Plan,[20] alongside the development of new infrastructure for storage and hydrogen. Substantial investments are required to build new transport and distribution equipment, as well as upgrading existing/ageing networks, creating grid-scale electricity storage to handle decentralized and intermittent generation while connecting new industrial centres. The European Commission estimates that 584 billion euros will be necessary by 2030. French TSO estimates the required investment at around 100 billion euros, while Germany projects a figure three times higher. These investments will inevitably raise network costs, which will be passed on to consumers, potentially affecting industry costs when electrification is crucial. Careful decisions on cost distribution will be essential to prevent overburdening industries and maintaining their global competitiveness.

[20] European Commission (2023), Communication Grids, the missing link - An EU Action Plan for Grids, COM/2023/757 final, 28.11.2023.

Figure 2: Evolution of electricity transport tariffs in Belgium 2024-2027



Source: CREG, ELIA, December 2023

A recent proposal by German authorities (BMWK 2024) to introduce local price signals to address grid constraints in a high renewable energy mix highlights how flexibility and grid-related issues can affect the industry. While this proposal is sound from a strictly microeconomic perspective,[21] it adds stress to the industry by failing to fully account for its operational and economic constraints in an open economy. This underscores the tension between economically sound policies in theory and their practical impact on industries navigating the transition, a recurring dilemma the EU is increasingly facing.

Indeed, in the European strategy, the decarbonization of energy system and the industry transition are meant to go hand in hand, progressing and supporting each other. Assessing the likelihood of this strategy's success requires analysing whether the European industry is well positioned to compete *globally*, considering the EU energy dependencies and relative standing of competitors in *other regions*. From this perspective, the current European regulatory and policy framework for energy and decarbonization still presents challenges and might lack coherence, which could hinder the industry's transition.

[21] See Zwölf Energieökonomen: Der deutsche Strommarkt braucht lokale Preise, *Frankfurter Allgemeine Zeitung* 10.07.2024.

3. The structural problems of EU energy policy in comparison with its main competitors

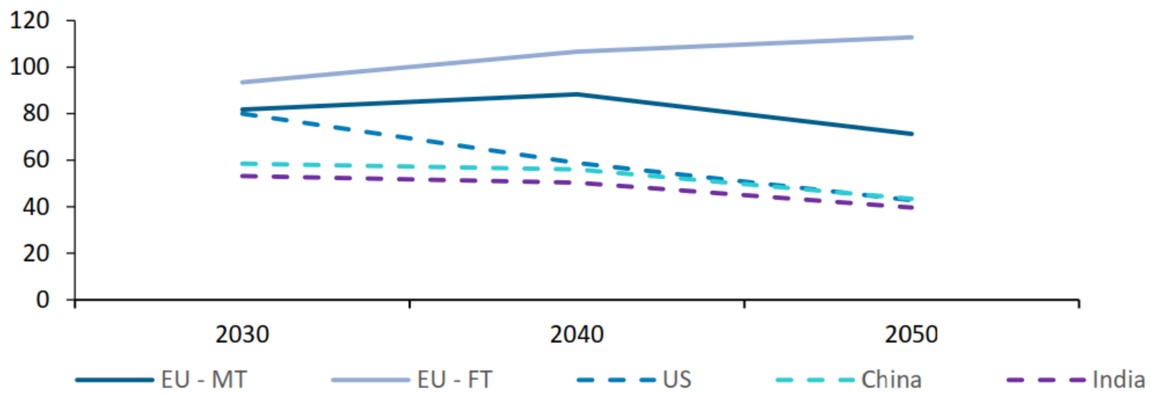
3.1 A stronger dependency on foreign raw materials and energy sources

The problem of the EU's security of energy supply has emerged progressively since the gas crisis between Kiev and Moscow in 2006 and 2009, and even more urgently since 2022. These events highlighted the issue of the EU's overdependence on Russian gas, the supply of which is subject to the will of government-controlled Gazprom. Despite the target of the European Commission in 2015 to reduce the EU's dependence on Russian gas,[22] it was only after the outbreak of the war in Ukraine in 2022 that the EU diversified its supplies by turning to the international LNG market and establishing bilateral agreements with new suppliers (e.g. Azerbaijan and Algeria) (Goldthau and Sitter, 2022). This delay was caused especially by the reluctance of countries heavily dependent on Russian gas, notably Germany, to reduce this source of supply, not least because of the impact this would have on its industry. This highlights the difficulty of creating a genuine EU energy security policy in the presence of different national energy mixes across the bloc (Baechler, 2015).

Despite diversification efforts, the EU remains significantly reliant on natural gas and other fossil fuels. The global LNG market is inherently volatile and subject to international competition, particularly between high-demand regions (Europe and Asia), which can drive up prices. As frequently observed in recent market evolutions, LNG supply is vulnerable to geopolitical tensions, disruptions to maritime routes, and technical issues at major exporting facilities (e.g., in the U.S. and Australia). These factors contribute to a widening structural price gap between Europe and other regions, impacting both the EU's energy markets (see next section) and the competitiveness of its industries, putting the EU at a disadvantage compared to its primary global competitors over the long term.

[22] European Commission (2015), Communication *A Framework Strategy for a Resilient Energy Union with a Forward-Looking Climate Change Policy*, COM/2015/080 final, 25.0.2015.

