



**NEW
STRATEGIC
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Deindustrialization of the EU

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Reports on the EU economic future look gloomier than ever, especially when it comes to Germany. Deindustrialization is high on the agenda. A sharp rise in energy prices initially triggered by failed energy policies and later amplified by the war in Ukraine has led to a massive migration of industrial production abroad.

Alarming messages also come from manufacturers. Some claim that businesses in the EU and, particularly, in Germany are under enormous stress and even expect some sort of 'industrial exodus'. Indeed, the United States and China are increasingly considered by German manufacturers as a new destination to move to because energy prices and taxes there are low compared to Germany and the European Union in general.



Besides, economic policies in the EU and its members are rather complicated, not to say enigmatic. Politicians respond to current challenges with regulations ranging from taxonomies to supply chain laws to decarbonization constraints to war sanctions. Bureaucratic requirements are often impossible for companies to comply with. This hinders business instead of encouraging innovation and investment.

The danger of deindustrialization is clear and present in the EU. The tricky thing about this phenomenon is that it happens generally unnoticed, while some EU ideological circles even laud it as a positive impact of the Green Deal.

The reluctance to recognize or attempts to negate this reality will result in increasing poverty, social and political strain, and, ultimately, growing unrest inside countries. Eventually, they will change the political topography of the European Union towards exit-oriented political parties and, ultimately, destroy the Union. From this perspective, it is crucial to address the issues of the current deindustrialization in the European Union with clarity, foresight, and ideological neutrality. The future of the whole continent is at stake.

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Summary

Europe's prosperity rests on its robust industrial sector, which currently faces sustainability threats due to deindustrialization processes. The ramifications for the EU include increasing trade deficit, job losses, diminished purchasing power, skills, and potential in research and development, decline in strategic industries, critical reliance on exports, decreasing living standards, and growing social tensions.

The deindustrialization that Europe is currently facing is in large part caused by the energy deficit and the price volatility in energy markets. The consequences of the 2022 price shocks and the instability of the gas market anticipated over the next five years most acutely impact energy-intensive industries where electricity costs account for more than 15%, including chemical, glass, metal, fertilizer, pulp and paper, ceramics and cement production, as well as car manufacturing and machine-building.

The entire spectrum of deindustrialization symptoms is not currently visible in the EU's economy, as companies are actively spending to survive, cutting investments that provide for long-term competitiveness. The unprecedented capital flight from Germany exacerbates the prospects of European industrial development in general. German business continues to urge the national and the EU authorities to take coordinated actions to change the situation. However, the EU budget capabilities are limited, and Germany is frequently accused of subsidy abuse.

The challenges of energy pricing in the EU are neither momentary nor transitory, as prompt systemic solution to the energy supply deficit remains a far cry. Addressing the repercussions of the energy crisis through the implementation of renewable energy projects is pivotal for Europe's strategic autonomy. However, as of now, it fails to meet the ongoing demand, especially in energy-intensive industries.

European economy is on the brink of a major crisis. Economic indicators of the euro area and the European Union signal deceleration, with projections increasingly pointing towards recession. Export growth rates are declining, bankruptcies are getting widespread. The inflation is high, interest rates are rising, profit margins in the industrial sector are reduced. The business activity index has plummeted. PMI indices for industrially developed EU countries are hitting record lows, for the demand is decreasing, and the costs are increasing. The cost of servicing the EU debt is expected to nearly double due to the rise in the key interest rates. Consequently, opportunities for subsidizing or supporting priority programs are limited.

The decline in living standards is happening largely due to an unprecedented number of bankruptcies among small and medium-sized enterprises, as well as inflation. Energy deficit is leading to a reduction in consumption and amplifying the trend towards further economic

downturn. **A decrease in the financial stability of industrial enterprises may result in the shrinking middle class, which is the financial and political backbone of European stability.**

The processes of transitioning to a net-zero policy meet the demands for energy security, but on the other hand, they reduce company investment capabilities. Taking into account the need to save the planet with all due regard, **the shortage of resources to achieve zero emission without proper support for industries can trigger a cascade of consequences, including further deindustrialization in metallurgy**, crucial for producing equipment, processing rare earth metals and critically important raw materials (hereinafter CRMs). Carbon capture technologies also result in a significant increase in energy consumption.

In addition, relying upon Chinese raw materials against the backdrop of production decline inflicts irreparable damage and significantly increases CO₂ emissions compared to similar European production, nullifying Europe's environmental efforts. Thus, it is necessary to find a delicate balance between the needs and requirements of domestic producers and achieving the net-zero emission goals.

The processes of deindustrialization, triggered by extreme volatility in supply and energy price spikes combined with the protectionist policies of the USA, where energy prices are significantly lower, have led to the relocation of some major enterprises from the EU. Surveys of industrial production sentiments demonstrate a significant deterioration both in business climate and in the overall confidence in future stability.

Countries of the European Union, especially Germany, are losing their status as global production leaders. The objective of establishing and preserving domestic industries associated with the transition to green energy technologies is of an existential nature. There is a discernible loss in the competitiveness of EU products in international markets, largely due to the unpredictable increase in production costs. Both the volume of orders and indicators of business activity are declining. The growth rate of exports from the EU has significantly decreased. In the automotive industry, a flagship sector for Europe, the current positive margin dynamics are based on internal combustion engine technologies, which remain elusive for electric vehicles. The competition posed by inexpensive Chinese electric cars subjects the industry to stringent competitive conditions.

Intensification of international competition, combined with a complex regulatory environment for industries, promotes the relocation of enterprises from the EU. This contributes to an increased shortage of skilled labor, slowing the momentum of the 'green transition'. The outflow of manufacturing from the EU to the US is largely facilitated by the protectionist IRA law in the fields of green energy and automobile manufacturing. With its influence on supply chains, it can contribute to the deindustrialization of Europe. According to surveys by AmCham Germany, 35% of German companies are considering relocating to

the US in the nearest future. Some major manufacturers, such as BASF, have started heavily investing in their Chinese branches, moving their production facilities there. The flight of industrial manufacturing from Europe is recognized even by optimists, including members of the Association of European Economic Research Institutes, as a significant threat of detrimental structural changes to the European economy.

The introduction of the **IRA** is a dividing line, highlighting the US's inclination towards a game-with-no-rules approach when it comes to new development opportunities. American supply chains are more resilient and diversified than the European ones. The expanding scale of resource extraction both domestically and abroad, combined with the relatively low cost of energy resources, **provide a handful of competitive advantages. These advantages are more significant than the mere factor of subsidies** in attracting European investments and industrial capacities. Moreover, despite the meager funding for green energy and decarbonization compared to the cumulative European measures, the volume of tax incentives can be scaled and significantly exceed the stated funding amounts.

Europe lags behind other developed nations in securing critical resources essential for industrial growth and energy security. The future prosperity is determined by stable provision in raw materials and technological capacity for green energy production. In the second section of the present study, the compiled facts underline the high risks of resource shortages and external negative factors for achieving decarbonization goals for 2030 and 2050, at rates and volumes sufficient for industrial growth and the manufacturing industry competitiveness. This is particularly relevant for the manufacturers of solar panels and wind turbines. Analytical centers worldwide forecast international and inter-industry competition, deepening deficit, and rising prices for critically important raw materials that ensure the possibility of integration of new features, durability and high energy efficiency of any equipment.

The study also outlines prospective challenges in investments and supply chains against the background of resource scarcity. The complexity of expanding extraction could potentially be resolved through recycling and minimizing the risks of price shocks at the peak of an infrastructure boom. However, introducing recycling capacities at a sufficient level before 2030 is unfeasible. To achieve this, it's essential to prioritize subsidizing chemical and metallurgical industries, which are currently experiencing a significant downturn and partial production relocation. Otherwise, losing strategic drivers in the production and processing of rare earth metals is inevitable, which would lead to a critical dependency on Chinese supplies at all production stages of renewables.

Diversifying the supply of CRMs, especially rare earth metals, from Latin America, Africa, and other resource-rich regions bears high risks, including resource nationalism, and is subject to stiff competition for technological supremacy, in particular from allied countries such as the USA. The viability of the open globalization model per se is now being

questioned, as increasing efficiency and productivity through intensified international cooperation can no longer be achieved in times of high geopolitical tension.

China threatens the competitiveness of European end-of-life cycle manufacturing of solar panels and electronics – products with high value added. This is facilitated by Chinese dominance in the extraction and processing of CRMs the resource base for renewable energy and electronics, and the rapid pace of development of manufacturing technologies.

The EU lags behind the US and China in terms of CRMs due to limited extraction capabilities, bureaucratic hurdles, and higher environmental standards. The Critical Raw Materials Act (CRMA) adopted in March of this year in response to the IRA is largely declarative in nature, providing no specific roadmap for supply chain changes. It fails to account for local and geopolitical risks of overseas extraction and offers neither a clear structure and volume of financing nor large-scale and long-term investment incentives. Even under the most favorable conditions, the problem of dependency on Chinese supplies cannot be resolved sooner than within a decade.

These factors are further compounded by infrastructural challenges that impact the pace of introducing new renewable energy capacities at an adequate scale. To meet the demands of the European Union, wind power contributions to the European energy market must nearly double, and solar energy production must increase five-fold, all of the above under the condition of maintaining the current share of natural gas in the supply chain.

Consequently, solar and wind energy cannot entirely cover the current energy needs for industrial development due to resource-based, climatic, and other infrastructural constraints.

The expansion of European development funds should be accompanied by profound changes in their investment methods, transforming public-private collaboration with the aim of expanding the technological base. In other words, Europe has created an excessive number of administrative and regulatory barriers for its financial instruments, which are to be lifted.

Decarbonization measures of restrictive nature can significantly undermine Europe's competitiveness and, as a result, slow down the increase of renewable energy share in the grid. In the long term, this may again augment dependence on third countries, especially China. The re-industrialization aiming to restore production capacities in strategic sectors, on the other hand, is necessary for maintaining sovereignty.

Manufacturing and other industries await a clear strategic plan to address the challenges they currently face. The present crisis requires political solutions that would reinforce the 'territorial loyalty' of manufacturers, with a focus on minimizing energy consumption. Furthermore, it's crucial to significantly simplify bureaucracy and address the shortage of

skilled personnel. Consequently, energy policy should be addressed from the most pragmatic perspectives. An unwillingness to face reality will lead, inter alia, to exacerbating power shortages, cyclic power outages, irreversible loss in competitiveness, widespread deindustrialization, job reductions, economic decline, and billion-dollar fines for CO₂ emissions for companies. For society, this will mean increased poverty, further inflation pressures, overburdened social safety nets, and heightened social and political conflicts and tensions. The political ramifications of the energy crisis and deindustrialization will also bring paradigm shifts in the European Union's political landscape, favoring parties with anti-European or extremist agenda.

Modern Deindustrialization of the EU: Characteristics and Dynamics

Role of Energy Crisis Against a Backdrop of Deindustrialization of the EU's Industrial Production

Since 2000, Europe has undergone significant deindustrialization. For instance, the contribution of the manufacturing industry to European GDP decreased from 18.5% in 2000 to 15% in 2012, and between 2008 and 2012, this sector suffered a loss of 3.8 million jobs. [1]

The current wave of deindustrialization in Europe stems from the sharp rise in gas prices following Russian invasion of Ukraine. According to many experts in Europe, the energy crisis of 2022 has drastically influenced the present economic situation. This claim was substantiated by data from numerous European surveys and studies. [2]

Although a series of measures adopted in Europe in the first half of 2023 prevented an anticipated recession, the repercussions of the energy crisis are still felt in certain sectors of the economy. [3] Plans to enhance Europe's competitiveness were postponed. Funds that could have been directed to assist those affected by economic restructuring were spent on energy subsidies.

Energy-intensive industries, such as metallurgy and chemicals, felt the blow and faced extraordinarily high energy costs. For instance, Dutch aluminum producer Aldel went bankrupt due to soaring fuel prices [4], while Norwegian fertilizer producer Yara announced in September 2022 that it was reducing its ammonia production in Europe because of the costly gas situation [5]. Europe's economic growth slowed down, and business confidence plummeted, raising alarms about a recession.

According to energy policy analyst Chiara Proetti Silvestri (RIE), the main consequences of the energy crisis are as follows:

- Gas prices peaked at 316 €/MWh on August 26, 2022.
- Energy inflation in the euro area reached 44.3% in March.
- Europe's GDP growth forecast: +0.3% in 2023 and +1.6% in 2024.
- 35 million people are employed in European manufacturing industry, making up 15% of the active population.
- Energy-intensive sectors consume 87% of the total industrial gas demand.
- 70% of fertilizer production in Europe was halted or slowed down.
- 50% of the production capacities for aluminum and zinc were lost.
- Steel, paper, ceramics, and glass manufacturing plants were either closed or suspended.
- Shortages of primary raw materials also impacted some production processes. [6]

In turn, these processes stimulated a shift towards renewable energy sources and an ambition to reduce net carbon emissions to zero. However, even as the global consensus on the energy transition strengthens, the upcoming challenges also appear difficult to implement. [7]

As a result of the winter energy crisis, European production, particularly the one in Germany, experienced significant shocks, reducing gas consumption by approximately 15 percent without a corresponding decrease in overall production volume.

Given the challenges faced by the European industrial sector, coupled with uncertain rates of technological advancement and its implementation, the following aspects merit special attention:

- the reinstatement of energy security, which is of paramount importance for the manufacturing industry of all EU countries;
- the lack of consensus regarding the desired and feasible pace of the transition period, especially due to the economic shocks that might arise as a result;
- the widening gap between developed and developing countries in terms of transition period priorities;
- challenges in advancing mining activities and establishing supply chains of essential minerals required for achieving the goal of net-zero emissions.

The need for energy security has become a much more pressing issue over the past few years. The energy shock, coupled with the economic hardships it induced, the unprecedented surge in energy prices, and geopolitical conflicts – all these collectively forced many governments to reassess their strategies and recognize that the energy transition must be grounded in economic security.

The instability of Europe's energy sector triggers structural issues, which are further exacerbated by the continent's drive to shift its energy system from carbon-emitting fossil fuels to 'green' sources. Despite the importance of this step for strategic industrial security, decarbonization efforts also contribute to an increased demand for electricity across Europe. Industries and households suffer from unprecedented supply restrictions and sharp increases in energy prices.

The avalanche-like changes in the energy sector, leading to the plummeting nature of economic instability of EU industrial enterprises due to a significant reduction in the continent's dispatch capacity, were caused by the convergence of the following factors:

- The Ukrainian conflict led to a reduction in Russian gas supplies. Before the invasion of Ukraine, Russia supplied 30 percent of Europe's natural gas – a resource that has a major impact on electricity prices and underpins the continent's energy balance. This share declined to 15-20 percent in 2022 and continues to decrease this year.

- By the end of 2021, gas prices not only reached unprecedented levels but also showed high volatility.
- Price increases were observed across all fuel markets. Making up for the deficit through coal deliveries was also challenging due to rising prices and limited capacity. Coal prices tripled in the second quarter of 2022, with the German manufacturing industry consuming the largest share.
- Failures in France's nuclear installations, where 32 out of 56 reactors in the country were shut down for maintenance in September, meant nuclear power output during the same period decreased by 14 percent. The return of French nuclear capacity is expected to positively impact the overall dynamics.
- Low hydroelectric power output mainly due to drought meant that from January to September 2022, hydroelectric generation across Europe decreased by 19 percent compared to the same period in 2021.
- The economy's positive push towards net zero and emission minimization policies did not allow for adequate reserve capacity to be built up. Investments in renewable energy sources, such as solar and wind, were not accelerated sufficiently prior to the crisis, hence they couldn't serve as alternatives in adequate volumes. [8]

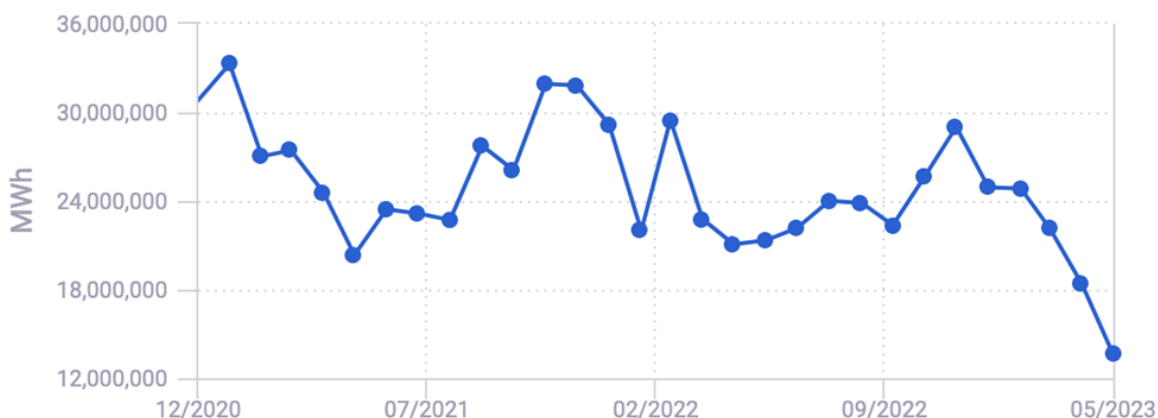
According to Eurostat data for the euro area, in March 2023 compared to March 2022, energy production decreased by 6.1%, intermediate goods by 4.7%, capital goods by 2.1%, and durable consumer goods by 0.8%, while the production of non-durable consumer goods increased by 6.8%. In the EU, the production of energy resources declined by 9.1%, intermediate goods by 5.6%, and durable consumer goods by 3.1%. Less than half of the energy consumed is produced within the EU territory, with 58% being imported.

Electricity prices in Europe have risen by 300% from the end of 2019 to the beginning of 2023. Gas prices peaked, increasing from 72 euros/MWh on February 22, 2022, to 280.50 euros/MWh on August 23, 2022.