Figure 3: Electricity generation costs projections in a selection of jurisdictions (EUR/MWh) – 2030-2050

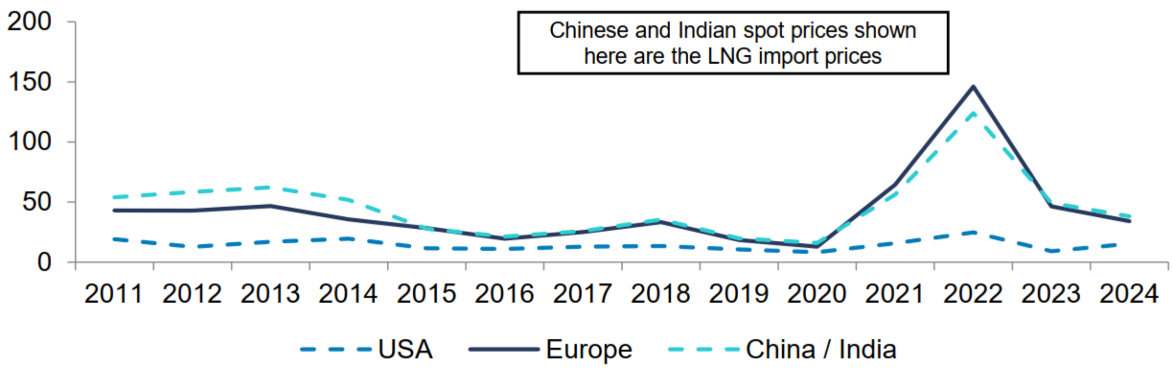


Source: Compass Lexecon study for BusinessEurope, July 2024.

Note: "MT" and "FT" refer to the two scenarios envisaged by the study and stand for "managed" or "frustrated" transition.

The United States, in particular, has benefited from its shale gas production since the early 2010s, which has allowed it to avoid the energy supply tensions experienced in other regions. In fact, the U.S. has become one of the main suppliers of natural gas to Europe, having provided 45 % of its LNG supply in 2024.

Figure 4: Historical monthly gas price (USD/MWh 2023)



Source: Ibid.

With greater energy security, the U.S. also enjoys several other advantages in the race for clean technologies and the transition. It boasts technological leaders in key sectors, such as electric vehicles, and pursues a more assertive trade policy designed to protect its technologies and strategic markets (e.g., steel, EVs) from foreign competition, particularly from China. Moreover, the U.S. adopted a more pragmatic approach to supporting the energy transition. Rather than implementing a carbon pricing system similar to the European cap-and-trade model, it has chosen to incentivize the transition through simpler mechanisms, such as tax credits under the Inflation Reduction Act (IRA) and local content requirements aimed at boosting domestic industries.[23]

Europe's situation also stands in contrast to China, which has been described as a 'systemic rival' by the EU since 2019.[24] China's geographical and strategic proximity to Russia grants it access to natural gas via the Power of Siberia pipeline, soon to be reinforced by a second pipeline, while new energy corridors with Central Asia (e.g., Turkmenistan, Kazakhstan) further mitigate energy risks. China also benefits from extensive access to strategic raw materials essential for clean technologies, in stark contrast to the EU, which recently adopted the Critical Raw Materials (CRM) Act in an effort to mitigate this disadvantage. In addition, China has implemented an expansionist industrial policy characterized by opaque (WTO, 2024) and strategic subsidy practices (Mercier and Giua, 2023) aimed at dominating entire supply chains in key sectors. This strategy has enabled China to rapidly scale production capacities across several industrial sectors, leading to long-documented overcapacities in areas such as steel (OECD, 2024). More recently, concerns have grown within the European manufacturing sector regarding key technologies such as electric vehicles (EVs), photovoltaics (PVs), and batteries, which now face increased competitive pressure and overcapacities. Investigations and provisional duties already adopted by the EU[25] suggest that part of the cost differential between Chinese and European products is not entirely market-driven, further fuelling concerns over a competitiveness gap in Europe.

3.2 The problems of the organisation of the EU electricity market for industry competitiveness

The microeconomic theory of electricity markets (Léautier, 2019) has long demonstrated the merits of a market design based on the marginal principle and peak-load pricing (Zachmann and Hirth, 2023). Under this paradigm, the wholesale market price is set by the last unit needed to satisfy demand, which reflects scarcity and provides the correct price signal to economic operators. Additionally, the single coupling of the different European bidding zones (BZ) allows for the consideration of interconnections when calculating prices in the day-ahead market (ACER, 2022). However, when viewed from an industrial perspective in an open economy, these features pose several challenges in light of the EU's geopolitical dependencies and the relative positioning of industries in third countries.

First, the marginal principle inherently causes a disconnect between the actual emission factor of electricity production and the emission factor derived from the wholesale market: fossil fuel