As of the end of 2022, electricity prices in Denmark, Germany, and Belgium were approximately twice as high as in France and Greece. In comparison, electricity prices in many European countries are more than two to three times higher than the global average of \$0.14 per kilowatt-hour, for instance, \$0.44 in Germany. Gas prices in the USA are \$0.05 per kilowatt-hour, \$0.21 in Germany, with the Netherlands having the highest rate at \$0.41. [10]

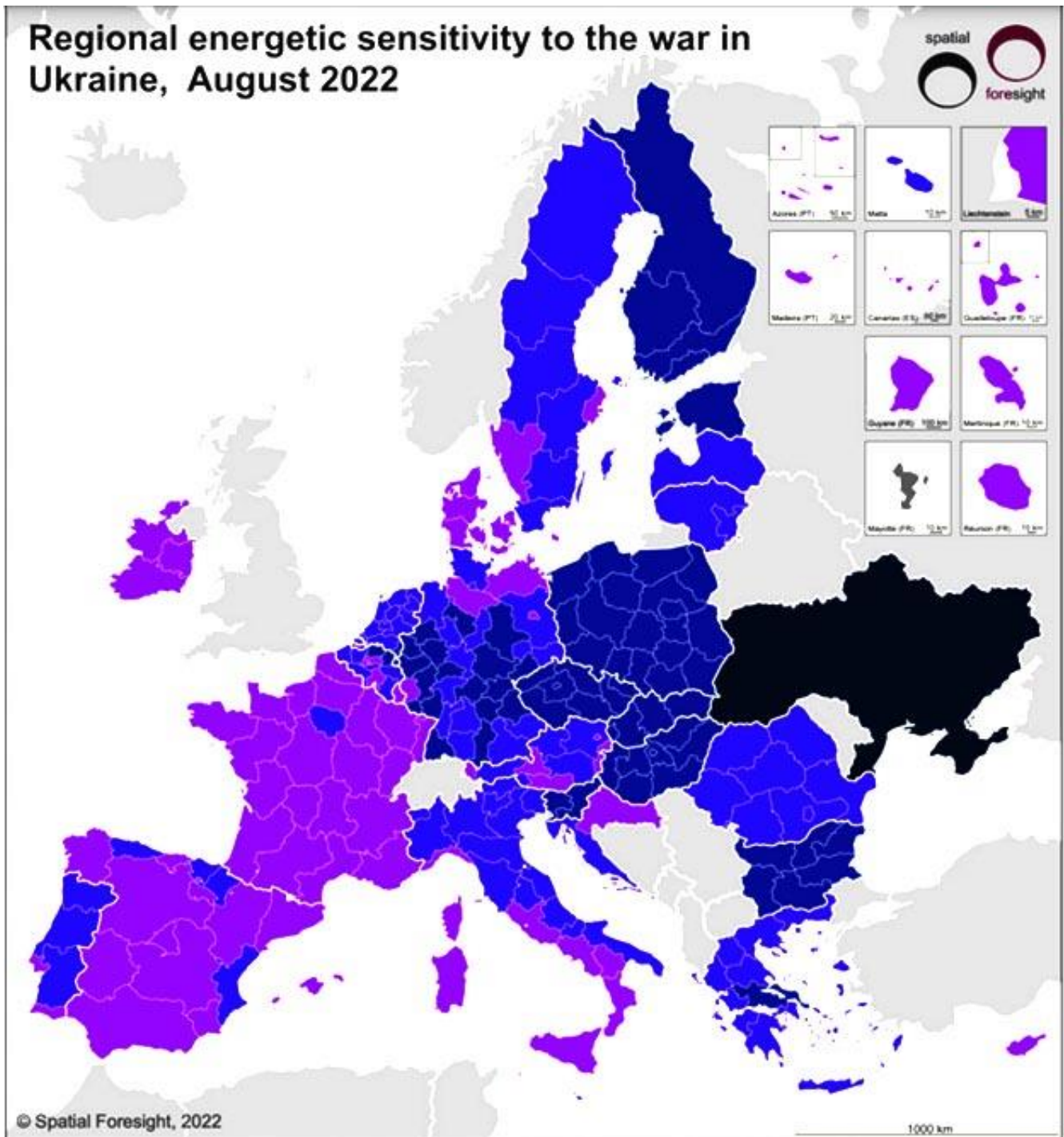
On average, in France, the price of electricity for corporate clients increased by 84% in 2023 compared to 21% in 2022. In response to these developments, each of these countries introduced national measures to mitigate the impact of rising energy prices on businesses. This led to a certain stabilization in the first half of 2023, but these measures have a short-term effect. In the longer term, the prohibitive cost and volatility in the energy market are causing pessimistic sentiments among European entrepreneurs.

Electricity Generation



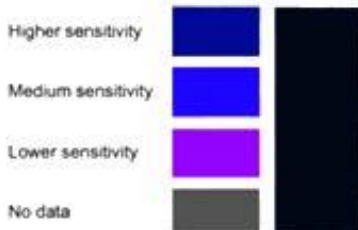
The severity of the electricity supply crisis in Europe, driven by Russia’s actions, was exacerbated by the low production of hydroelectric power in Southern Europe and the shutdown of French nuclear power plants. With the onset of the war in Ukraine, the countries of the European Union most vulnerable to the collapse in supply volumes from Russia, as indicated on a map from the European Parliament report [9] below, include Poland, Bulgaria, Finland, Greece, Slovenia, Hungary, Slovakia, Czech Republic, Germany, and Estonia. The least sensitive regions are in Ireland, Spain, France, the area surrounding the Tyrrhenian Sea in Italy, Cyprus, the Zagreb region of Croatia, certain parts of Austria, Denmark, and the Stockholm and Gothenburg regions of Sweden.

Industrial enterprises in the northern regions of Italy, including Emilia-Romagna, Lombardy, Piedmont, and Veneto, faced significant challenges due to the sharp increase in energy and gas prices. From 2019 to 2022, total expenditures on electricity and gas in these regions amounted to approximately 4.5 billion euros. Moreover, the presidents of the General Confederation of Italian Industry emphasize that the situation at the height of the crisis became critical and unbearable for businesses. [11]



Administrative boundaries: Eurostat GISCO, NUTS 2 (2016)

Impacts in terms of exposure and sensitivity



Source: own elaboration based on the following data inputs

Sensitivity

Energy intensity (Eurostat 2022), share of gas imports from Russia (Eurostat 2022), share of oil imports from Russia (Eurostat 2022), and share of solid fossil fuels from Russia (Eurostat 2022), and share of employment on gas-intensive manufacturing sectors (Eurostat 2022).

Exposure

Exposure assessment describes countries being directly affected by the war, resulting in high exposure and countries being indirectly affected, described by low exposure.

According to a survey [12] conducted by the Federation of German Industries (Bundesverband der Deutschen Industrie), a percentage of medium-sized enterprises consider the increase in energy and raw material prices to be the most challenging factor for entrepreneurship. Over 90% of companies view the rise in energy and raw material prices as quite serious while 34% view it as a critically vital issue. In February 2022, only 23% deemed this problem as critically vital.

Issues with deliveries and delays are viewed not merely as serious (71%) but as critically vital by about three-quarters of enterprises. Due to price changes, around 40% of companies are compelled to postpone investments in ecological and digital transformation.

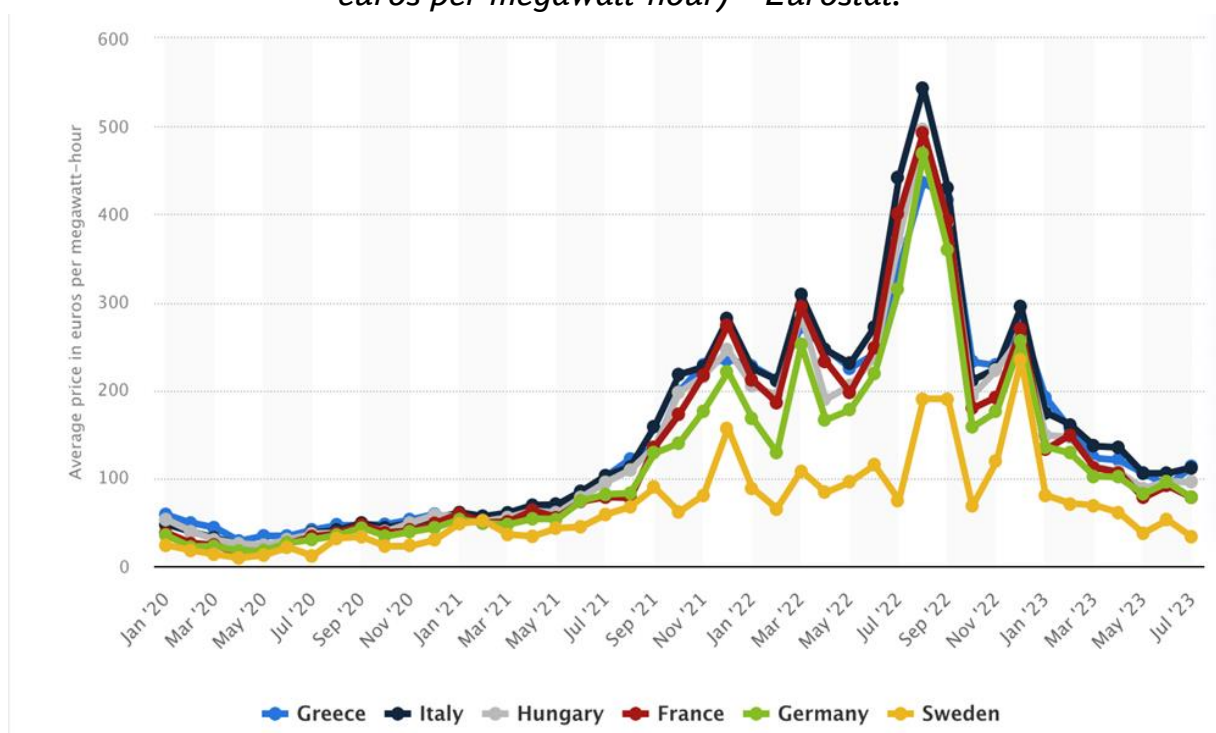
In the medium term, 28 percent of enterprises plan to switch to another type of fuel to reduce their reliance on gas. More than a third of enterprises (37%) currently cannot make this switch and remain dependent on natural gas. Every tenth enterprise is currently forced to transition from gas to oil.

Almost every tenth enterprise has reduced or halted its production in Germany. Furthermore, every fourth enterprise is contemplating or has already begun relocating portions of the company or parts of production and jobs abroad. They anticipate that during the crisis, such a move would help limit energy expenses, significantly reduce bureaucracy, and address the issue of a skilled labor shortage. [13]

After extreme volatility and unprecedented peaks in 2022, electricity prices in Europe surged by 300% from the end of 2019 to the beginning of 2023. In France, the price of electricity for corporate clients will increase by 84% in 2023 compared to 21% in 2022. Wholesale prices for both electricity and natural gas soared nearly fourfold compared to previous records in the third quarter of 2022 relative to 2021. This sparked concerns about a sharp rise in electricity costs for consumers and businesses. Since then, prices have unexpectedly dropped.

Since the beginning of the current year, the energy price crisis has been on the decline, and the cost of electricity has significantly stabilized. Key positive factors that helped mitigate the impact of the sharp increase in energy prices were partly due to mild weather conditions – a gentle autumn and winter contributed to a 5% decrease in electricity demand in the first half of 2023 compared to 2022. By the beginning of February 2023, EU storage facilities had more gas than at the same point in 2022.

Price dynamics of energy carriers in the EU countries from 2020 to 2023 (average price in euros per megawatt-hour) – Eurostat.



However, the trend in addressing systemic issues of EU energy security is far from stable. The continent benefited from decreased demand in other markets globally, as well as from the uninterrupted operation of LNG transportation facilities. Reduced gas consumption via the LNG channels by China, due to its slowing economic growth and the country’s shift to other fuel types, also positively impacted the stability of supplies. [16] According to analysts, there are significant risks of change and the imposition of external effects detrimental to the EU on LNG supplies, which may cause renewed, industry-sensitive price fluctuations and cause instability in supplies in the future. [14]

The assessment of the likelihood of extraordinary incidents plays a crucial role in evaluating the risks of future deliveries. In June 2022, an explosion at the LNG liquefaction plant in Freeport, Texas, temporarily reduced the US export capacities by about one-sixth. Freeport LNG received permission to reopen only in February 2023, meaning that LNG exports from the US were limited for eight months. In practice, this didn’t significantly affect Europe since regasification plants were already operating at full capacity. However, if more incidents occur at other facilities next year—which isn’t out of the question given the maximized utilization—gas supplies to Europe might also suffer. [15]

The Belgian analytical center Bruegel [16] modeled the impact of various winter temperature change scenarios, considering whether Russia restricts gas supplies or not, and if the EU maximizes its LNG imports. The worst-case scenario would result in Europe having to reduce its gas demand by a full 26% compared to the average level of the previous five years.

The accumulated gas volumes allow the EU to endure the winter with 35% storage capacity reserves by the end of the cold season without further demand reduction. However, the manufacturing industry is forced to significantly reduce consumption, regardless of the increase in average summer temperatures. Another factor of instability is the interconnectedness of supplies in the EU internally: changes in demand and supply in one country have significant ripple effects throughout Europe. Higher consumption in one country leads to gas outflow from neighboring countries. Furthermore, reducing storage volumes by the end of the winter season, below the 35% mark due to weather and other factors, can result in repeat price spikes for gas at the magnitude of the August-September 2022 levels as storage is replenished.

The International Energy Agency also warned that even fully filled gas storage facilities ‘are not a guarantee’ against market conditions during the winter period. Among the most significant risks, the IEA highlights lowered temperatures in Europe and Northeast Asia during the winter, as well as economic growth in China exceeding forecasted values. [18]

According to predictions by the head of Chevron’s global gas business – a company involved in LNG deliveries to the EU, the spot market for liquefied natural gas on the global stage will remain unstable until 2025, and even a normal winter in Europe could prove challenging in terms of gas supplies. [17]

According to the expert assessment by McKinsey analysts [19], the combination of an expected increase in the frequency of high-intensity heat anomalies, additional nuclear plant shutdowns scheduled for 2023, and further reductions in Russian gas imports will not lead to the return of pre-crisis levels, at least not until 2027.

The forecasts from the consulting agency regarding the dynamics of energy resource prices in the EU, published in January 2023, anticipate a high price level with a gradual reduction, associated with the transition to renewable sources. The demand for electricity will grow substantially, and the absolute consumption across Europe will increase from 2900 TWh in 2021 to 3700 TWh by 2030.

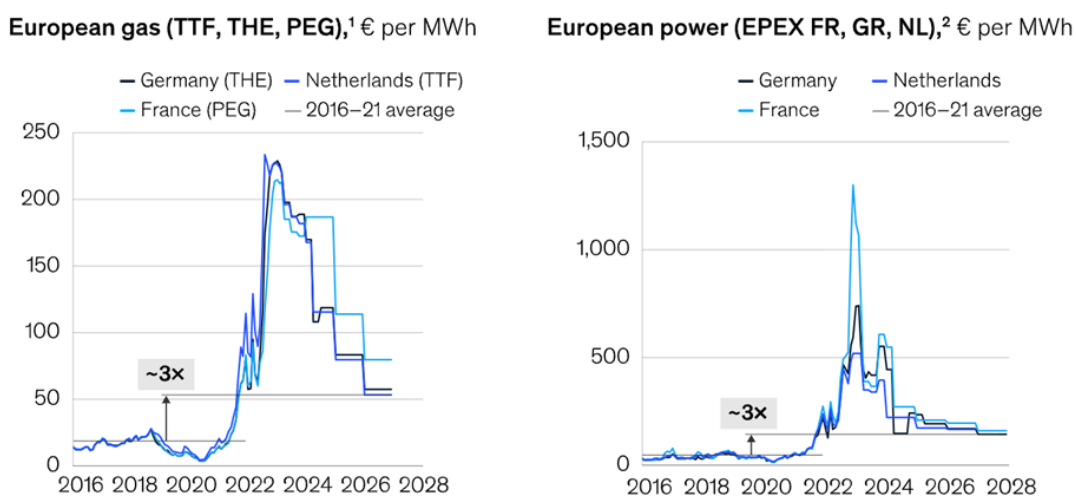
According to the model presented by researchers, to maintain the necessary dynamics of fossil fuel substitution with increasing consumption rates, the volumes of wind generation in the structure of the European energy market should almost double by 2030 and almost triple by 2050 compared to the 2021 levels. The changes in solar energy output, in turn, should increase fivefold by 2030 and approximately sevenfold by 2050. In this model, the share of natural gas in supplies remains unchanged at the 2021 level up to 2050.

Together, these sources, which are crucial components of Europe’s decarbonization efforts, will account for 60 percent of energy capacities by 2030. However, achieving this goal will

require large-scale construction of new facilities. For instance, in Germany, the annual pace of new construction will need to triple compared to the 2018 – 2021 period.

The instability in price dynamics indicates structural challenges faced by Europe as it endeavors to transition away from fossil fuels that emit carbon dioxide. The uncompromising decarbonization policy intensifies the surging demand for electricity in Europe at a time when the market is experiencing unprecedented supply constraints.

The sharp increase in wholesale electricity prices and the forecasted dynamics



Note: Historical data: daily wholesale average prices computed into a monthly basis. Forecast data as of September 16, 2022. Monthly data until June 2023, quarterly data until Q1 2024, and yearly data until 2027–28.
¹Title Transfer Facility, Trading Hub Europe, and PEG (monthly price produced by EEX).
²European Power Exchange: France, Germany, and the Netherlands.
 Source: Bloomberg; European Energy Exchange (EEX); Nasdaq; PEGAS; McKinsey analysis

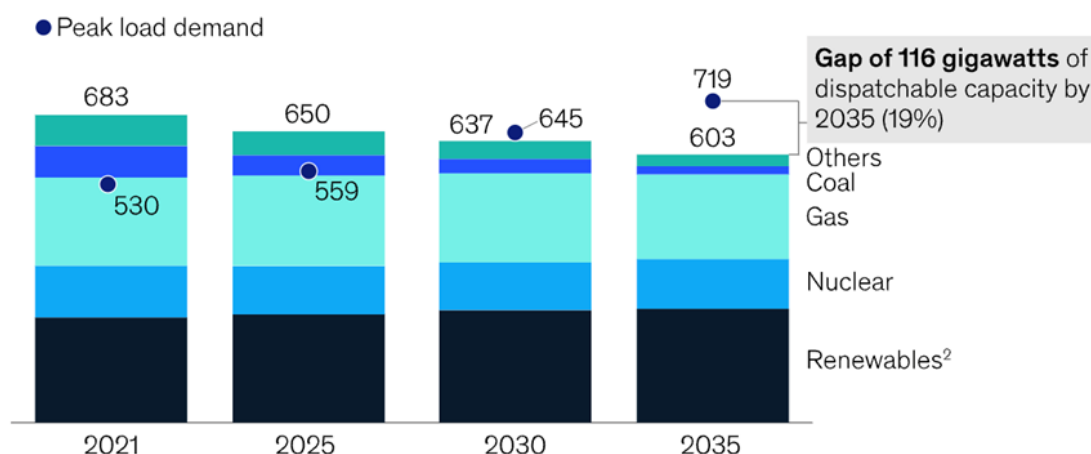
McKinsey & Company

If alternative energy capacities are not constructed in the required scale, projections indicate a looming disparity between peak electrical demands and the power available for distribution. This deficit will notably intensify as the contributions from hydroelectricity, natural gas, and nuclear energy decline. By 2035, this gap in Europe will equate to 19% of the transmitted power, or 116 GW.

The accelerated restructuring of Europe’s energy market necessitates the success of concurrent endeavors, such as consolidating investors, expanding the resource base for the ‘green’ transition, hedging volatility through averaging out costs and selling on a futures basis by regulators (which poses significant burdens on the EU budget), and segregating electricity pricing based on its source without direct linkage to gas prices.

Assuming no new capacity is built, Europe could face a gap in dispatchable power by 2035.

Dispatchable installed capacity in Europe¹ without new build, gigawatts



The complexity of challenges that European countries must address to achieve these goals without harming the manufacturing industry also demands equal success in stabilizing energy resource prices, ensuring environmentally friendly supply, harmonizing bureaucratic institutions, and fostering public-private as well as international collaboration in addressing critical resource supply chain issues.

The International Renewable Energy Agency (IRENA) noted that the EU is increasing its use of renewable energy sources at a rapid pace, surpassing target indicators for 2022. However, considering the EU’s current target set for 2030 at 42.5% as of March this year, the 21.8% share recorded for 2021 appears highly ambitious.

Experts from Economist Intelligence, analyzing the impact of the energy crisis on Europe’s competitiveness, note that soaring prices of energy resources will have long-term consequences, including an increase in the debt burden, business disruptions, and changes in the transition to a ‘green’ economy. Supply constraints mitigate the decrease in prices, and the primary strategies to reduce demand will have a negative long-term impact on the competitiveness of industries such as chemicals, steel, copper, ceramics, which are reducing production or shutting down for an extended period. [20]

The planned gradual reduction in reliance on Russian gas during the transitional period of expanding green energy capacities was artificially accelerated and will not return to pre-crisis levels. As a result, the achievement of the targeted decarbonization outcomes by 2030 entails the expansion of dual-purpose LNG gas infrastructure that can be transformed into hydrogen-based systems. This considerably increases costs and also mandates the use of hydrogen technology, the carbon neutrality of which is questionable. The International Agency for Renewable Energy Sources asserts that hydrogen production already results in the emission

of approximately 830 million tons of carbon dioxide annually and, additionally, requires a significant amount of water.

In 2021, the Commission published its proposal to amend the Renewable Energy Directive, aiming to increase this target to 40% by 2050 [21]. The REPowerEU plan for 2022 further elevates this objective to 45% [22]. The set decarbonization threshold, unattainable without substantial investments, implies uncertainty and financial burdens across all sectors for the industrial domain. For the steelmaking industry, this poses formidable technological and financial barriers, especially considering the ramifications of the Covid-19 crisis.

In the *Journal of New Energy Law*, a discussion is presented [23] on Henrik Paulitz's book '*Energy Crisis of the Economy — Why Energy Transformation Needs Correction*' [24] criticism is directed towards the EU's 'Green Transition' policy and its influence on the deindustrialization process. The author also cites experts who concur with his stance. Dr. Peter Becker and Professor Lorenz Jarass confirmed in the February 2021 edition: 'In ensuring power supply, the government is playing Russian roulette' [25]. Professor Uwe Leprich, former head of the Climate and Energy Department of the Federal Environmental Agency, wrote in the May 2021 edition: 'In summary, Paulitz rightly points out the need for additional backup capacities in Germany for times when the pillars of the power supply system, dependent on weather conditions (wind and solar installations), lose power'. [26] The discussion's core arguments in this material can be summarized as follows:

1. Despite having a combined wind and solar installation capacity of over 110 gigawatts (GW), the 'guaranteed capacity' of these installations ranges from 0 to 1 GW. Phases of instability, when wind and solar installations across the nation supply the grid with 5-20 GW, occur quite frequently, resulting in an energy deficit of up to 85 GW.
2. This issue cannot be resolved by merely multiplying the capacity of wind and solar installations several-fold as they yield almost zero energy without the presence of sun and wind.
3. If low levels of energy security continue to produce negative structural changes, key industrial sectors are likely to flee Germany due to the energy transformation. The implications of such a development could be much more severe, (the author cites research [27] from the German Economic Institute) as the emigration of energy-intensive firms could exert significant negative impacts on the remaining industries, since the 'value creation chains can no longer maintain their current structure'. The emigration of energy-intensive industries represents an overarching 'risk scenario for Germany's economic model'.

Within the ambit of Europe's ambitious decarbonization targets, the adverse costs for manufacturing threaten to introduce the Carbon Border Adjustment Mechanism (CBAM). Accelerating its implementation, as per the analytical assessment by IFRI (Institut français

des relations internationales), is anticipated to induce substantial disruptions in supply chains, comparable to the repercussions of the COVID-19 pandemic.

According to the head of IndustriAll, the U.S. and China's strategies in expanding renewable energy sources recognize the critical importance of metallurgy, chemicals, cement, glass, and ceramics for 'green transition' purposes, in contrast to the European 'Green Deal Industrial Plan for the Net-Zero Age'. Their role is vital in supply chains, influencing sustainable development through their products and industrial transformation, as well as ensuring Europe's strategic autonomy.

Excessive regulation for decarbonization purposes exacerbates the already prevailing uncertainty and instability. [28]

A significant portion of the EU's manufacturing industry believes that the CBAM will turn climate change mitigation efforts into a factor undermining competitiveness. Only a small fraction of industrial sectors, representing a minority in GDP generation, has voluntarily agreed to be included in the initial scope of the CBAM. Meanwhile, the four sectors selected in the European Commission's (EC) proposal (cement, steel, aluminum, and fertilizers – besides electricity) are lobbying against any reduction in their preferential thresholds until the CBAM proves itself as an effective tool against carbon leakage.

The political significance of the CBAM is to align the EU's climate and trade objectives, ideally matching the ambitions of the 'green course' for building a climate-neutral and thriving economy. It aims to level the playing field between domestic producers and external competitors from the EU while the EU implements systemic changes with a set of measures responding to the demands of decarbonizing Europe's economy. This requires sectors covered by the Emissions Trading Scheme (ETS) – primarily electricity and heat production and major industrial installations, to reduce emissions by at least 61% by 2030 compared to 2005 levels. [29]

Unilateral, geographically limited policy increases production costs for producers in Europe, competing at an international level with manufacturers from unregulated regions. This asymmetry, besides risks to competitiveness, raises concerns about carbon leakage – the shifting of CO₂ emissions from a region with emission constraints to an unregulated zone with higher emissions, rendering excessive pressure on production in the EU pointless. Since climate change depends on cumulative global emissions, carbon leakage threatens to negate the consequences of unilateral political efforts. [30]

A region that enacts policies aimed at reducing carbon emissions faces the consequences of decreased production, which subsequently leads to employment loss and diminished well-being, in addition to the ineffectiveness of the environmental strategy. The situation is particularly challenging for carbon-intensive industries with substantial impacts on consumer

markets. In addition to its primary focus on basic materials, the Carbon Border Adjustment Mechanism (CBAM) should consider the complexities arising in the value creation chain to prevent distortions in the sales markets of finished products.

Consequently, Europe's industrial policy necessitates an overhaul to ensure resilience, competitiveness, and alignment with the EU's climate objectives. These goals should be framed within a comprehensive understanding of heightened geopolitical and energy instability. Governments must prioritize innovation, transition to a 'green' economy, and collaboration to implement a prudent industrial strategy, not merely relying on market forces as an inherent self-propelling mechanism given the influence of external disruptive trajectories. The establishment of target indicators and carbon pricing should consider the manufacturing industry's needs to recover from a series of shocks and changing global contexts to bolster European innovative capacities.

Economic Trends in the Decline of the EU's International Competitiveness

Europe stands as one of the world's paramount economic entities, accounting for 36.2% of global exported products in 2022, compared to 37.7% in 2021. The five leading European exporters – Germany, the Netherlands, Italy, Belgium, and France – constituted nearly half (49.4%) of the products introduced to the international markets in 2022. [31]

Phenomena indicative of deindustrialization processes are manifested in the consistent decline of European industry. Many of today's leading economies have undergone stages of deindustrialization. For instance, in the United States during the 1970s, factories began relocating en masse, shifting production to newly industrialized nations with lower wages such as South Korea, Hong Kong, Taiwan, and Singapore. Manufacturing processes were automated, with a significant portion of the remaining workforce replaced by robots, leading to the depopulation of former industrial hubs.

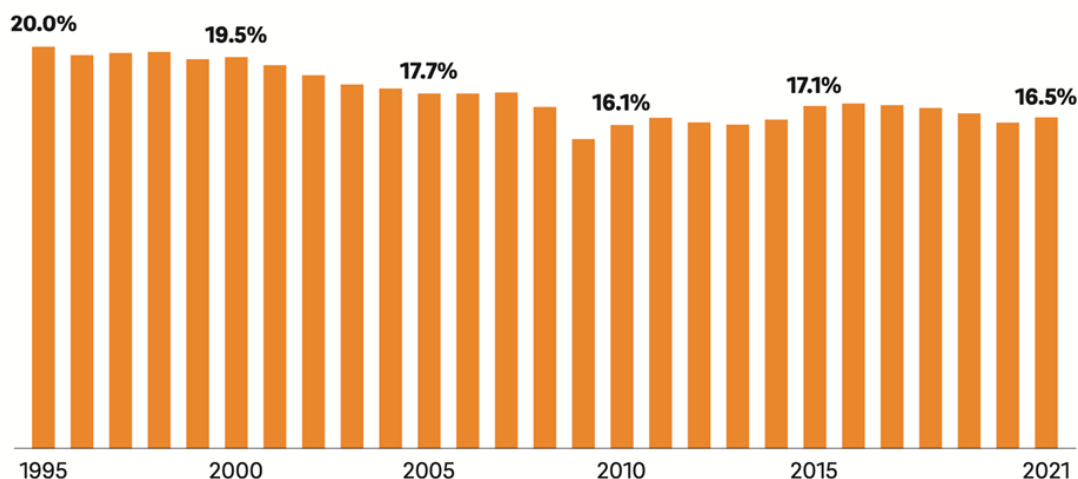
During the same period, France grappled with profound deindustrialization, witnessing a halving of the industrial share in its GDP, which today stands at 11%. In contrast, Germany and Italy maintain a figure closer to 20%. Since the 1970s, the asset allocation to the manufacturing industry has also reduced by half. From the year 2000 alone, the sector lost one million jobs. While the deindustrialization trend was halted in the early 2010s, certain sectors such as steelmaking and shipbuilding were wholly engulfed by the economic crisis. Deindustrialization can be defined as a process of economic and social transformation marked by the diminishing significance of industrial sectors, particularly the manufacturing and heavy industries. The intensity of this process can be quantified by the reduction in the manufacturing sector's contribution to the added value.

According to Eurostat data, **there has been a decline in the industrial sector's contribution to gross value added (GVA) since 1995:** The overall share of the manufacturing industry in the EU's GVA decreased from 20% in 1995 to 16.5% in 2021. In 2021, approximately one-

sixth of the EU’s gross value added was generated within the manufacturing sector. Around 31.5 million individuals, constituting 16% of the workforce, are employed in the EU’s manufacturing companies. The three largest European economies – Germany, France, and Italy – account for over half of the EU’s manufacturing industry GVA. [33]

The Berger Research Centre, in its study titled ‘De-industrialization in Europe,’ also emphasizes the significant increase in costs associated with deindustrialization. Profit margins are declining in the most competitive energy-intensive industries, such as automotive and metallurgy. Given the homogenous product structure in global markets, these sectors have limited flexibility in price adjustments. Consequently, companies are increasingly bearing the burden of rising prices through their margins.

Share of manufacturing GVA in the EU’s total GVA

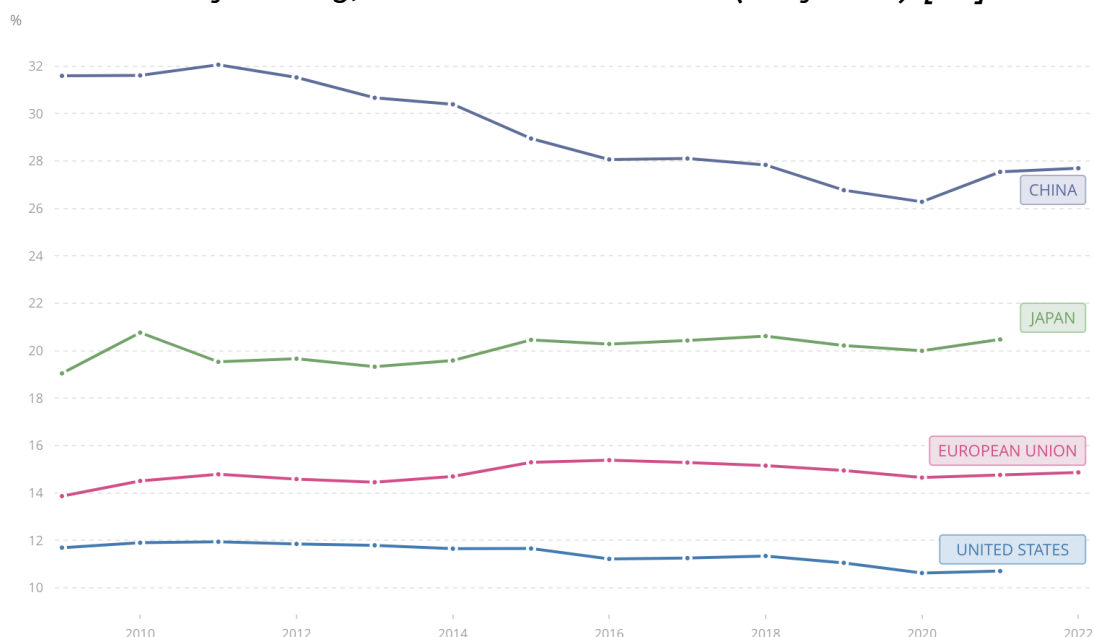


Source Eurostat



The expansion of renewable energy sources is advancing at an insufficient pace, with Germany being particularly affected. Numerous enterprises operating in energy-intensive sectors have exhausted all short-term measures to reduce gas consumption, barring production cutbacks. Any subsequent actions, such as transitioning to alternative energy sources, necessitate significant investments. Currently, obtaining such investments is especially challenging for energy-intensive industries due to the ESG (Environmental, Social, and Governance) criteria that complicate their financing efforts. Given these constraints, an increasing number of companies are opting to relocate their operations to the United States.

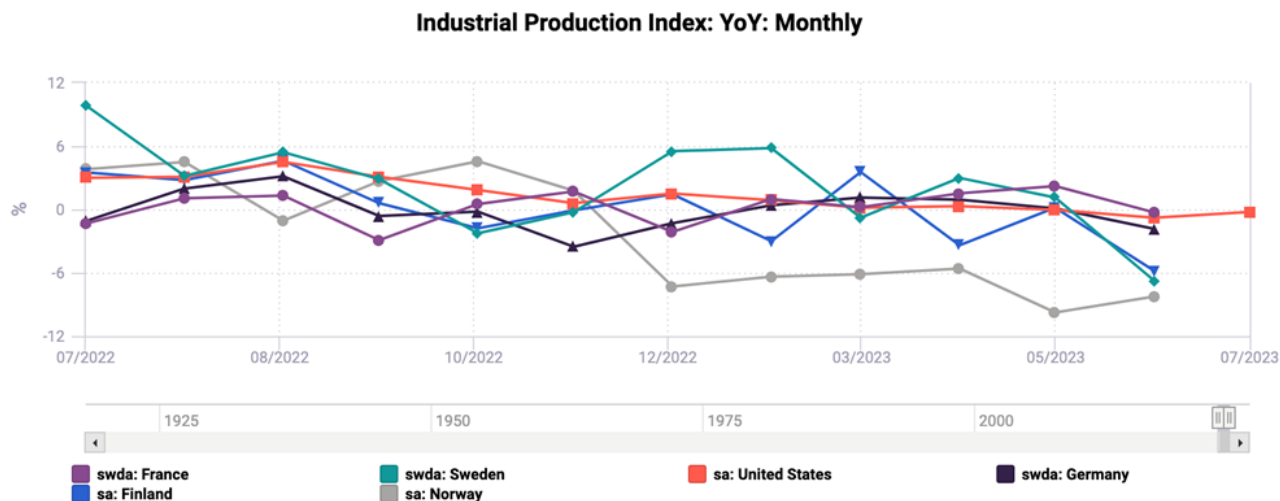
Manufacturing, value added 2010-2022 (% of GDP) [34]



Compared to industrially developed nations such as Japan and China, European Union countries possess a significantly smaller share of the manufacturing industry. The data suggests that **the U.S. is experiencing an industrial decline, lagging behind the benchmarks set by developed countries.** This has influenced their motivation to attract capacities and the notable adoption of the IRA. The industrial proportion in Europe’s gross value added has diminished since its mid-1990s levels. However, since 2010, this rate has remained relatively consistent. The current energy crisis is further driving this percentage down, indicative of deindustrialization. Limited global demand, supply bottlenecks, and rising energy costs adversely impacted the euro area export metrics in 2022. The sharp rebound in exports following the COVID-19 pandemic over the last two years has now shifted to a more modest growth trajectory.

Reversing the trend may be possible through the elimination of supply bottlenecks, which would bolster the outlook for global trade in the short term, including the euro area. However, European exporting firms remain confronted with challenges associated with persistently high energy costs.

The decline in industrial production of certain European countries compared to the industrial dynamics of the USA.



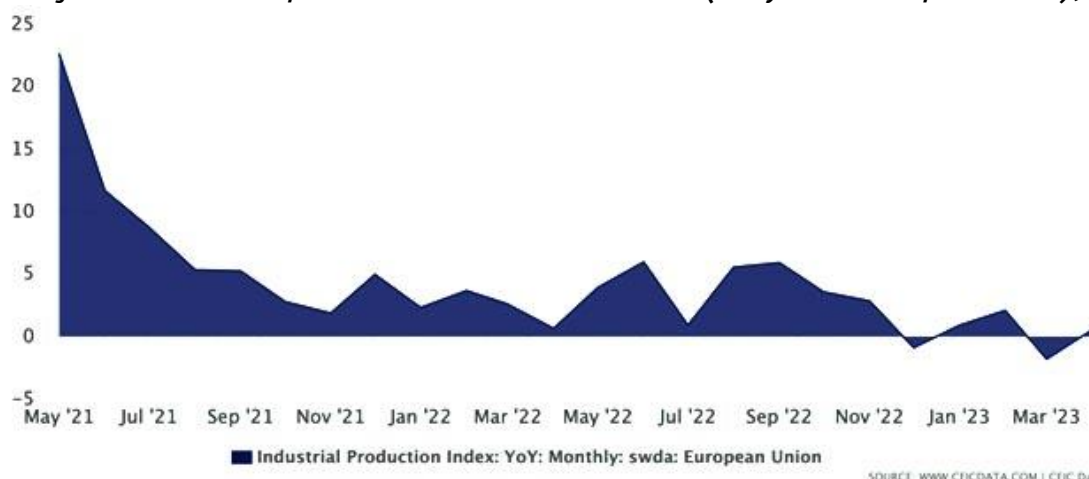
Pertaining to the industrial dynamics of the European Union, in July 2023, when compared to July 2022, there was a noted decline in energy production by 7.4%, a decrease in the production of durable consumer goods by 7.3%, and intermediate goods by 5.5%. Among the member states for which data is available, the most significant annual reductions were observed in Bulgaria (-11.5%), Estonia (-9.5%), and Latvia (-8.6%). Conversely, increments were recorded in Denmark (+5.7%), France (+2.8%), and Malta (+2.3%). [35]

According to the industrial production index, the most pronounced reductions were witnessed in Sweden, Norway, and Finland. Sweden’s industrial output declined by 4% year-on-year in July 2023, following a revised 2% drop the previous month. This marked the second consecutive month of declining industrial activity, driven primarily by a decrease in manufacturing production (-4.3% compared to -1.3%), most notably in the chemical and pharmaceutical sectors (-7.3%). [36] Meanwhile, mining industry production showed a recovery, registering a 0.2% increase as opposed to its 15.4% slump in June. [37]

The growth dynamics of the industrial production index also highlights the deindustrialization processes in Europe. This year, for the first time in a decade, this metric shifted into the negative realm: on a year-over-year scale from May 2022 to May 2023, its values fluctuated between 5.98 in July 2022 and -1.87 in March 2023. In April 2021, this index peaked at 40.5%, but by April 2020, plummeted to a record low of -27.8%.

Between 2014 and 2019, **European firms grew on average 40 percent slower than their American competitors** and spent 40 percent less on research and development. Despite the revival in 2022, exports from the euro area as a whole lagged behind the global trade recovery, and losses in global export market share during the pandemic were not recouped.

Growth of the industrial production index in the EU (May 2021 – April 2023), % [46]



Top 10 export categories in the EU’s total export volume (represented as percentages of the value in exports, % per year) [38]

Product Label	2020	2021	2022
Nuclear reactors, boilers, machinery and mechanical appliances; related parts	13.66	12.99	11.96
Vehicles other than railway or tramway rolling stock, and parts and related accessories	11.36	10.66	10.14
Electrical machinery and equipment and related parts; sound recorders and reproducers etc.	9.85	9.5	9.09
Mineral fuels, mineral oils and products of their distillation; bituminous substances etc.	3.48	5.13	8.6
Pharmaceutical products	8	7.72	7.73
Plastics and plastic articles	4.16	4.53	4.27
Optical, photographic, cinematographic, measuring, checking, precision etc.	3.86	3.68	3.38
Iron and steel	2.11	2.79	2.79
Organic chemicals	2.69	2.56	2.66
Articles of iron or steel	2.09	2.14	2.11

The share of the manufacturing industry in the total export volume is over 93%. The main export items of the European Union are industrial goods, such as machinery and vehicles, chemicals, as well as food and beverages. The United States is the largest importer of goods from the EU, accounting for 18 percent of the total export volume, and this figure is growing.

However, due to the local content requirements of the IRA, a decrease in this share is expected in the medium term.

The weakness of exports in the euro area was partially a reflection of subdued global trade dynamics as firms grappled with supply chain disruptions. Such energy-intensive and knowledge-intensive industries as machinery manufacturing, engine production, electronics, combined with metal production and the chemical industry, account for about a third of the EU’s exports. Their share in exports is gradually declining due to rising production costs influenced by fluctuations in global oil prices and decreasing production volumes. In the fourth quarter of 2022, exports from the metallurgy and chemical industries decreased by 18% and 14%, respectively.