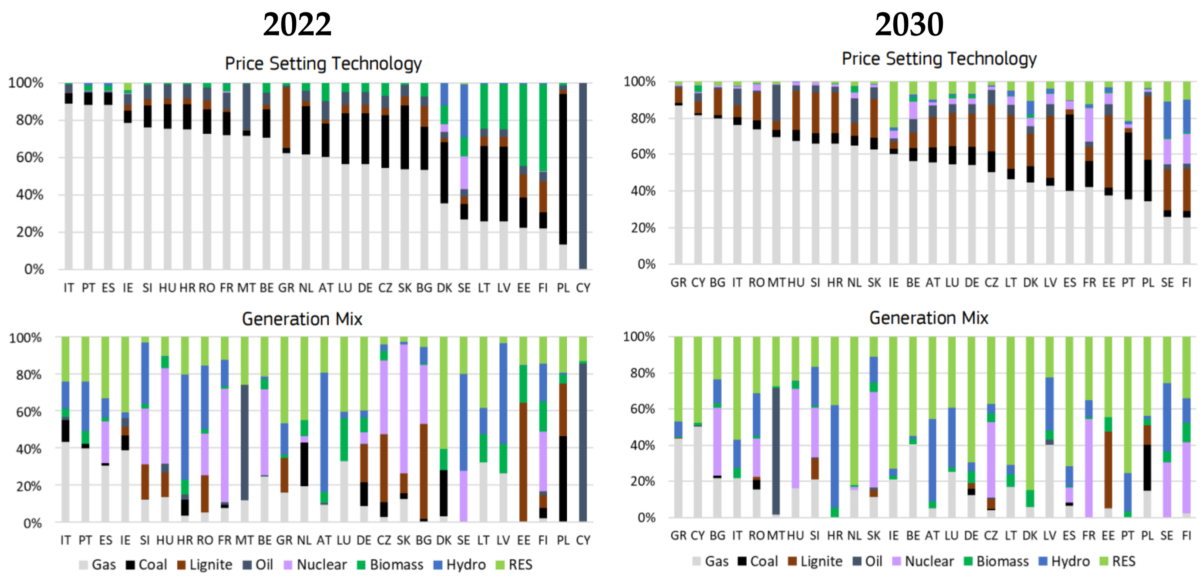
[23] White House, Inflation Reduction Act Guidebook, available at: https://www.whitehouse.gov/cleanenergy/inflation-reduction-act-guidebook/.

[24] European Commission (2019). Communication EU-China – A strategic outlook, Strasbourg, JOIN(2019) 5 final, 12.3.2019.

[25] In the ambit of its investigation, the European Commission imposed provisional countervailing duties on Chinese EV in July 2024 (Implementing Regulation (EU) 2024/1866 of 3 July 2024).

generation technologies set the market price far more frequently (in terms of hours per year) than their actual contribution to total electricity production (in share of total production in MWh). Despite the increasing share of renewable generation in the European electricity mix, this results in structurally higher electricity prices on the wholesale market, which are not entirely offset in the – few – European countries that choose to implement indirect cost compensation. [26] This effect has been confirmed by recent projections from the Commission (Gasparella et al., 2023). Given their impact on competitiveness, these forecasts should ideally be regularly updated by the Commission services.

Figure 5: Price-setting technologies vs electricity generation mix by country in the EU (2022, projections 2030)

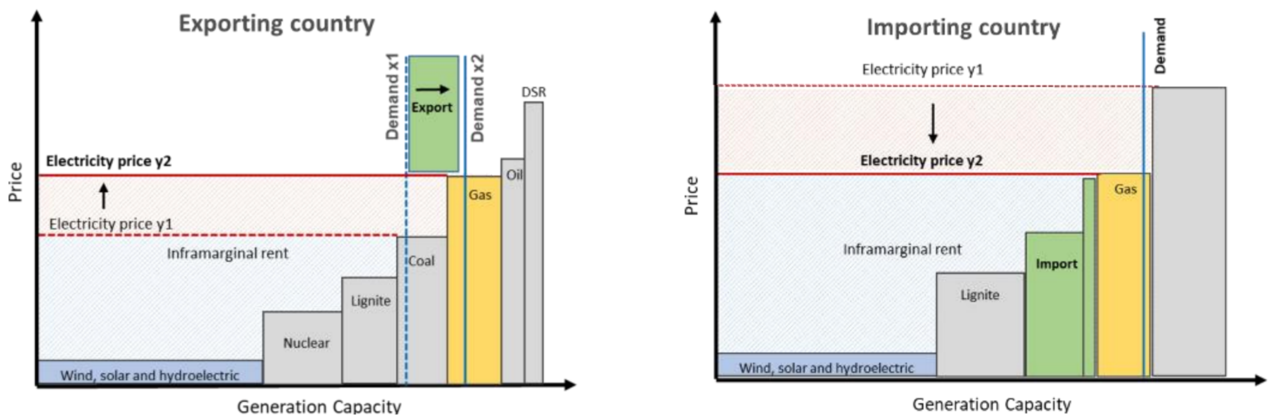


Source: EC JRC (Gasparella et al. 2023), based on METIS Simulation results

Second, while interconnections between BZ enhance supply security by coupling these zones, they also amplify the influence of fossil technologies as price setters: a single fossil fuel unit can set the price across multiple interconnected zones. As interconnections grow, zones function more like a single market, leading to a "contamination effect", where fossil fuel-based pricing spreads across regions. This paradox highlights how national choices in terms of energy mix can still impact neighbouring MSs.

[26] Under the EU ETS and state aid rules, willing MSs can compensate part of this indirect cost of CO2 in electricity for exposed sectors. This compensation is however optional and unevenly applied across the EU and in terms of level of compensation and allocated budget.

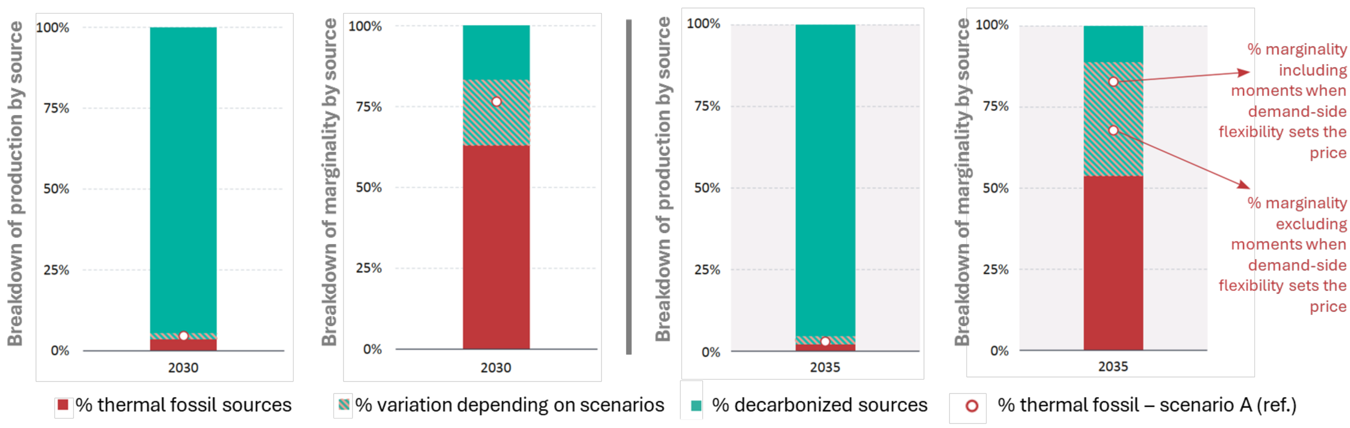
Figure 6: Import and export merit order impact



Source : Ibid.

According to the French TSO's projections (figure 7), while more than 95% of electricity production in 2030 is expected to come from decarbonized sources (renewables and nuclear), fossil fuel technologies will still set the market price over 75% of the time, and still more than 50 % of the time in 2035 (RTE, 2024).

Figure 7: Comparison of the share of fossil sources in France's electricity production and the contribution of fossil sources to projected wholesale price formation by 2030 and 2035



Source: RTE, Économie du système électrique (July 2024)

Third, the overrepresentation of fossil fuel generation in the wholesale spot market also extends to other markets and instruments. On the future/forward markets, the price reflects the market's expectations for future spot prices (e.g., the CAL 2026 market price reflects the anticipated average spot market price for 2026). As the spot price is strongly correlated to fossil generation technology, this has a knock-on effect on future prices. This over-representation also affects price negotiations for Power Purchase Agreements (PPAs), where future market prices are often used as a benchmark or reference point for negotiations with off-takers. This raises questions about the extent to which PPAs can truly decouple gas and electricity prices: instead, it could be argued that they 'lock in' a snapshot of these intertwined markets for the duration of the PPA.

3.3 A regulatory framework for decarbonising the European industry affecting its competitiveness

The EU has engaged the decarbonisation of its industry through the implementation of the European Trading System (ETS), adopted in 2003 in response to Europe's commitments under the Kyoto Protocol (1997).[27] Following the Paris Agreement (2015) and in the ambit of the Fit-for-55 package, the ETS was strengthened and complemented with a Carbon Border Adjustment Mechanism (CBAM).

3.3.1 Despite CBAM, the European industry risks facing a higher carbon price than other regions

The Carbon Border Adjustment Mechanism (CBAM) entered its transitional phase in October 2023 and will mark the gradual phase-out of free allowances for a few key industrial sectors. This is expected to have a significant impact on the competitiveness of European industry, particularly in the context of intensifying foreign geoeconomic competition.

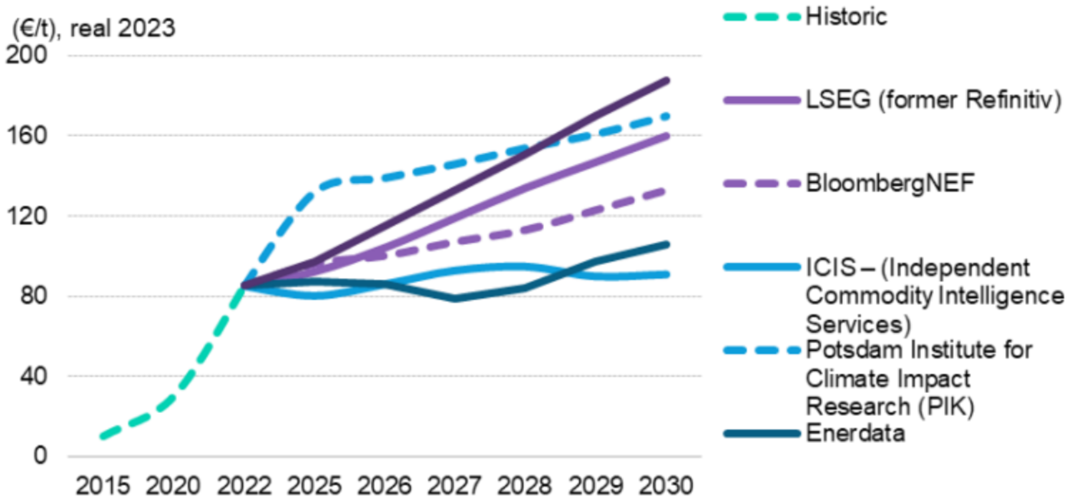
Energy-intensive sectors, such as steel, aluminium, hydrogen and fertilizers, are especially vulnerable due to the risk of 'carbon leakage' that justified the free allocation mechanism. While the phase-out of free allocations will allow the European carbon pricing system to realize its full potential by exposing industries to the real cost of their direct emissions (Pellerin-Carlin and Vangenechten, 2022), the current design of CBAM presents several limitations. Some of them, such as the need for an export solution, extension to downstream sectors, and prevention of circumvention, could potentially be addressed before the mechanism enters its definitive phase in 2026. However, other limitations are inherent to the system. For instance, CBAM seeks to establish a level playing field only in terms of carbon costs,[28] leaving other crucial factors affecting industrial competitiveness—such as energy cost differentials and distortions in energy markets—unaddressed.