*Top 10 EU countries by export volumes – export growth in value terms, %
(Exported growth in value, %) [39]*

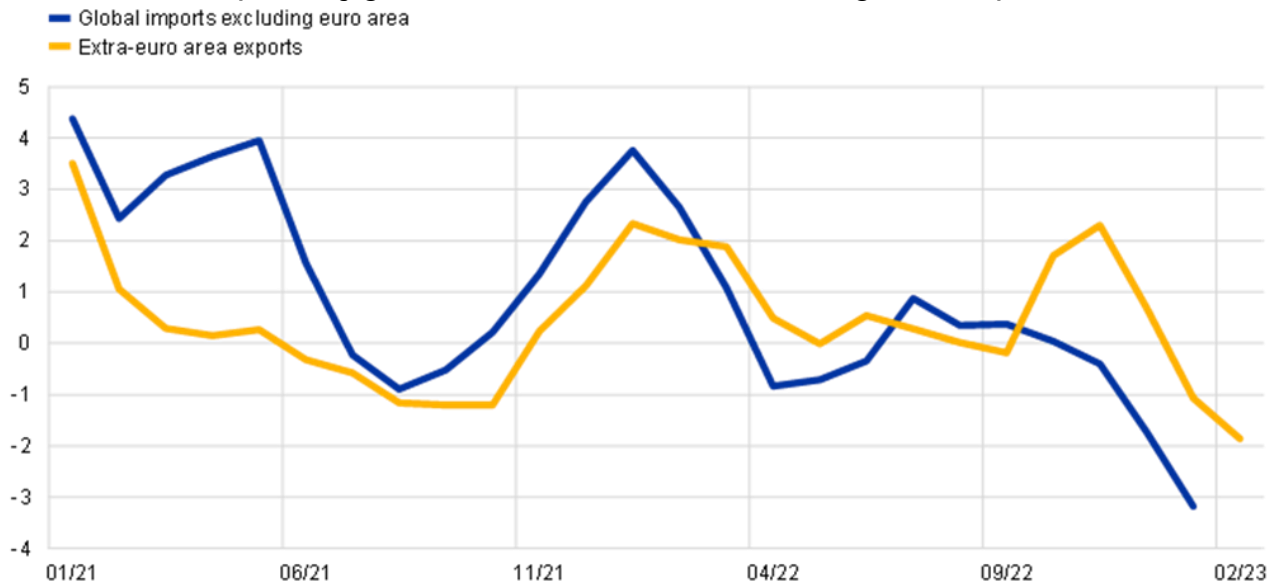
Exporters	2018–2019	2019–2020	2020–2021	2021–2022	Exported value in 2022, US Dollar thousand
Germany	-4	-7	18	2	1,658,442,825
Netherlands	-2	-4	26	11	770,306,572
Italy	-2	-7	23	14	700,314,893
Belgium	-5	-6	31	16	636,424,483
France	-2	-14	20	6	606,853,494
Spain	-3	-7	25	8	424,286,055
Poland	-4	1	25	8	342,844,658
Czech Republic	-2	-4	18	6	241,132,362
Ireland	3	8	6	12	219,304,152
Austria	-3	-5	20	8	210,279,459

The most noticeable slowdown in export growth rates compared to the percentage figures of 2020–2021 is observed in Estonia, Finland, Germany, France, Portugal, Sweden, and Austria.

According to the European Central Bank (ECB), the historical decomposition of shocks, based on a structural vector autoregression (SVAR) for the aggregate export of goods outside the euro area, indicates that **the main factors driving export dynamics last year were changes in global demand conditions and the effects of supply bottlenecks**. The energy

supply shock played a less significant role in dampening export growth, reducing the export growth rate by an average of about 0.6 percentage points over the past year.

Exports of goods outside the euro area and global imports.

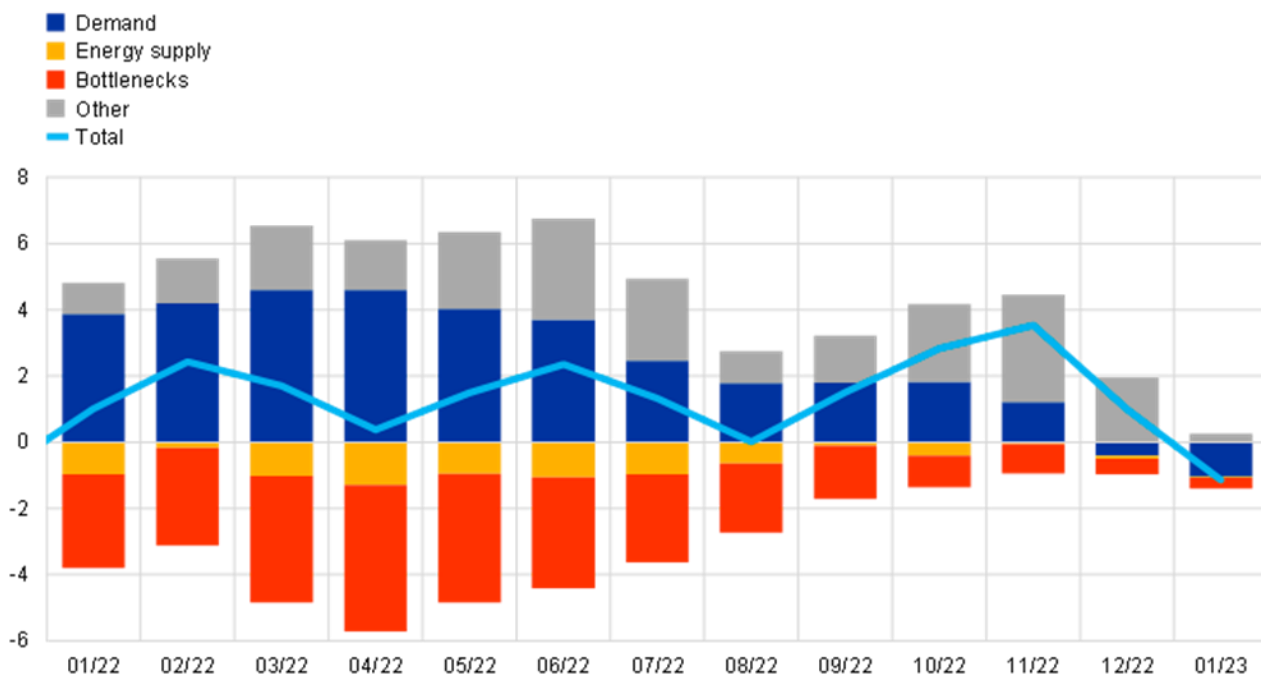


The European Central Bank’s study [40] ‘The Energy Shock, Price Competitiveness and Euro Area Export Performance’ also identified two channels through which energy supply constraints impact exports from the euro area.

1. Higher global energy prices reduce global demand as income is redistributed from energy-consuming countries to energy-producing countries. These energy-producing nations typically have a lower marginal propensity to spend.
2. This led to a surge in production costs, diminishing the EU’s competitiveness in global markets, considering the disparity in their growth in other countries. For instance, in 2022, wholesale gas prices in the euro area were on average 13 times higher than in 2020. In contrast, in the United States and Asia, they were 3.5 and 9 times higher than their respective 2020 levels. [41]

In 2022, there was an observed increase in competitiveness due to the depreciation of the euro, indicating a more pronounced role of the price shock on energy carriers for the euro area compared to its competitors.

Historical decomposition of the volume of goods exported outside the euro area using the SVAR model.



Medium-term competitiveness prospects are also complicated by the disparity in gas prices in the euro area. There they remain significantly higher than in Asia and the United States, where prices stabilized at December 2019 levels. Supply instability further dampens forecasts and necessitates the exploration of alternatives. Investments in green energy are likely to enhance efficiency and yield long-term positive effects, notably through significant reductions in electricity costs. However, during the transitional phase, increased energy costs will lead to higher production expenses, potentially continuing to weaken the euro area price competitiveness in the medium term, as recent shifts in real effective exchange rate indicators suggest.

Gas futures for 2025 in the euro area are three times higher than comparable figures in the United States and feature more volatile import prices. At the same time, in the medium term, the euro area also needs to account for the potential costs of transitioning to ‘green’ energy, which in Europe could amount to 6.5% of GDP from 2021 to 2050 – the highest expenditures among developed economies.

Among the major economies in the euro area, the largest budget gaps were recorded in Italy (-8.0 percent compared to -9.0 percent in 2021), Spain (-4.8 percent compared to -6.9 percent), and France (-4.7 percent compared to -6.5 percent). Germany recorded a smaller deficit of 2.6 percent (compared to -3.7 percent in 2021).

Europe is losing its investment appeal. The Confederation of European Business, commonly known as BusinessEurope, in its 2023 Reform Barometer study, shows that almost

all members of this community rate the EU's investment environment as less favorable compared to global competitors than they did three years ago.

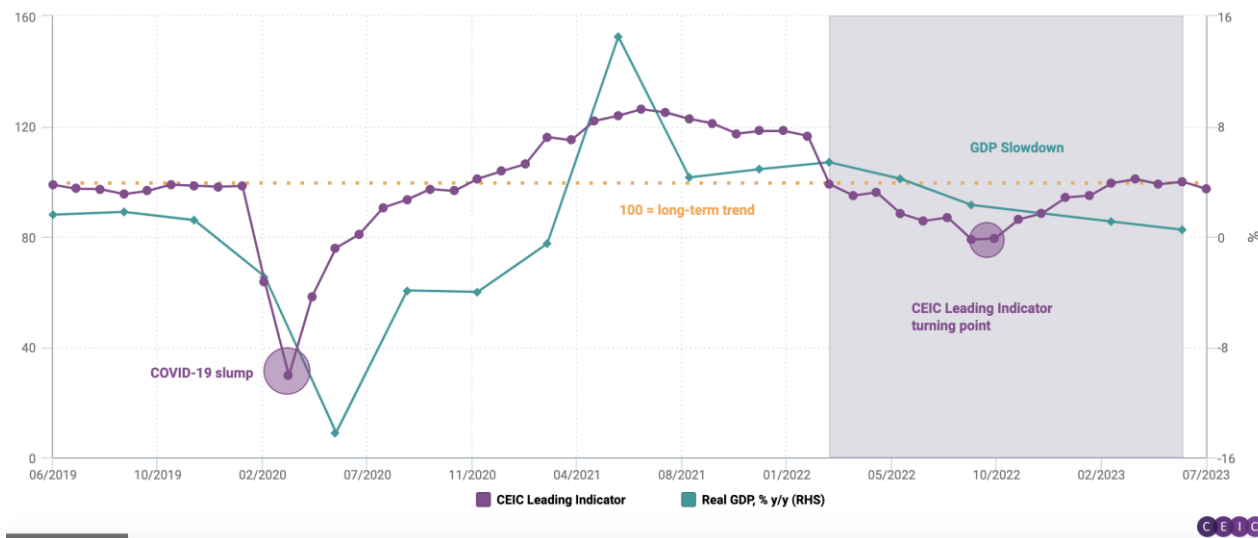
Germany's GDP shrank by 0.1% in the third quarter following a 0.3% decline, putting the euro area's largest economy into a technical recession. The French economy proved more resilient, with GDP growing by 1% year-on-year, faster than in the first quarter (+0.8% year-on-year). Thus, instead of the anticipated growth in 2023, a decline of 0.4% is now expected. German institutes forecast a more substantial GDP decline ranging from 0.4% to 0.7%. An even more significant downward revision, from 1.8% to 0.5%, occurred in the Netherlands.

After declining by 0.4% in the first quarter of this year, the Dutch economy entered its first mild recession. In the second quarter of 2023, GDP also decreased by 0.3%, according to data from the Netherlands' Statistical Office. Since the beginning of the year, data from Nevi Netherlands on the manufacturing business activity index indicate weakening trends across the entire sector: companies often report reduced production due to deteriorating demand conditions, particularly from some of the country's key trading partners.

Ireland's Gross Domestic Product at the start of the year shrank the most within the euro area, falling by 4.6%, followed by Lithuania with a GDP decline of 2.1%.

According to an assessment by analytical agency CEIC [43], as of the end of August 2023, the prospect of a further downturn in the euro area economy is becoming more probable. Influenced by high inflation, tighter financing conditions, and the lingering effects of the ongoing war in Ukraine, the forecast for the current quarter from Now-Casting Economics anticipates a real GDP decline of 0.8% compared to the second quarter of 2023 [44]. If this materializes, it will signify a sharp downturn in activity compared to the GDP growth of 0.3% QoQ in the second quarter of 2023. Nowcast forecasts a return to 0.9% QoQ growth in the subsequent quarter, the fourth quarter. However, compared to an annual average downturn of 3.5% in 2022, real GDP growth is expected to slow sharply in 2023. The latest forecasts are: IMF at 0.9%, European Central Bank at 0.5%, World Bank at 0.4%, while the private sector expert consensus from FocusEconomics stands at 0.6%.

CEIC Leading Indicator vs Real GDP

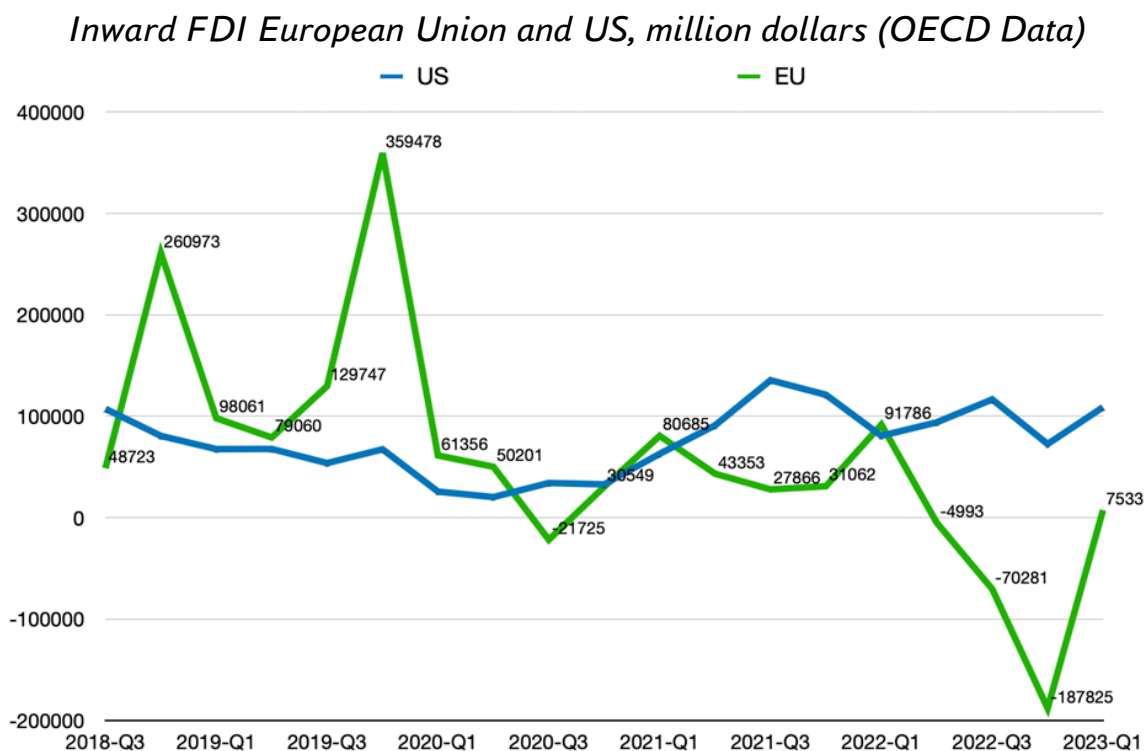


The average forecasts from FocusEconomics for key indicators in July underwent no significant revisions, with the exception of foreign trade. According to forecasts, the export of goods and services will increase by 1.8%, down from the 2.5% average forecasted in July. The average real GDP growth forecasts for 2023 have remained around 0.6% over the last three months as of July, while private consumption and capital investment are projected to remain at their current levels for 2023.

In a situation of high demand for subsidies to energy-intensive enterprises, record inflation, and significant anticipated costs for the ‘green transition’, **the EU budget remains invariably deficit-laden**. According to Eurostat data for April 2023, the seasonally adjusted public budget deficit stands at 4.5% of the EU’s GDP. The annual ratio of the public deficit to GDP in the euro area decreased to 3.6% in 2022, down from a revised upward figure of 5.3% in 2021, as shown by the first notification from EU member states in 2023 concerning the implementation of the Excessive Deficit Procedure (EDP).

By the end of 2022, in anticipation of a recession, **inward foreign direct investment (Inward FDI) in the EU had shrunk to a record level** of -187,825 million dollars. A recovery was noted in the first quarter of 2023, but the figures are still far from the peak levels preceding the epidemic. In contrast, the FDI dynamics in the US have been relatively steady, with an upward trend over the past three years.

In August 2023, the euro area economy experienced its most significant contraction since November 2020, according to the latest S&P research on the HCOB PMI euro area index. The portfolio of new orders declined at the fastest rate in over three years. As a result, forecasts have become less optimistic than at any other time since the start of the year. Factory employment levels decreased for the third consecutive month in August, with job creation almost coming to a standstill.



The data continues to indicate a **sharp deterioration in the euro area’s manufacturing sector’s economic health**. This is evident as the total volume of new orders and new export transactions decreased at record rates, and the amount of unfinished work drastically declined.

Purchasing activity declined once again as companies continued their efforts to reduce inventories. Regarding prices, input costs plummeted, with product prices falling for the fourth consecutive month. In fact, excluding the pandemic months, this marked the sharpest decline in growth rates since the sovereign debt crisis in March 2013. For the first time since the beginning of the year, both industrial production and business activity in the service sector decreased.

The service sector in the region, which had been more resilient than the manufacturing industry in recent months, is beginning to experience a downturn following struggling factories. The production in the euro area’s mining industry decreased by 13.60 percent in June 2023 compared to the same month of the previous year. [45]

HCOB euro area Manufacturing PMI [41]



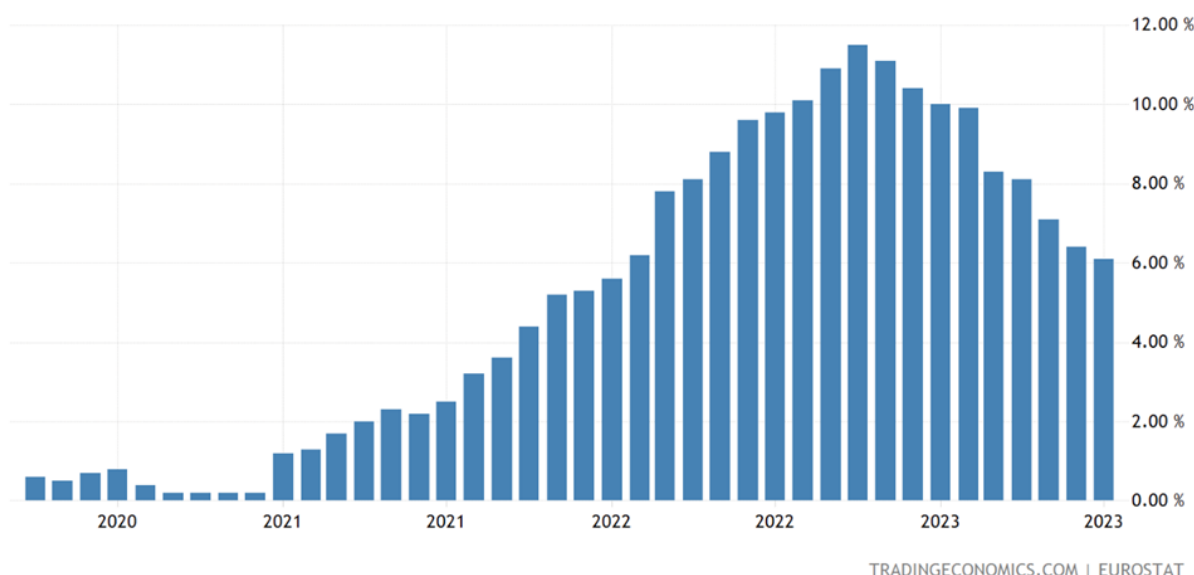
Simultaneously, there's a **decline in production volumes** over the past five months, despite companies catching up on previous backlogs. Factories are cutting back on purchasing capacities and raw material inventories. Weak economic conditions and lower purchasing prices have shortened delivery times and positively impacted supply chains overall, leading to sharp declines in raw material prices and product payment discounts. However, September shows a concerning acceleration in purchasing price growth. [46]

Despite the decrease in demand, the deflation of manufacturing capacities slowed down. Manufacturers' production volume expectations have been decreasing for six consecutive months, reaching the lowest level since December 2022. The significant decline in industrial production is mainly attributed to a slump in the intermediate goods sector, as unfinished production couldn't fully offset the sharpest decline in new orders since 2009, excluding the initial pandemic months. Consequently, purchasing activity was reduced, and businesses trimmed inventories.