Under the EU ETS, electricity producers, who are not exposed to carbon leakage risks, do not receive free allowances and must internalize the carbon cost, which is passed through in the marginal bidding of the wholesale market: when a gas-fuelled power plant sets the market price, a portion of that price

[27] European Commission (2001), COM(2001) 264 final, A Sustainable Europe for a Better World. A European Union Strategy for Sustainable Development, 15 May 2001.
[28] Which is also questionable. European installations will bear the full carbon cost under the EU ETS, while their non-EU competitors will only incur this cost for the portion of their production exported to the EU and subject to CBAM.

reflects the carbon cost incurred by the producer under the ETS. This carbon cost component is expected to increase significantly in the coming years, exerting additional upward pressure on electricity prices (see previous section).

Figure 8: Historical Trends and Forecasts of Carbon Prices in Europe (EUR/EUA)



Source: ERCST, State of the EU ETS report, may 2024. Prices are in real 2023 EUR per metric ton.

All these factors combined are likely to make electricity significantly more expensive for EIIs, even though their transition pathways often require a substantial increase in their electricity consumption.

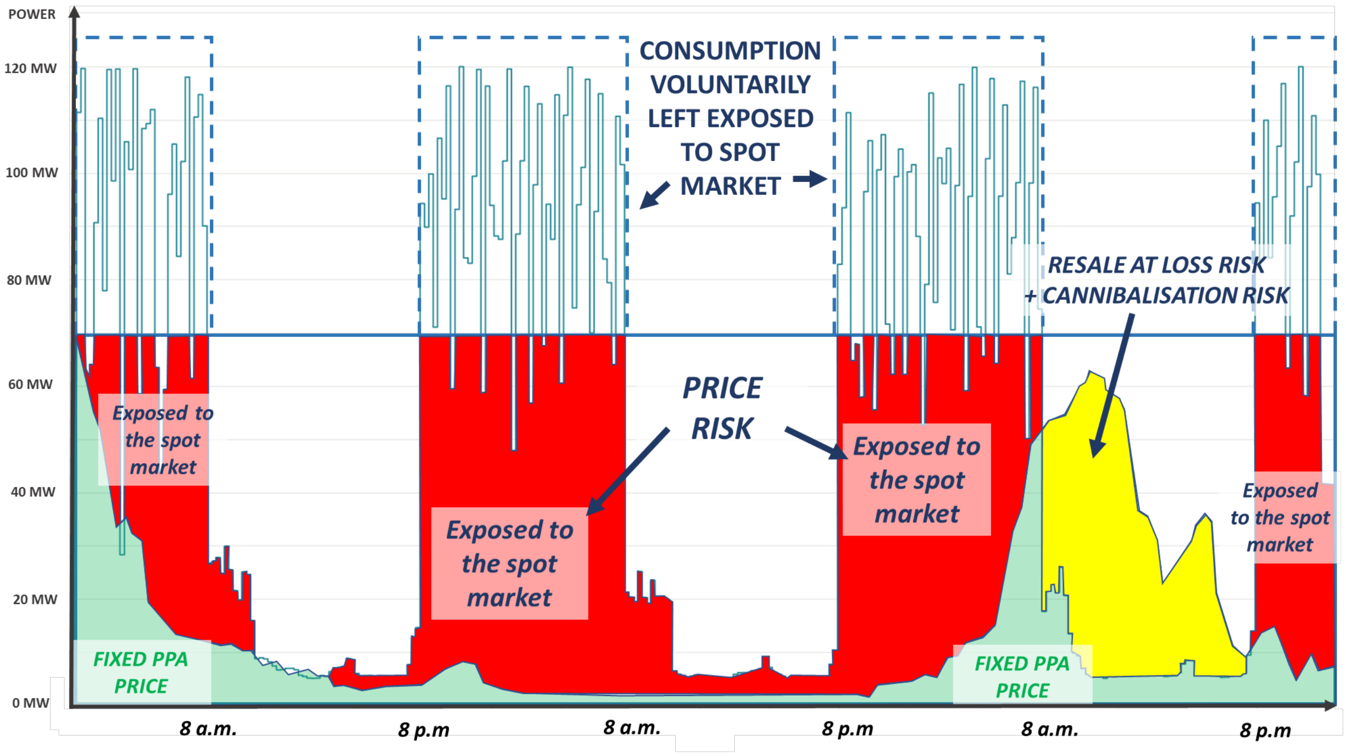
Finally, the potential integration of indirect emissions into CBAM for energy-intensive goods is also complicated by current market design disparities. For non-EU producers, indirect emissions could be calculated using the average emission factor of their country's electricity mix, as most countries lack liberalized, transparent markets and do not rely on marginal pricing. In contrast, EU producers would bear the carbon cost of their indirect emissions through higher wholesale electricity prices, driven by fossil-based price-setting technologies, despite often having a low average emission factor in their electricity mix. This disparity could result in significant differences in carbon costs exposure, distorting competition further.

3.3.2 In the current regulatory framework, PPAs present difficulties to energy-intensive industries

Faced with these challenges, PPAs may at first glance appear to be a viable way to boost Europe's industrial competitiveness during the energy transition. However, the regulatory framework and market design limit their effectiveness as a stand-alone solution for hedging power supply. While renewable PPAs help to secure guarantees of origin for ESG purposes, their ability to provide competitive prices is often overestimated (European Commission, 2022, 2023),[29] as intermittency poses significant risks for the off-taker, reducing their value as a hedging tool from the consumer's perspective:

- Price Risks: The cannibalization effect creates an opportunity cost—in the current market design, during high renewable output, spot prices may drop or become negative, but industries with long-term contracts miss out on these lower prices for PPA contracted volumes. Additionally, in pay-as-produced PPAs, the off-taker must resell unused electricity at the spot price, risking losses (as selling at negative prices means buying a second time) during high renewable output.
- A volume Risk: When renewable output is low, the PPA may not deliver, forcing the consumer to buy from the spot market, where prices can spike due to reliance on fossil fuel generators.