Forecasts suggest that the euro area economy will likely downshift its growth momentum, growing by 0.8% in 2023, below the previously projected 1.1% increase, as persistently high inflation continues to pressure consumption, and the ongoing influence of tight monetary policy restrains economic activity—as indicated by the European Commission's 2023 economic forecast. Moreover, this weaker growth impulse is expected to persist into 2024, with the GDP forecast being revised down to 1.3% from an earlier estimate of 1.6%. Among the bloc's major economies, Germany is projected to contract by 0.4% this year. Spain, France, and Italy are forecasted to expand by 2.2%, 1%, and 0.9% respectively in 2023.

A significant factor in deindustrialization is the high inflation in the euro area, which leads to a reduction in production investments. For instance, while inflation in Japan and China remains at 2.5% and 2% respectively, it has reached 7.5% in Austria as of August 2023. The forecasted inflation for the EU for the current year stands at 5.6%, slightly lower than the May prediction of 5.8%. However, the inflation forecast for 2024 has been revised upwards slightly to 2.9% from 2.8%, primarily due to rising oil prices. [48] In 2022, the highest annual inflation rates among EU member states were recorded in Estonia (19.4%), Lithuania (18.9%), and Latvia (17.2%). That same year, the highest annual price increases in the EU were seen in housing, water, electricity, gas, and other fuels (with an increase of 18.0%), and transportation (with an increase of 12.1%). [49]

EU Inflation Rate

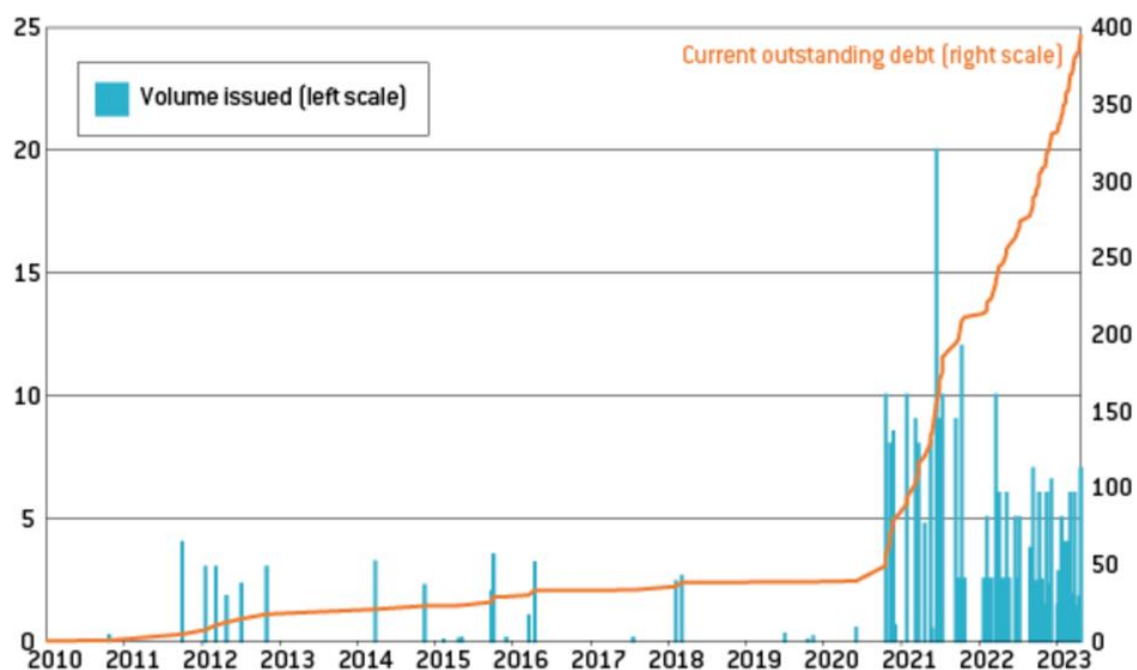


Following another hike in key interest rates, the **European Central Bank (ECB) has raised interest rates** in ten steps – starting from 0% in July 2022 – to 4% for the deposit facility and 4.5% for main refinancing operations. The tenth consecutive key rate increase is fully reflected in business lending. According to ECB data, the average interest rate in the euro area for corporate loans stands at 4.9%. The combined and anticipated inflation for 2022 and 2023 will reduce the initially expected annual real cost of the EU budget expenditure programs by 10 – 20% in the current and subsequent years. [50] The indirect impact of the key rate is that it will restrain wage growth, as companies face an investment shortage, leading to a reduction in the multiplier for private consumption. [51]

A serious issue of post-pandemic and energy crisis is companies teetering on the brink of viability, with their productivity growth at critically low levels. Unproductive and often debt-laden firms remained solvent due to ultra-low debt servicing costs. **A combination of rising interest rates and input costs might ultimately lead to a wave of bankruptcies.** Rescuing critically important enterprises from this number could substantially strain the budget. [52]

The ECB Bank Lending Survey (BLS) revealed that credit standards for loans and credit lines to enterprises tightened to levels witnessed in 2011 during the sovereign debt crisis, and this trend is expected to intensify. Risks associated with economic outlooks and a firm’s specific situation remained the primary drivers behind the tightening of credit standards. The demand for loans declined due to high-interest rates.

Issuance and outstanding debt of the EU (in € billions)



The EU is facing an escalating debt crisis. The volume of debt securities issued by the European Commission on behalf of the European Union has significantly increased, and the cost of debt servicing will double, compare to initial estimates. Given this situation, the likelihood of expanding support for priority programs is low. With rising interest rates, the spread between the yields of EU bonds and those of major European issuers has widened. Interest expenses are covered by the EU budget. These funds, amounting to 421 billion euros (by the end of 2026), are intended to finance unprecedented non-repayable support: grants from the Recovery and Resilience Fund, additional financing for existing EU programs within the budget, and concessional loans for Ukraine. The liquidity of bonds from the EU, Germany, France, and Spain has been declining since the beginning of 2023. [42]

According to forecasts from the KKR Global Institute, **the scale of inflation will increase by the end of 2023**. Almost every company, producing goods and services among the respondents, is actively seeking price hikes. Given the lag in establishing intermediate prices, which is usually observed in the corporate sector, this price increase will have a broader impact on the economy in 2023. [53]

**World Economic Outlook
Growth Projections**

(Real GDP, annual percent change)

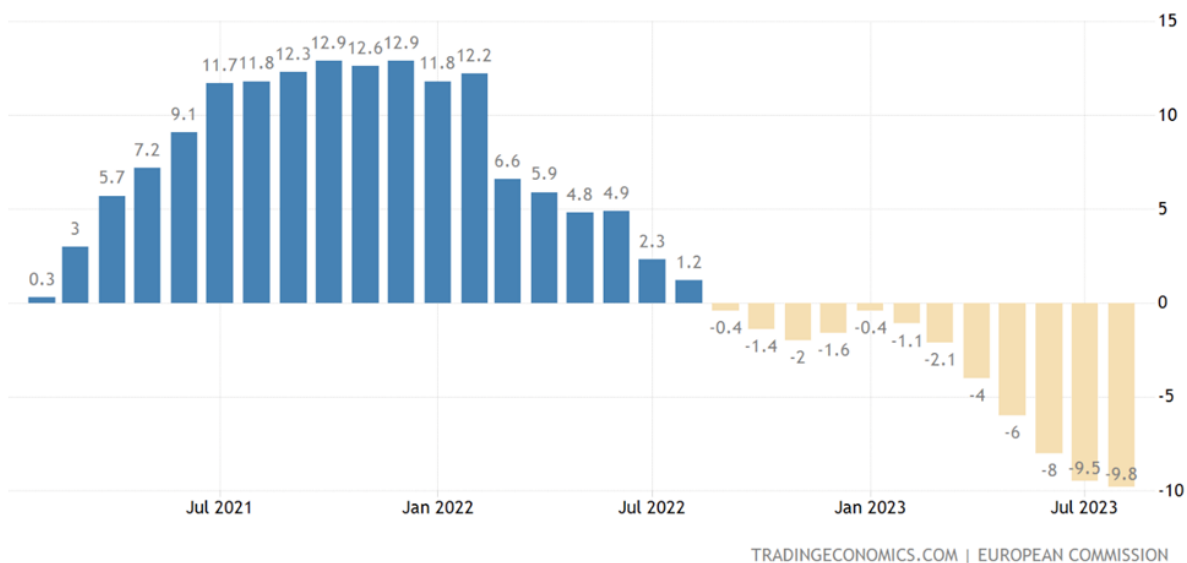
	2022	PROJECTIONS	
		2023	2024
World Output	3.5	3.0	3.0
Advanced Economies	2.7	1.5	1.4
United States	2.1	1.8	1.0
Euro Area	3.5	0.9	1.5
Germany	1.8	-0.3	1.3
France	2.5	0.8	1.3
Italy	3.7	1.1	0.9
Spain	5.5	2.5	2.0
Japan	1.0	1.4	1.0
United Kingdom	4.1	0.4	1.0
Canada	3.4	1.7	1.4
Other Advanced Economies	2.7	2.0	2.3

During the summer of 2023, the International Monetary Fund (IMF) revised this year’s economic forecast for Germany downwards. The German economy’s decline in 2023 is estimated at -0.3%, making it the only negative value among the developed economies. The general pessimistic forecasts are attributed to a slump in the German industrial sector in the automotive industry by 9%. [54]

According to updated economic assessments by the Ifo Institute, the **business climate index fell** to 85.7 points in August compared to 87.4 points in July. This marks its fourth consecutive decline. Evaluations of the current situation dropped to the lowest level since August 2020. Moreover, companies are increasingly pessimistic about the upcoming months. Weakness in the manufacturing industry is also putting pressure on the transportation and logistics sectors. [55]

The business confidence index in the European Union, an indicator of sentiment among manufacturers, is in the negative zone. The manufacturing sector is becoming increasingly negative about the current situation and its own prospects.

European Union Industry Confidence



The ZEW Economic Sentiment Index for the euro area fell to -8.9 in September 2023 from -5.5 the previous month, below market expectations of -6.2. In September, 58.5% of surveyed analysts did not expect changes in economic activity, 25.2% anticipated deterioration, and 16.3% forecasted an improvement in economic activity. Meanwhile, indicators for the current economic situation and inflation expectations also decreased.

Europe’s prosperity is largely linked to a strong industrial sector that ensures innovation, competitiveness, and robust exports. The EU production sector provides employment for 32 million people. It accounts for nearly three-fifths of all EU exports and more than half of all research and development expenditures. Moreover, the manufacturing industry is closely interconnected with other sectors through value-added creation networks, which indirectly affect job creation in other sectors of the economy. European industrial companies are also among the most important demand-side consumers of other industrial goods, as well as services from the tertiary sector in Europe.

However, there’s a concerning trend of the erosion of the manufacturing industry’s interests from the ideological priorities of economic policy, manifesting in a shift in focus from economic growth. This shift is evident in the rhetoric of changing criteria and economic models for assessing development, coordinates, and drivers of the EU economy.

In May 2023, the European Parliament held a conference titled ‘Beyond Growth: Pathways towards Sustainable Prosperity’ where **the dependency on economic growth as the primary policy driver and the use of GDP as the key economic indicator was discussed.** The reason for this is the distribution and depletion of shared environmental goods and social costs. Within this context, the idea of sustainable development justifies indifference towards economic growth, presenting reduced consumption as the new normal.

Proponents of economic growth argue that GDP remains a clear and established indicator, that economic growth itself still positively correlates with many favorable social outcomes, and that environmental damage can be mitigated through innovations.

However, the document justifies a move away from the concept of ‘green’ and inclusive growth, where growth is central to policy objectives that require environmental corrections. The economy is closely linked with employment levels, state tax revenues, pension systems, and business interests. This idea is criticized for only bringing about minor changes to the status quo. The ‘Postgrowth’ direction, according to the authors, is more promising and corresponds to more moderate positions compared to the stricter alternative of ‘Degrowth’, where growth itself is the issue. The Postgrowth concept is indifferent to growth. **According to Postgrowth, the economic model should be designed in such a way as to achieve environmental and social goals, regardless of whether this is accompanied by economic growth or not.** The specific growth rates do not necessarily automatically correlate with social benefit or environmental damage since it all depends on what is growing or shrinking (i.e., how production and consumption are organized). Instead of GDP, within this concept, it is suggested to measure the Human Development Index, the Social Progress Index, and the Sustainable Development Goals (SDG) index. [56] At the core of this economic model is not industrial development, but non-profit enterprises. Economic activity is evaluated based on the ‘good’ and ‘bad’ principle in an ecological and social context. [57]

In the event of a strategic shift towards Postgrowth, coupled with the strengthening of regulatory standards and environmental priority systems, there is a heightened risk that industries, already facing an unfavorable amalgamation of destabilizing factors and uncertainties, might find themselves in an even more vulnerable position. Given Europe’s energy challenges and significant constraints and risks that can profoundly impact the pace of integrating renewable energy capacities required to offset deficits, many energy-intensive industrial enterprises, teetering on the edge of acceptable costs, may end up being detrimentally affected or even cease to operate altogether.

Labor Market in the Context of Impending Deindustrialization

In its annual labor market review for the current year, the European Commission reported that the employment rate in the EU remains high, with unemployment significantly reduced. However, according to the European Commission, the sustained high fuel costs of pose a serious risk to jobs in the EU, especially in energy-intensive manufacturing sectors.

A shortage of skilled labor is a significant destabilizing factor for Germany’s economy, which is experiencing an unprecedented outflow of investments. These companies find themselves in a predicament: they need to expand production and introduce innovations, but they lack the necessary personnel to do so. Demographic changes, primarily the aging of society and the workforce, exacerbate the existing shortage of skilled workers in many countries. This

amplifies obstacles to production and threatens governments' financing conditions overall. [58]

The unemployment rate in the European Union is currently the lowest since 1999, at 6.5%. However, there is a significant decline in living standards due to high inflation and rising energy prices, leading to energy poverty among households. According to Eurostat, the number of people unable to adequately heat their homes in 2022 rose to 9.3% (data as of June 2023), compared to 6.9% in 2021.

The total number of jobs created in Europe as a result of direct foreign investment declined by 16% year-on-year to 343,634. This drop indicates investors' caution amid uncertainties in European markets. American companies announced the creation of most jobs (over 10,000) in 2023, followed by Chinese investors with about 4,600 jobs.

According to a May survey by EY, economic challenges related to rising interest rates (45%), high inflation (40%), and growing levels of government debt (36%) are cited as the three main risks influencing investments across Europe.

The increase in labor costs aimed at curbing the erosion of household purchasing power could further diminish the competitiveness of companies. In some areas, these elevated costs cannot be passed on to clients and might result in a sharp decline in corporate revenues, exacerbating a drop in investment activity. [59] It's worth noting that the impact of the industrial sector on employment is significant – each new job in the manufacturing industry creates between 0.5 to 2 jobs in other sectors.

In December, the European Foundation for the Improvement of Living and Working Conditions (Eurofound) released a list of job losses, including 441 layoffs at an aluminum oxide factory in Tulcea, Romania, in June; 300 at a plant in Žiar nad Hronom, Slovakia, by the end of 2022; and 350 at a ceramic tile manufacturing plant in Poland. The organization stated that the impact of the energy crisis on employment in the bloc is likely just beginning.

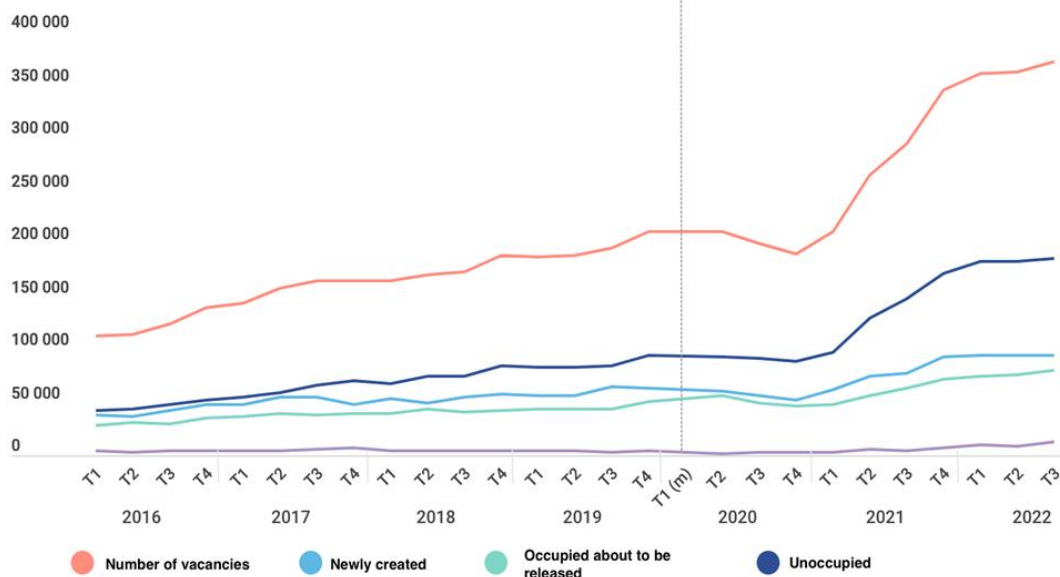
Triangle warned that, similar to former industrial towns in Northern England that supported Brexit, an accelerated industrial decline in Central and Eastern Europe could trigger a backlash against the EU by voters, which might become a lasting legacy of the crisis.

From 2017 to 2022, the number of job vacancies in the French industry tripled and reached around 60,000, with an annual value-added deficit of 4.8 billion euros. The share of job vacancies in the manufacturing, mining, and other industries (57,500 vacancies) in 2022 constituted 46%, with 21% of those employed on the verge of being laid off. [60]

The manufacturing industry of the Île-de-France region has a significant impact on employment, but its share in the economy remains moderate. The region faced challenges

such as job losses due to competition and changes in production processes, affecting the industry’s structure.

Trends in job vacancies in France from 2016-2022.



By the end of 2015, approximately 460,000 people were employed in the Île-de-France region’s industry, accounting for 14.1% of all industrial workers in France. Since the beginning of the crisis in 2008, the Île-de-France region has lost 60,000 industrial jobs. 18% of industrial workers are aged 55 and over, a percentage higher than in other economic sectors. While employees aged 25-54 constitute the majority of the workforce, their share is also declining. The profession attractiveness to younger workers and education for the older generation are emerging concerns. [61]

According to a study by the analytical portal La Fabrique de l’industrie, hiring skilled personnel in the French industry has become incredibly challenging: in 2022, 67% of industrial sector enterprises reported hiring difficulties. Training for new technical experts for key industrial professions will only meet half the needs by 2030. Overall, a larger volume of projects in France creates fewer total jobs (38,102) and on average (33) than in the UK (46,779 in total, 59 on average), partly due to higher wage costs and stricter labor regulations. [62]

In Germany’s automotive industry, there are high expectations for increasing layoffs, which have been observed for four consecutive years. New waves of staff reductions are linked to investment costs and rising expenses. Automotive industry suppliers are also experiencing tough times and have been more affected by the aftermath of the energy crisis, potentially leading to an increase in layoffs. [63]

Share of employees in three types of activity, among young people who left education at secondary school in 2017 and who entered employment, according to the training track.

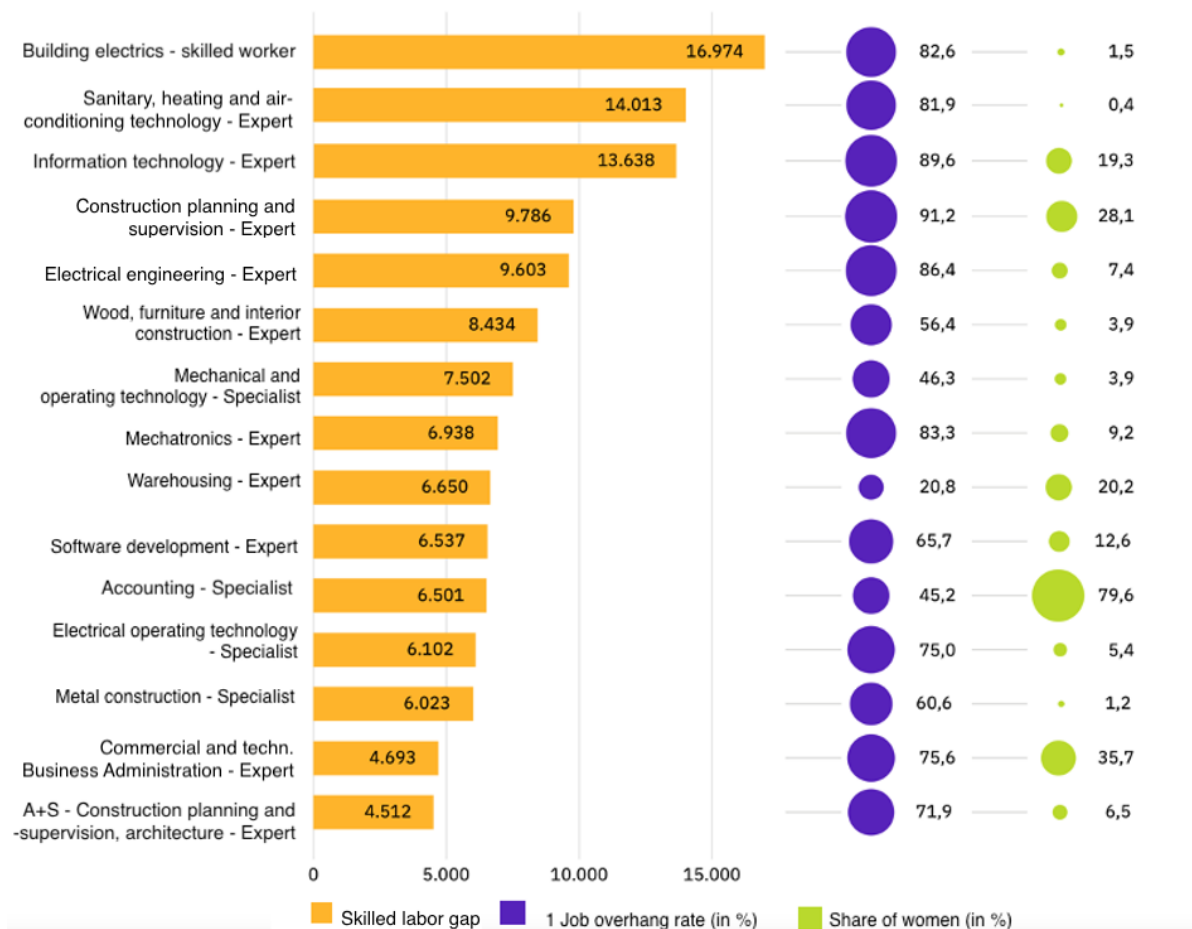
Source: Cereq (2023)

	At first job			In three years		
	Industry	Non-commercial services	Commercial services far from the industry	Industry	Non-commercial services	Commercial services far from the industry
Fundamental industrial technologies	12%	26%	13%	8%	31%	17%
Multi-technological specialties of transformations	32%	16%	7%	40%	21%	4%
Multi-technological specialties flexible materials	16%	13%	17%	8%	11%	24%
Multi-techno specialties. mechanical-electrical	39%	7%	11%	51%	12%	5%
Engines and car mechanics	19%	6%	9%	15%	8%	4%
Metal structures	33%	5%	10%	35%	4%	4%

Note: under the term "commercial services far from the industry", we understand accommodation-catering, information-communication, finance-insurance-real estate, and household services. The "non-commercial services" include the public administration, teaching, medical-social accommodation, and social action.

The shortage of skilled labor is the greatest threat to the business sector's transition to sustainable development. This is the opinion of the Director-General of the Confederation of Swedish Enterprise, Jan-Olof Jacke. He believes that the shortage of skilled labor is the most significant threat to the transition of the business sector to sustainable development, following problems with electricity supply. He considers that the lack of skilled professionals could affect Sweden's ability to achieve its climate goals. The most in-demand competencies, according to the expert, are specialists in energy, automobile manufacturing, and artificial intelligence developers. [64]

The main professions related to solar and wind energy by the number of vacancies, for which there are not enough qualified unemployed people throughout the country, on average for a year from July 1, 2021, to June 30, 2022 (orange – skills gap/ purple – staff shortage).



According to a study by the Instituts der deutschen Wirtschaft [65], there is a significant unmet demand for IT professionals in the green energy sector, which holds high hopes for a systemic solution to the energy crisis:

- About 32% of companies expect an increased need for IT specialists to develop eco-friendly technologies and products in the next five years.
- 19% of companies anticipate a rise in the demand for engineers or environmental engineers.

Across all companies, there is a growing need for other experts in mathematics, computer science, natural sciences, technology, and other qualified professionals.

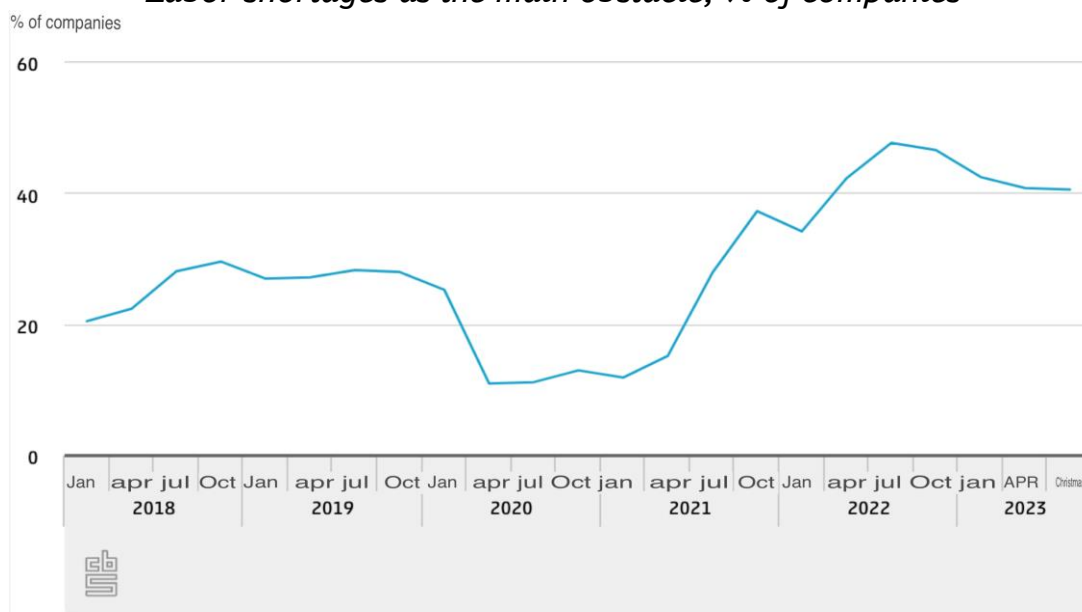
The research center Kompetenzzentrum Fachkräftesicherung (KOFA) [66], in analyzing professions necessary for expanding solar and wind energy, points to the problem of incomplete competencies and a shortage of qualified staff in the industry.

Gerd Landsberg, the Managing President of the German Association of Cities and Municipalities, summarizing the data from the aforementioned KOFA study and other research, comes to the following conclusions [67]:

- Germany has a shortage of around 350,000 employees, including staff related to energy transition tasks.
- A particular influence on the situation is the lack of construction specialists responsible for the planning and approval of renewable energy systems.
- By 2030, the situation is expected to worsen, and more than 500,000 employees will leave the labor market.
- It's forecasted that the public sector will be short of more than 800,000 workers, including not only specialists but also regular employees.
- The shortage of skilled staff in Germany is a serious issue, impacting various sectors from clean technologies to heating systems, potentially negatively affecting the country's energy transition and climate goals.

Based on the Netherlands business review (COEN) for July 2023, the Statistical Office of the Netherlands [68] shows statistics that over 75% of enterprises in the country face a labor shortage. More than 40% (primarily in the fields of trade, repair, and the automotive industry) relatively often consider the deficit a major obstacle for their business activities.

Labor shortages as the main obstacle, % of companies



Source: CBS, KVK, EIB, SME-Netherlands, VNO-NCW'

Germany as the Epicenter of Modern Deindustrialization in the EU

Germany continues to remain the leading industrial European exporter of goods, yet it is undergoing a technical recession, which many experts perceive as a primary symbol of deindustrialization.

The Composite PMI (Purchasing Managers' Index) for Germany measures activity in the manufacturing sector and the service sector, taking into account parameters such as new

orders (30%), production volume (25%), employment (20%), suppliers' delivery times (15%), and purchasing stocks (10%). According to the latest data, its value declined to 44.7 in August from 48.5 in July, marking the lowest level since May 2020. [69]

Based on surveys by S&P Global, Germany, as the largest European economy, appears particularly weakened by the decreased demand from China towards the EU and the prolonged energy crisis. The European Commission has stated that Germany will be the only major country experiencing a downturn this year, and concerns regarding long-term prospects are intensifying.

Dynamics of Germany's PMI 2019–2023.

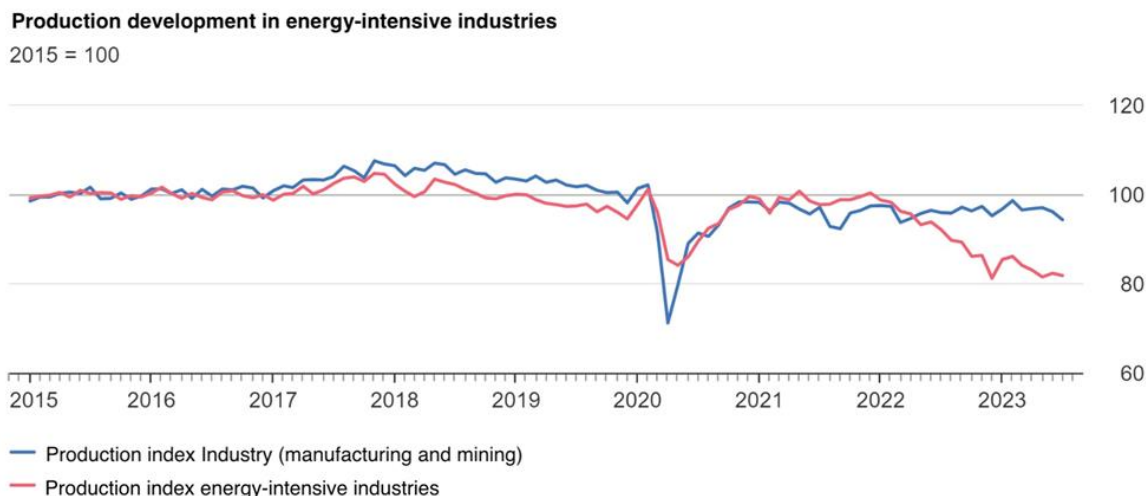


The number of new orders declined most significantly over the last three years due to customer uncertainty, weakness in the construction sector, and an overall reduction in investments. Moreover, new export orders significantly decreased, driven by declining sales to China and throughout Europe. Manufacturers continued to have a pessimistic outlook for the upcoming year, despite minor improvements in business sentiment.

From the beginning of 2022, production in energy-intensive industrial sectors almost continuously dropped, resulting in considerably weaker indicators compared to the industry as a whole. From February 2022 to July 2023, production in energy-intensive industries decreased by 16.7%. Over the same period, overall industrial production declined by only 2.8%. [70]

Germany's industrial production weakened further in July, with the energy-intensive industry (represented by the red line) nearing its lowest point again, which was set in December during the peak of the energy crisis.

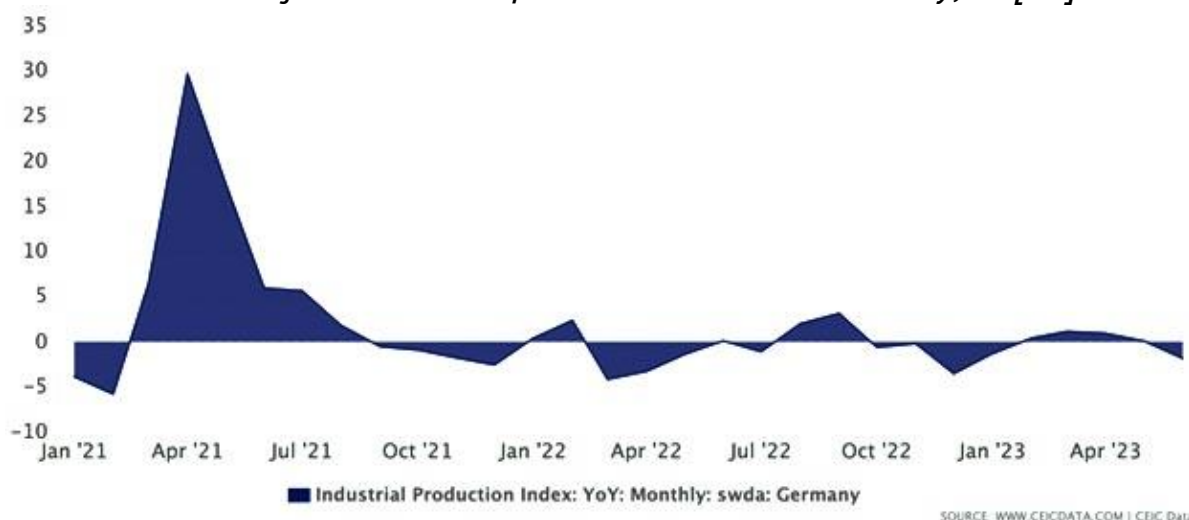
Development of production in Germany's energy-intensive industrial sectors from 2015–2023.



The five industrial sectors with the highest energy consumption collectively required 77% of the total industrial energy consumption in 2021, while their share in the gross added value, in the industry, at factor costs, was only 17%. In 2021, these sectors employed about one million people at 6,986 industrial enterprises in Germany.

The decrease in the industrial production index in Germany during the pandemic in April 2020 reached an anti-record of -25.4%. In early 2021, it showed a sharp rise, and in April, this figure reached a record high of 29.7%. Afterward, it began to decline and stagnated in the range of 4 to -4 percentage points during the energy crisis.

Growth of the industrial production index in Germany, % [71]



The Berger study [72], focusing on deindustrialization, provides a conservative estimate of a fourfold increase in energy costs for Germany. This would mean that companies engaged in chemical production or metal processing would have to spend almost three-quarters of their

revenues on electricity. The cost of electricity in Germany has increased by 34.55 euros/MWh, or by 231.72%, according to the latest spot benchmarks offered by sellers to buyers priced in megawatt-hours (MWh) since the beginning of 2023. [73] Despite the recent decrease in energy carrier prices for the manufacturing industry, it doesn't affect production in energy-intensive industrial sectors due to the policy of reducing energy consumption.

Studies from the Transatlantic Business Barometer show that 80% of American companies operating in Germany do not expect high energy prices to impact their business operations. At the same time, a third of American companies are cautious about future investments in the country: 27% of respondents intend to reduce their planned investments in the future due to rising energy spending, and 6% even plan to temporarily suspend investments. [77]

The German Economic Institute (Der Informationsdienst des Instituts der deutschen Wirtschaft, IWD) has recently reported **an unprecedented capital outflow from Germany**, hinting at the potential deindustrialization of the euro area's largest economy.

Investment lending opportunities are diminishing as the bank lending rate consistently rises due to high inflation forecasts and the subsequent increase in the ECB's key interest rate. In Germany, the average interest rate for loans escalated to 6.39% in July, compared to 1.8% at the beginning of 2022. [78]

Dynamics of capital outflow from the German industrial sector 2013–2022. [74]

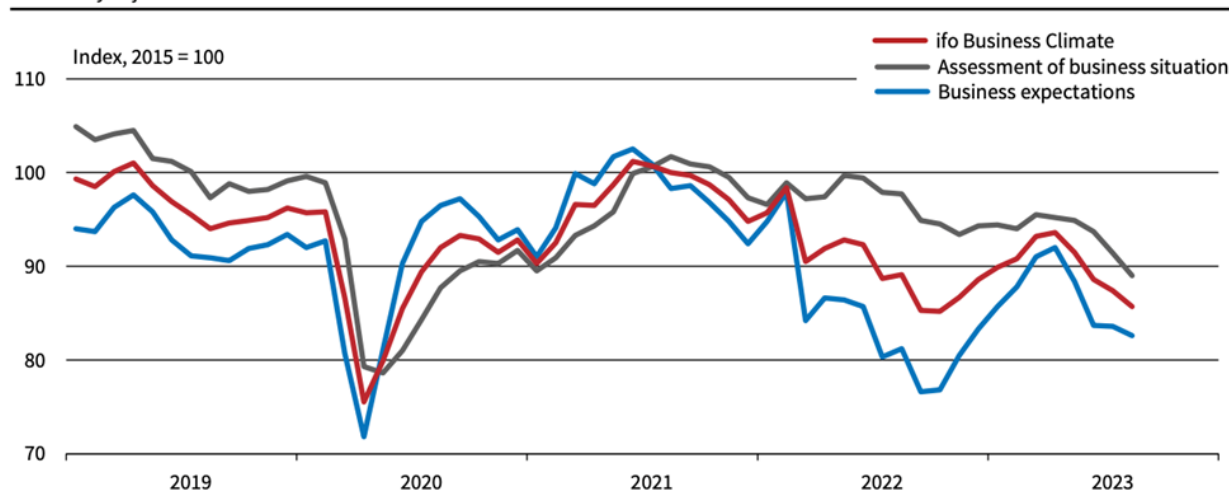


According to a recent survey, **Germans' confidence in the nation's strength has sharply declined**: the Allensbach study indicates that 50% of Germans believe that the Federal Republic will no longer be among the world's leading economic powers in the next 10 – 15 years – a significant increase from 30% in 2022. Furthermore, 58% of business leaders stated that Germany has reached the top. 68% of the populace perceives a consistent weakening of the industrial sector – a similar proportion considers this a grave issue. Additionally, 76% of company executives believe the fears that high electricity costs will lead to deindustrialization are well-founded. [79]

The Leibniz Institute for Economic Research at the University of Munich, named after Clemens Fuest – the Ifo Institute, conducts a monthly survey of 9,000 managers regarding their business's current state and their expectations for the subsequent six months. **Ifo researchers anticipate that Germany's GDP will decrease once again in the current quarter**. According to the revised economic assessments by Ifo, the business climate index dropped to 85.7 points in August, down from 87.4 points in July. This represents its fourth consecutive decline. The evaluations of the present situation plummeted to the lowest level since August 2020. Furthermore, firms are increasingly pessimistic about the months ahead. Weakness in the manufacturing industry is also exerting pressure on the transport and logistics sector. [80]

ifo Business Climate Germany^a

Seasonally adjusted



^a Manufacturing, service sector, trade, and construction.
Source: Ifo Business Survey, August 2023.