Figure 9: Illustration of risks posed by intermittency in a PPA for a typical EAF steel consumption profile



Source: author.

Explanation: The graph represents the load profile (electricity consumption) over a few days of an electric arc furnace (EAF) steelworks, which consumes up to 120 MW during steel production. The production schedule is optimized for off-peak hours (i.e. nighttime). This example illustrates a theoretical pay-as-produced PPA based on a 70 MW offshore wind asset, showing the asset's electricity generation during this period. Green areas: the PPA generation matches the EAF's consumption, electricity is purchased at the PPA's contractual price. Red areas: the EAF consumes electricity while the wind asset does not generate power. In this case,

[29] European Commission (2023), Communication *European Wind Power Action Plan*, COM(2023) 669 final, 24.10.2023.

electricity must be sourced from the spot market, unless another hedging strategy is in place (e.g. future market). Yellow areas: the PPA generates electricity, but the EAF does not consume it. The surplus electricity is still purchased at the PPA price but must be sold on the wholesale spot market, posing a high risk of loss.

Although these risks can theoretically be mitigated through shaping (e.g., securing biomass backup or storage), doing so raises overall costs of the contract and is more challenging for EIIs due to the often very large scale of their energy needs.

Despite the EU's effective and ambitious policies to increase the share of renewable and low-carbon energy in its energy mix, recently reinforced doubts persist about the ability of its energy system and markets to support the industry's transition and competitiveness (BCG, 2024). These concerns are amplified by a shifting geopolitical environment, with competitors increasingly defending and promoting their industries in clean technologies. Other regions also enjoy better access to natural resources – natural gas, renewable potential – and rely on different market structures to support their EIIs. Negative interactions between EU policy instruments – ETS, CBAM, EMD – risk further exacerbating these disadvantages for European producers, necessitating targeted interventions to ensure a successful industry transition.

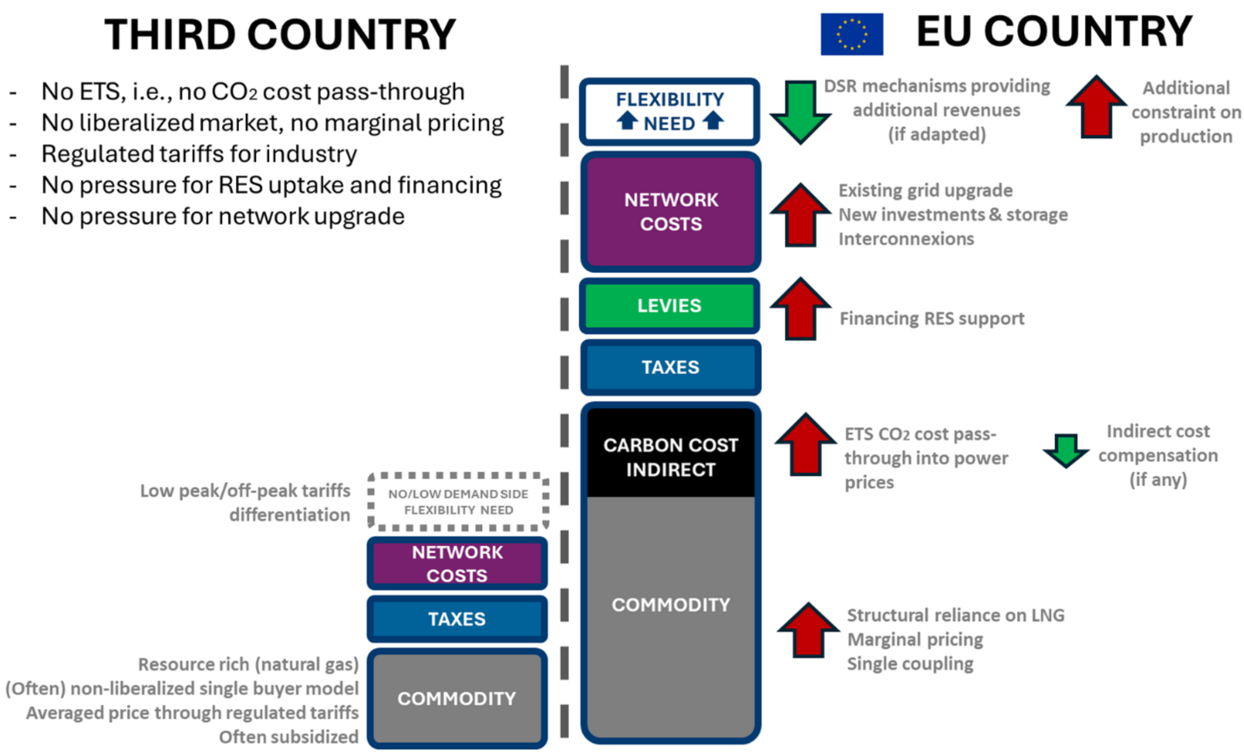
4. Conclusion and Policy recommendations

So far, competitiveness in relation to energy policy and industry has often been treated in the EU as a single challenge that could be addressed through a horizontal approach aimed at improving the integration and functioning of the energy sector.[30] (European Commission, 2023). Instruments such as PPAs and CfDs, recently reinforced and promoted, were often viewed from a supply-side perspective rather than addressing the urgent energy-competitiveness challenges faced by EIIs that also stem from external factors and distortions.

The following graph summarises the analysed dynamics and differences in the total energy cost structure for Energy-Intensive Industries (EIIs) in the EU compared to a third country with regulated energy tariffs, highlighting the impact of external cost distortions.