© Ifo Institute

The ZEW indicator's assessment of Germany's economic situation showed a decrease of 8.1 points. This research encompasses up to 350 questions related to financial and economic analysis. The value for September 2023 has dropped to its lowest in the last three years: negative 79.4 points, marking the lowest level since August 2020, which is below the market consensus forecast of -75, according to the Centre for European Economic Research (ZEW). [81]

The German government is attempting to implement additional support measures for the manufacturing sector through a new multi-billion-euro subsidy scheme to compensate industrial enterprises for high energy costs. However, the specifics of how such a plan will operate and be funded are under discussion. The prospective measures include tax reductions for energy-intensive industries and the expansion of a price subsidy, covering certain costs within the EU's emissions trading system.

A dispute remains unresolved with the European Commission, which opposes the subsidy schemes interpreting them as excessive state intervention in the market. Germany's share in the structure of state subsidies amounts to 53% of the total EU expenditures of 672 billion euros. This could lay grounds for accusations of undermining competition within the EU. [82]

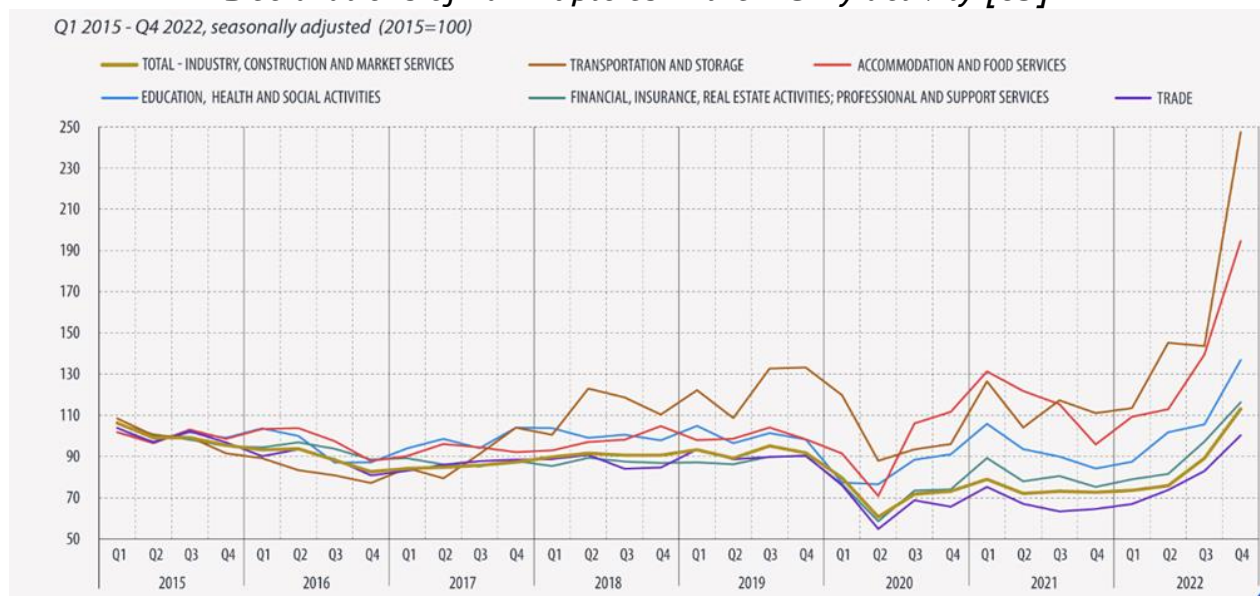
Rise in the Number of Bankruptcies as a Sign of Impending Deindustrialization

The prevailing electricity prices have tripled the production costs of cement in the EU. Coupled with the substantial rise in prices for other energy sources, this poses a direct threat to cement manufacturing in Europe. **Unless urgent measures are taken at both the EU and national levels, the closure of plants across the EU is inevitable**, exacerbating the ongoing erosion of European manufacturing. Indeed, cement imports into the EU have surged by 300% over the past five years, a trend that accelerated in the first three months of 2022 (with a year-on-year increase of 47%).

According to Eurostat data, the number of bankruptcies in EU countries in the second quarter of 2023 rose by 8.4% compared to the first quarter, reaching the highest level since 2015 when data collection began.

In the accommodation and food service sector, the number of companies that went bankrupt increased by 23.9%, primarily attributed to issues related to the cost-of-living crisis. This represents a colossal surge of 82.5% compared to the last quarter before the introduction of pandemic restrictions. A sharp rise in the number of bankrupt companies has also become the norm in the transportation and storage sector, directly influenced by the steep rise in energy prices.

Declarations of bankruptcies in the EU by activity [83]



Recent data indicates that only in two sectors – manufacturing industry and construction, was there a lower number of insolvencies compared to the last quarter of 2019.

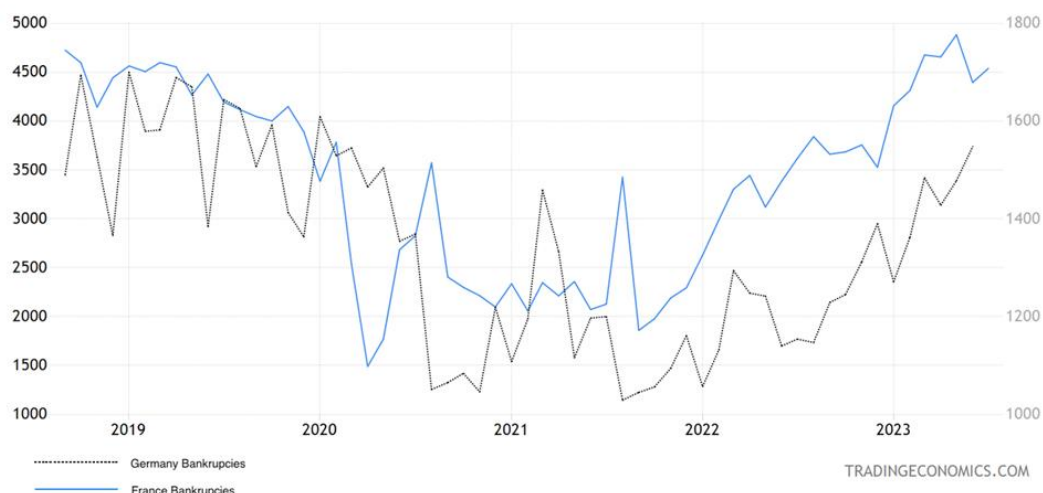
As can be deduced from **the dynamics, the majority of bankruptcies have affected sectors with a higher share of small and medium-sized enterprises.** However, many large enterprises have fallen victim to the shock of energy prices. Here are some examples.

Germany is witnessing a rising wave of bankruptcies. In the first half of the year, the number of insolvency instances increased by 20 percent. In June 2023, there were 13.9% more bankruptcy filings than the previous year. In April 2023, local German courts reported 1,428 declared corporate bankruptcies based on final results. This represents an increase of 14.4 percent compared to April 2022. According to Destatis, the number of corporate bankruptcies has been consistently growing since August 2022.

Experts anticipate that in the upcoming months, an even greater number of companies will face challenging circumstances, as their expenses sharply increase. At the same time, a weak economic environment is suppressing sales. In this context, the myriad support measures and preferential actions that the government employed to assist companies during recent crises – with expenditures running into the billions – are coming to an end. Based on the results from the first half of the current year, local courts reported 8,571 corporate bankruptcies. This is an increase of 20.5% compared to the previous year. The total sum of outstanding creditor demands amounted to nearly 14 billion euros. This includes unpaid employee wages, unsettled invoices from suppliers, or unredeemed loans. In the first half of 2022, this potential damage sum was significantly lower – around eight billion euros.

In France, the number of bankruptcies is growing at a faster pace than in Germany. The count of insolvent companies surged by more than 48% in 2022, after a decline observed during the healthcare crisis, exceeding 41,000 within a single year. Thus, compared to 27,592 in 2021, this represents a jump of 48.6%. For the Bank of France, which cites these figures, this trend towards normalization is common across all economic sectors and is somewhat more pronounced for small and medium-sized enterprises whose sizes are undefined.

Comparative dynamics of bankruptcies in France and Germany from 2019–2023.



The number of bankruptcies in comparison to Germany since the onset of the deindustrialization phase of the energy crisis reveals a greater vulnerability of the country to energy price surges, even though the amplitude was somewhat lower domestically. A significant rise in bankruptcies in France in 2022 was observed in the industrial sector (+64.3%), trade and vehicle repair (+54.4%). The increase in economically insolvent companies is particularly pronounced among small and medium businesses (+48.7%), especially micro-enterprises (+95.8%) and small firms (+92.2%). There are significantly fewer bankruptcies among medium and large businesses (+20.8%). In its latest survey published at the end of October, the Confederation of Small and Medium-Sized Enterprises (la Confédération des petites et moyennes entreprises) asserts that 9% of SME leaders are considering the possibility of ceasing their operations due to rising energy prices.

The morale of households confronted with these entrepreneurial challenges, who will predominantly have to raise their prices, remains suppressed, despite a slight decline in inflation.

The outlook for living standards in France is almost at a historic low since the 1970s. As of July 2022, household morale reached a historical nadir. Currently, the situation is leaning towards stabilization due to decreased seasonal demand for energy resources, but risks

changing its trajectory with the onset of colder weather and heightened political uncertainty related to the escalation of the war in Ukraine.

Deindustrialization, prompted by surges in energy prices, has pushed numerous venerable companies to the brink or even into bankruptcy, many of which possess centuries-long histories.

For instance, Saxony's oldest German company, specializing in the casting of turbocharger housings, exhaust manifolds, and engine parts, found itself on the verge of insolvency due to escalating raw material and energy costs. **Eisenwerk Erla GmbH**, with a history spanning over 600 years, filed for bankruptcy under its own administration in March 2023. The potential winding-up process threatened the jobs of more than 300 employees. However, a reorganization plan enabled the company's preservation. Being part of the automotive sector of the Dynamic Technologies Limited group, Eisenwerk Erla GmbH is a member of a corporate consortium specializing in producing high-quality ferrous and non-ferrous components for technological applications for leading global automobile manufacturers. [89]

In April 2023, **Fluorchemie Dohna GmbH** declared bankruptcy due to severe financial challenges. The company is engaged in the manufacturing, processing, and distribution of binding hydrofluoric acids and calcium sulfate. The Dohna plant stands as one of the oldest hydrofluoric acid producers in Europe, having manufactured the acid since 1903. [107]

Currently, Europe's dependence on imports is nearly 50%. Recently, another aluminum production plant – **Slovalco** in Slovakia was compelled to shut down. In 2022, Slovalco laid off the majority of its 450 employees, citing high electricity costs. Instead of focusing on primary aluminum production, the company shifted to remelting, anticipating an annual production volume of approximately 75,000 tons. In January 2023, the company closed its remaining ten departments, ceasing aluminum production in the city after almost 70 years running. [97]

Waggonbau Niesky boasts a long-standing company history, including over 100 years manufacturing rail vehicles. In 2017, the company had previously filed for insolvency and was subsequently acquired by the Slovakian freight wagon manufacturer, Tatravagonka. It was earlier announced that the insolvency administrator would have to shut down the enterprise by August 31, 2023. However, in late June, the court revoked the bankruptcy and appointed a bankruptcy trustee. [90]

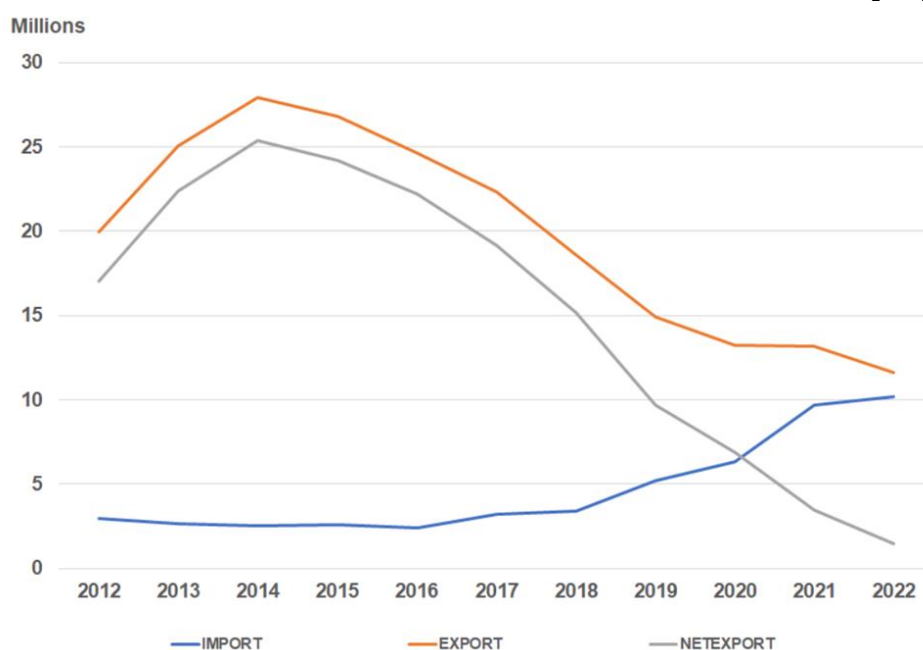
DGH Heidenau GmbH & Co. KG (DGH Group) declared the bankruptcy of its plant in Dohna, Saxony, which will cease operations by the end of 2024. This plant specialized in the manufacturing of technically complex parts made of aluminum and magnesium for the automotive industry. Over 200 employees are set to lose their jobs due to the impacts of climate policy and rising CO2 prices. The plant facilitated innovations across various sectors,

including mobile communications and energy consumption reduction. The crisis in metallurgy has alarmed entire industrial associations. [88]

Production Dynamics in Energy-Intensive Sectors of the EU

As previously highlighted, during the peak of the energy crisis in Europe, dozens of industrial sectors such as cement, glass, and petrochemicals were operating at 50% capacity or were entirely shut down. The stabilized energy prices remained persistently high. Firms that were previously staying afloat are now receiving fewer orders and are compelled to reduce production. Let's take a closer look at the signs of structural imbalances signaling the onset of deindustrialization.

Export and import of cement+clinker from 2012 to 2022. [84]



The cement industry has been severely impacted by the energy crisis, as it hadn't sufficiently recovered from the aftermath of COVID-19. Carbon capture technologies also negatively affect energy consumption. According to projections, the adoption of these technologies will lead to a significant increase in energy consumption, ranging from 68% to 119% by the year 2050. This is despite the anticipated decline in energy intensity of cement production by 2050 due to the integration of renewable sources. [85]

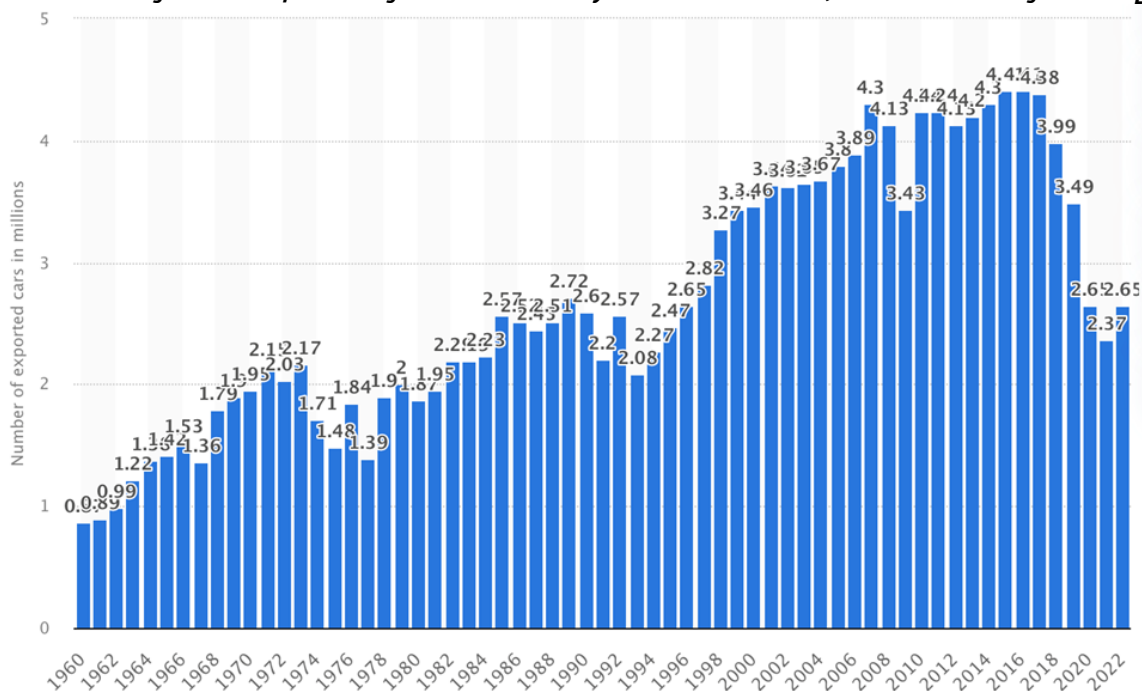
Regarding the **automobile industry**, compared to the figures before 2019, German car exports have nearly halved. However, overall, exports of automobiles and automotive parts from Germany increased by 16% in the previous year. In 2023, a decline of 9% was observed in the German automotive sector, prompting the IMF to lower its growth forecasts for Germany. Production has been deteriorating for three consecutive months, starting from July

of the current year. In July, the decline was recorded at -0.8%, which is worse than the -0.5% that was anticipated based on economic forecasts.

In the last four years, the workforce of the German automotive industry has been consistently declining, now amounting to over 774,000 individuals. Analysts from Ernst & Young anticipate further reductions due to the industry’s high demand for investments and increasing overheads.

A widening gap between automotive suppliers and manufacturers is evident. The sales growth of manufacturers in 2022 was more than four times higher than that of suppliers (whose employment again sharply dropped by six percent), whereas manufacturers remained stable. Supply shortages, inflation, and a weakening Chinese market intensify the negative trend. Current volumes are decreasing.

The number of cars exported from Germany in 1960–2022, in millions of units [86]

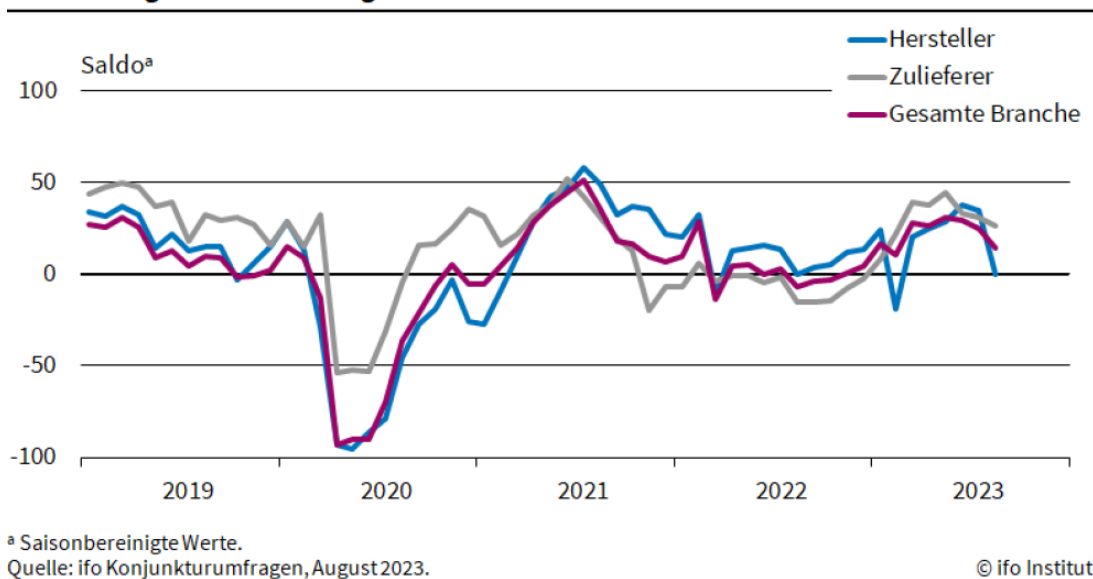


The EBIT profitability of manufacturing industry suppliers in 2022 was already below five percent, and a decrease of one percentage point is forecasted for this year. Production volumes in most places remain below the pre-crisis level. This results in significant overcapacities, reducing the load and operational efficiency. The competition is extremely fierce, and the price level is under intense pressure even at the early stages of innovations, complicating development opportunities.