[30] European Commission (2023), *Delivering on the EU offshore renewable energy ambitions*, COM(2023) 668 final, 24.10.2023.

Figure 10: Simplified Breakdown of Energy Cost Differentials and Trends for EIIs: EU vs. Non-EU



Source: author.

In view of all the challenges examined in this working paper, it appears that the steps taken so far may not be sufficient and that targeted intervention is needed not only to achieve the transition but also to keep energy-intensive industries in Europe. To this end in the Clean Industry Deal and the accompanying initiatives, the EU could seek to:

- **Better coordinate national energy policies and further diversify of natural gas supplies** through partnerships, in line with the External Energy Engagement Strategy.[31]

- **Develop new low-carbon generation capacities**, maximising the potential of two-way CfDs without imposing overly restrictive regulatory frameworks in forthcoming decisions, in particular for on-demand generation so as to minimize flexibility need and grid upgrades.

[31] European Commission (2022), *Communication on EU external energy engagement in a changing world*, JOIN/2022/23 final, 18.05.2022.

- **Protect industrial sectors as far as possible from foreseeable increases in all non-energy components of their cost structure**: network costs, taxes and levies on energy, whether or not related to support for renewable energy.

- **Undertake a comprehensive inventory of energy cost differentials** with other jurisdictions and examine the **underlying factors**, such as differences in market design (e.g., liberalised versus non-liberalised markets, tariff structures) and market distortions (e.g., subsidies). These factors should be better taken into account in CBAM and TDIs (e.g. the recently adopted the Foreign Subsidies Regulation but also countervailing duties).

- **Consider specific, targeted sectoral interventions for EIIs exposed to international competition** in order to facilitate their energy transition or to ensure that already decarbonised sectors remain in the EU. Ideally, these interventions would strive to give EIIs access, for at least part of their consumption, to electricity at prices close to generation costs.

- **Leverage existing instruments**, such as two-way CfDs, to drive the creation of new capacity at the lowest strike price with possibility to carve part of the capacity out of the support mechanism to sign PPAs at a price close to the strike price with EIIs exposed to international competition.[32]

- **Consider new flexibility mechanisms better suited** to industrial consumers to address their specific constraints and challenges and at the same time free a flexibility potential on longer time horizons ("multi-days").

- Although **alternative market design proposals** pose significant challenges, less intrusive modifications **could be considered**, especially during periods of tension in gas supply. For example, the 'shock absorber' mechanism (see Hogan et al. 2022) and its variations (Frangioni and Lacalandra, 2024), which modify the clearing process to reduce total costs without altering the merit order, would only require adjustments to the algorithm.

Finally, the EU should exercise great caution when considering economic analyses that suggest energy-intensive industries, due to price differentials and their supposedly low value-added for the EU economy, should be permanently outsourced to regions with greater renewable energy generation

[32] Such a mechanism combining CfDs and PPAs is already being considered for the Belgian Princess Elisabeth offshore wind farm. The only missing element is prioritizing the EIIs vulnerable to international competition.

potential.[33] First, as discussed, part of the higher energy costs in the EU is self-imposed, and many other countries do not yet have liberalized and transparent energy markets. Instead, they often rely on single-buyer models which allows for lower, averaged administrative—and frequently subsidized—tariffs for industry, which may divert investments flows more effectively than renewable energy potential. Second, such a strategy would mean abandoning industrial segments that are already among the most environmentally efficient globally, such as recycled steel (carbon and stainless) or aluminium, all of which are based on recycling processes in Europe. In contrast, production in third countries often relies on primary production routes – driven by lower energy costs –, resulting in a higher imported carbon footprint. This would undermine global climate goals and, in addition, impose significant CBAM costs on EU downstream sectors and consumers.

[33] Only certain sectors deemed strategic or selected based on economic criteria would be preserved, leading to a 'bonsai industry'—one that is small and carefully pruned to meet specific goals.

References

ACER (2023). Demand response and other distributed energy resources: what barriers are holding them back?. 2023 Market Monitoring Report, 19.12.2023.

ACER, Final Assessment of the EU Wholesale Electricity Market design, April 2022.

ACER-CEER (2024), Challenges of the future electricity system. Recommendations and commitments, Position paper, 11 July 2024, available at: https://www.ceer.eu/wp-content/uploads/2024/07/Future_electricity_system_challenges_2024.pdf

Baechler L. (2015), The Europeanization of Energy Security Policies, CERI-Sciences Po (Paris).

BCG Report for ERT (2024), *Competitiveness of European Energy-Intensive Industries*, March 2024, available at: https://ert.eu/wp-content/uploads/2024/04/ERT-Competitiveness-of-Europes-energy-intensive-industries_March-2024.pdf

Boldrini, A., Koolen, D., Crijns-Graus, W., Van Den Broek, M., Flexibility options in a decarbonising iron and steel industry, Renewable and Sustainable Energy Reviews, 189 (2024) 113988.

BMWK (2024), *Strommarktdesign der Zukunft. Optionen für ein sicheres, bezahlbares und nachhaltiges Stromsystem*, 04.09.2024.

Compass Lexecon (2024). Energy and climate transition: How to strengthen the EU's competitiveness. A study for BusinessEurope, Paris.

Cornillie J., Kneebone J., Conti I., Delbeke J. (2024). Five reflections on clean hydrogen's contribution to European industrial decarbonisation from 2024 to 2030, Policy Brief, Issue 2024/08, February 2024, Florence School of Regulation.

CREG Study (2024). Power Purchase Agreements: Overview and evaluation. 11 april 2024.

Defraigne, J.-C., Traversa, E., Wouters, and J. Zurstrassen, D. (2022). EU Industrial Policy in the Multipolar Economy. Edward Elgar Publishing.

Draghi, M., (2024), *Acceptance Speech at the Monastery of San Jeronimo de Yuste for the Carlos V European Award*, Spain, 14 June 2024.

European Commission (2020), *A Hydrogen Strategy for a Climate-Neutral Europe*, COM(2020)301 final, 08.07.2020.

European Commission (2023), Commission Staff Working Document, Reform of Electricity Market Design, SWD(2023) 58 final, Strasbourg, 14.3.2023

European Commission (2023), Communication Grids, the missing link - An EU Action Plan for Grids, COM/2023/757 final, 28.11.2023.

European Commission (2019). Communication EU-China – A strategic outlook, Strasbourg, JOIN(2019) 5 final, 12.3.2019.

European Commission (2015), Communication *A Framework Strategy for a Resilient Energy Union with a Forward-Looking Climate Change Policy*, COM/2015/080 final, 25.0.2015.

European Commission (2023), Communication *European Wind Power Action Plan*, COM(2023) 669 final, 24.10.2023.

European Commission (2001), COM(2001) 264 final, A Sustainable Europe for a Better World. A European Union Strategy for Sustainable Development, 15 May 2001.

European Commission (2022), *Communication on EU external energy engagement in a changing world***,** JOIN/2022/23 final, 18.05.2022.

European Commission (2023), *Delivering on the EU offshore renewable energy ambitions*, COM(2023) 668 final, 24.10.2023.

European Commission (2022), *EU Solar Energy Strategy*, COM(2022) 221 final, 18.05.2022

European Commission (2024), News announcement. DG ENER. Commission to ally with industry on Small Modular Reactors, 9.02.2024.

European Commission (2022), Recommendation on speeding up permit-granting procedures for renewable energy projects and facilitating Power Purchase Agreements, C/2022/3219 final, 18.5.2022.

European Commission (2024), Commission to ally with industry on Small Modular Reactors, European Commission website, February 9th 2024.

European Court of Auditors (2024), Special report 11, *The EU's Industrial policy on renewable hydrogen. Legal framework has been most adopted – time for a reality check*, 2024.

Frangioni A., Lacalandra, F. (2024). A bilevel programming approach to price decoupling in Pay-as-Clear markets, with application to day-ahead electricity markets, European Journal of Operational Research. Volume 319, Issue 1,Pages 316-331.

Gasparella, A., Koolen, D. and Zucker, A., The Merit Order and Price-Setting Dynamics in European Electricity Markets, European Commission, Petten, 2023, JRC134300.

Glachant, J.—M., et. Alii. (2021). Handbook on Electricity Markets. Edward Elgar Publishing.

Guerrieri, P. and Padoan, P. (2024). Europa sovrana. Le tre sfide di un mondo nuovo. Laterza.

Hancher L., Dezobry G., Glachant J.-M., and Menegatti E. (2024). Leveraging the Energy Transition: the role of long-term contracts. Florence School of Regulation, Report Project Report RSC/FSR 2024.

Hogan, M., Claeys, B., Pato, Z., Scott, D., Yule-Bennett, S., and Morawiecka, M. (2022), *Price shock absorber: Temporary electricity price relief during times of gas market crisis*, Regulatory Assistance Project, April 15th 2022, available at: https://www.raponline.org/wp-content/uploads/2023/09/rap-briefing-price-shock-absorber-2022-april-8-final.pdf

Jérémie P., Rosenblieh L., and Boudinet L. (2024), L'article 19 b du règlement Electricity market design au cœur de la réforme du marché intérieur de l'électricité, Energie-Environnement-Infrastructures, N°3, Mars 2024.

Kitzing L., Held A., Gephart M., Wagner F., Anatolitis V., and Klessmann C. (2024). Contracts-for-Difference to support renewable energy technologies: Considerations for design and implementation. Florence School of Regulation. RSC/FSR March 2024.

Léautier, T.-O. (2019). Imperfect Markets and Imperfect Regulation. An Introduction to the Microeconomics and Political Economy of Power Markets. The MIT Press.

Mercier, F. and L. Giua. (2023). Subsidies to the steel industry: Insights from the OECD data collection, OECD Science, Technology and Industry Policy Papers, No. 147, OECD Publishing, Paris.

Meeus, L. (2020), *The evolution of electricity markets in Europe*, Cheltenham Edward Elgar Publishing, 2020, Florence School of Regulation, available at: https://hdl.handle.net/1814/69266

OECD (2024), Latest developments in steelmaking capacity and outlook until 2026, DSTI/SC(2024)3/FINAL, 12.06.2024.

Pellerin-Carlin T., Vangenechten D., Lamy P. and Pons G. (2022). "No more free lunch. Ending free allowances in the EU ETS to the benefit of innovation", Policy brief, Jacques Delors Institute, E3G & Europe Jacques Delors.

Petrini, F. (2019). Energy policy: security, competitiveness and the environment. The impossible equation in Bussière E. et. al., *The European Commission 1986-2000. History and memories of an institution*, Publication Office of the European Union, pp. 301-311.

Réseau de transport d'électricité RTE (2024), Economie du système électrique, Rapport, Paris, 07.2024.

Jerzyniak, T., and Herranz-Surrallés, A. (2024, *EU Geoeconomic Power in the Clean Energy Transition*, in Journal of Common Market Studies, Vol. 62, Issue 4, pp. 1028-1045.

Zachmann, G., Hirth, L., Heussaff, C., Schlecht, I., Mühlenpfordt, J., and Eicke, A. (2023). The design of the European electricity market - Current proposals and ways ahead, Study for the ITRE committee, European Parliament.