According to the updated economic assessments of the Ifo Institute [87], in August, the indicator fell to 12.7 points after reaching 22.1 points in July.

While the market is reverting to its usual course, price competition will continue to escalate in the context of stagnant volumes. Currently, high profitability can only be realized for cars with internal combustion engines; electric motor models do not have a comparable margin. Meanwhile, Chinese exports of electric vehicles to the EU rose to 6.9 billion euros in 2022 from less than 800 million euros in 2020, posing a threat to the market’s development in Europe without further consistent import restrictions.

Assessment of the business situation in the German automotive industry.
Beurteilung der Geschäftslage in der deutschen Automobilindustrie

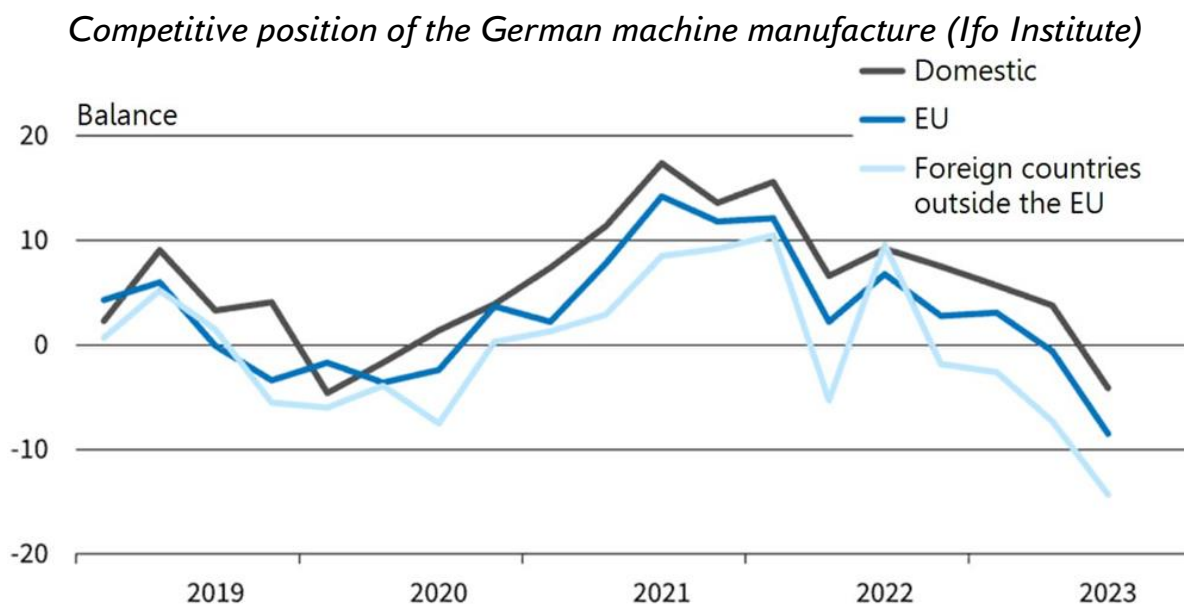


The German **mechanical engineering industry** is under threat, as Germany continues to sharply lose ground in the competitive struggle for market share among the machinery industries, according to the IFO review [55]. This is largely due to competition with Chinese manufacturers.

The competitive position assessment in the ifo survey plummeted to -14.3 points after -7.3 in April – this marks the lowest level since records began in July 1994.

The personnel issue defines the current challenges – the machinery manufacturing sector faces a shortage of suitable specialists. About 40% of the surveyed companies report this. Additionally, the increased cost of energy and raw materials can rarely be added to the sale price.

The 33% increase in variable production costs in **the metallurgical industry** led to a margin reduction of approximately 4 – 5%. The automotive industry took a particularly hard hit, with profits falling from 15.7% to just below 5.2% due to a 5% increase in variable production costs.



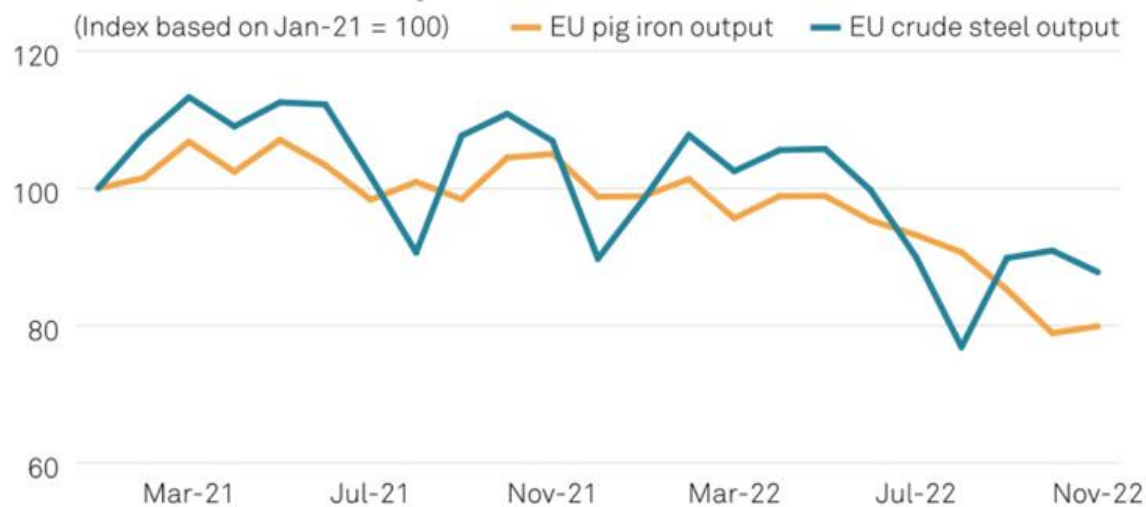
Comparing this with the approach of the American IRA law, iron and steel producers receive significant preferences, as these metals are key raw materials, for instance, in wind turbines where they make up a large portion of the weight. These energy-intensive productions in the EU continue to face challenges.

Several blast furnaces in Europe were halted from September 2022, leading to a diminished demand for raw materials. Rising costs weaken the automobile and construction sectors, which depend on domestic supply. In 2022, the EU imported 28.9 million tons of finished steel products, with exports consistently decreasing. [92]

Steel. According to recent data from the World Steel Association, by November 2022, daily pig iron prices in the EU had sharply declined compared to higher levels earlier in the year and in 2021. EU’s pig iron production in 2022 might eventually decrease by nearly 8 million tons compared to 2021.

As per S&P, the decline in the production of pig iron and steel in Europe adversely impacts the demand for pellets, a raw material. In October 2022, Eurofer reported that steel market outlooks had worsened for both the second half of 2022 and 2023, with the demand for steel dropping more than previously anticipated, falling by 3.5% in 2022 and by 1.9% in 2023. [93]

The downturn in pig iron and steel production in the EU.



Source: World Steel Association, S&P Global Commodity Insights

Furthermore, the combined effects of reduced free allocation and the CBAM (Carbon Border Adjustment Mechanism) are expected to significantly reduce the EU-based productions and export-related jobs. This might lead to additional inflation due to rising steel prices. Moreover, new market entrants from outside the EU will sell their (carbon-intensive) steel in the EU market, as many importers may circumvent the CBAM. [91]

Renewable energy sources, hydrogen, wind turbines, and electric vehicles all heavily depend on steel. The association Eurofer has estimated that just for expanding renewable energy production, over 74 million tons of steel will be required. The EU has shifted from being a net steel exporter to a significant net steel importer, losing 30 million tons of sales in both European and export markets. The IRA (Industry Risk Analysis) will lead to further reductions in export volumes. Additionally, the EU steelmaking industry lost 26 million tons of steel production capacity and 25% of its workforce. [94]

Currently, prices are heavily influenced by labor costs. Heavy steel structures can be acquired in low-wage countries like Turkey for just €1.85 per kg. In Central and Eastern European countries, prices are on average about 25% higher, with product inventory levels increasing.

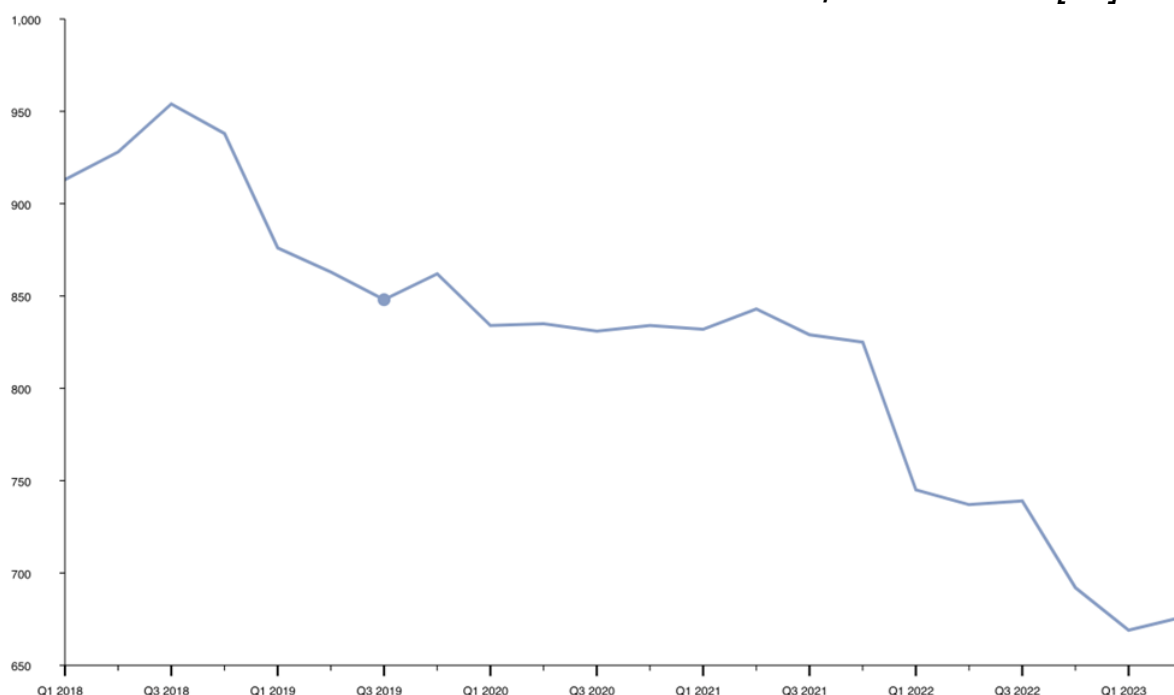
ThyssenKrupp, one of Germany’s largest steel conglomerates, faced negative trends in the third quarter of the 2022/2023 fiscal year, as shown in the quarterly report. The Group’s adjusted EBIT fell to €243 million, significantly lower than the previous year’s figure of €721 million. This decline is attributed to lower prices and decreased margins in Materials Services, coupled with reduced selling prices in Steel Europe. Production board estimates suggest that the steelmaking division of the MDAX Group will operate under reduced hours for some time. ThyssenKrupp has been utilizing short-term work in this division for several months.

LME, the French high-energy steel plant, which is 100% reliant on electricity, was forced to halt production for two months at the end of 2022 due to the energy crisis. The situation became critical because of rising electricity prices and issues with Russian gas deliveries. Production has since resumed.

In Küstine, close to Nancy (Meurthe-et-Moselle), a plant specializing in alloys and belonging to the **Le Bronze-Alloys** group, faced the necessity to shut down. The decision was finalized by the central committee on Tuesday, September 20, 2022. Currently, the company employs thirty-two permanent contract staff. Some of them are veterans from Manoir-Industrie, boasting over thirty years of experience in their profession. [95]

The aluminum industry experienced a sharp decline due to the exponential rise in costs. According to a press release by the Aluminum Germany industry association, the production of raw aluminum decreased by 14% to about 748,000 tons. Aluminum production in Europe is now at its lowest level since the 1970s.

Reduction in aluminum extraction in Central Europe 2018–2023. [96]



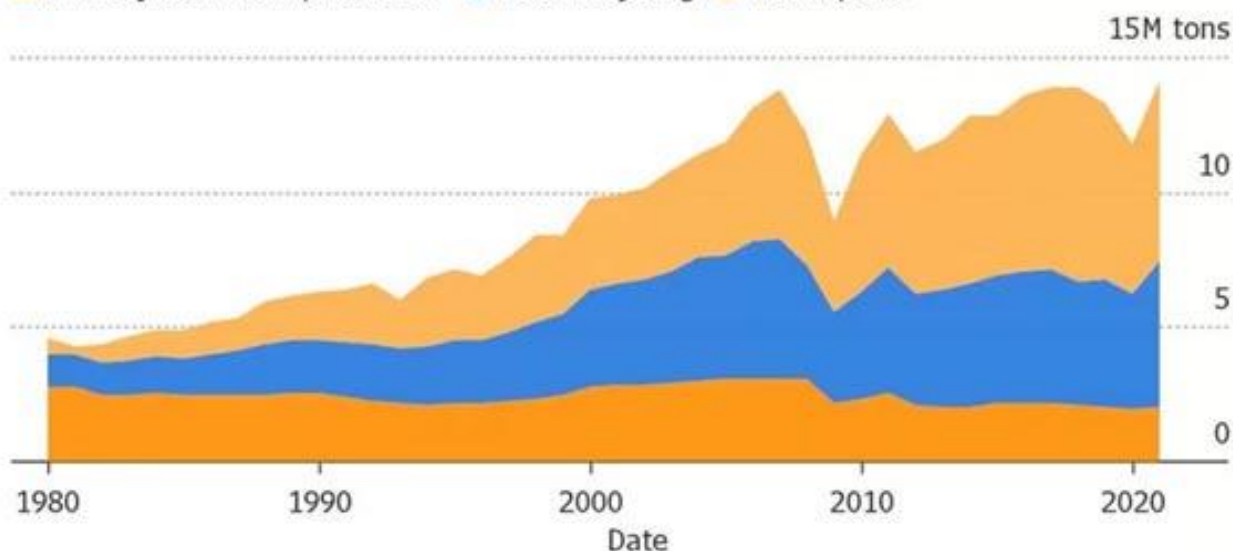
Compared to the same period last year, primary aluminum production fell by 50%, amounting to production of around 98,000 tons. Prior to the energy crisis, this figure was almost three times higher. The production of aluminum semi-finished products also saw a decline in the second quarter, amounting to just under 595,000 tons, marking a 12% loss. This decline rate was double-digit both for extruded product manufacturers (-16%) and for rolling manufacturers (-11%). In the first half of 2023, Germany produced 1.2 million tons of semi-finished products, representing a 10% decrease.

The European Union sources almost half of its aluminum from suppliers outside of the bloc.

Import Reliance

The EU buys nearly half of its aluminum from suppliers outside the bloc

■ Primary aluminum production ■ Total recycling ■ Net imports



Source: European Aluminium

Note: Data for EU countries. UK is included in 2021 data

Bloomberg

President of Aluminium Germany, Rob van Gils, commented on these statistics as follows: “The process of manufacturing industry departure has already begun, and it’s accelerating. Industrial production and, consequently, prosperity in Germany are at risk. The German government needs to intervene immediately. We are not talking about permanent subsidies but temporary support and more than 60,000 jobs in the aluminum industry. We welcome the Federal Chancellor’s statement on the intention to reduce energy prices in Germany to a competitive level through structural measures, but we cannot rely solely on this. The clock is ticking, and if significant parts of the manufacturing industry depart, they won’t return. This will have profound implications for the country’s industrial production and independence.”

Against the backdrop of declining domestic production, European consumers are compelled to resort to importing aluminum, which is purchased at a higher price and with a more significant environmental footprint. This is attributed to European industrial companies already incurring substantial costs to ship aluminum to local ports. As these expenses escalate, their competitive position in the global market deteriorates compared to companies from China and the USA. This phenomenon underscores not only the economic but also the environmental facet of the issue, as importing aluminum, which carries high transport costs, may contribute to additional carbon emissions and other environmental impacts during its delivery.

Eurometaux, the European metallurgical association, has urged the EU to take immediate actions to prevent ongoing deindustrialization, driven by rising electricity and gas prices. According to its statement, Eurometaux, as the leading organization, represents the decisive voice of the producers and recyclers of non-ferrous metals in Europe.

According to the association, Europe has already lost about 1 million tons of primary aluminum production due to reductions and closures of enterprises in 2021 and 2022.

40 leaders of European metallurgical companies, united by the European metallurgical association Eurometaux, appealed to the EU heads of state and government warning of the threat related to the energy crisis.

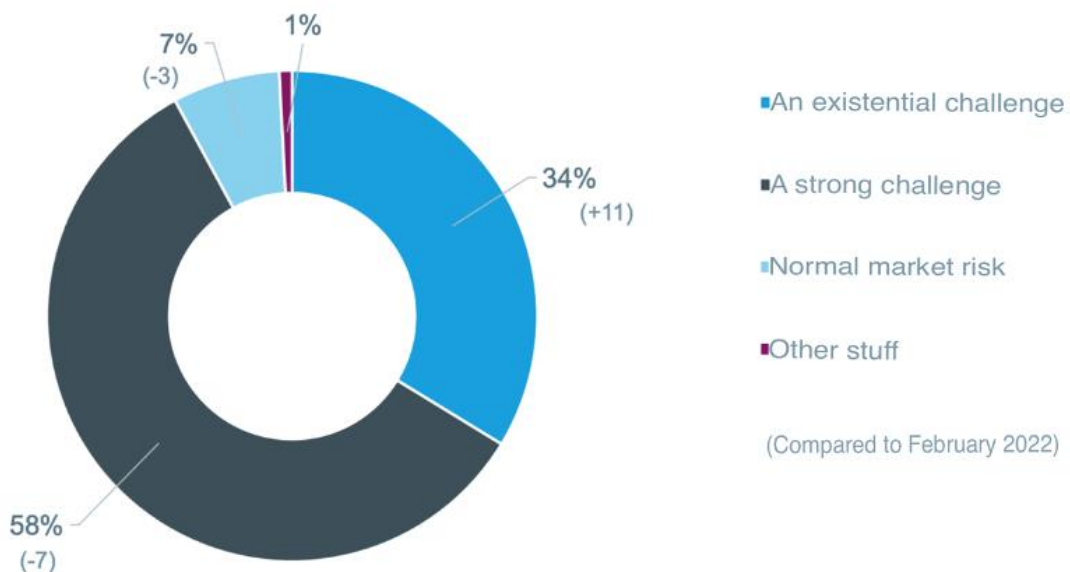
Endorsing companies include EU Rio Tinto RIO. L, Norsk Hydro NHY. OL, Albemarle ALB. N, Umicore UMI.BR, Northvolt, Solvay SOLB.BR, and Aurubis NAFG.DE. Mytilineos, Alcoa, AluminiumDunkerque, Anglo American, Atlantic Copper, Ecobat, BASF, Elkem, Eramet, KGHM, Livent, Nyrstar, Sibanye-Stillwater, Speira, SQM, and TRIMET.

The widespread adoption of variable renewable energy sources, including wind and solar photovoltaics, results in additional costs caused by operational interruptions. Several recent studies have examined these ‘integration costs’ and proposed new metrics that replace the traditional indicator known as the Levelized Cost of Electricity (LCOE).

During the acute phase of the energy crisis, Eurometaux urged the EU to raise the threshold of assistance that EU countries can offer to struggling companies to 50 million euros. They sought support through restrictions on taxes and surcharges on electricity and gas and advocated for the creation of an EU emergency aid fund for energy-intensive industrial sectors. Eurometaux stated that the energy crisis is an “existential threat to the future of European metallurgical plants.”

The association’s assessment of the situation as a threat to viability is not isolated. The Federation of German Industries (BDI) in a rapid survey for August/September 2022 among the leaders of 593 companies found that nearly 40% of their activities were related to metallurgy and the chemical industry.

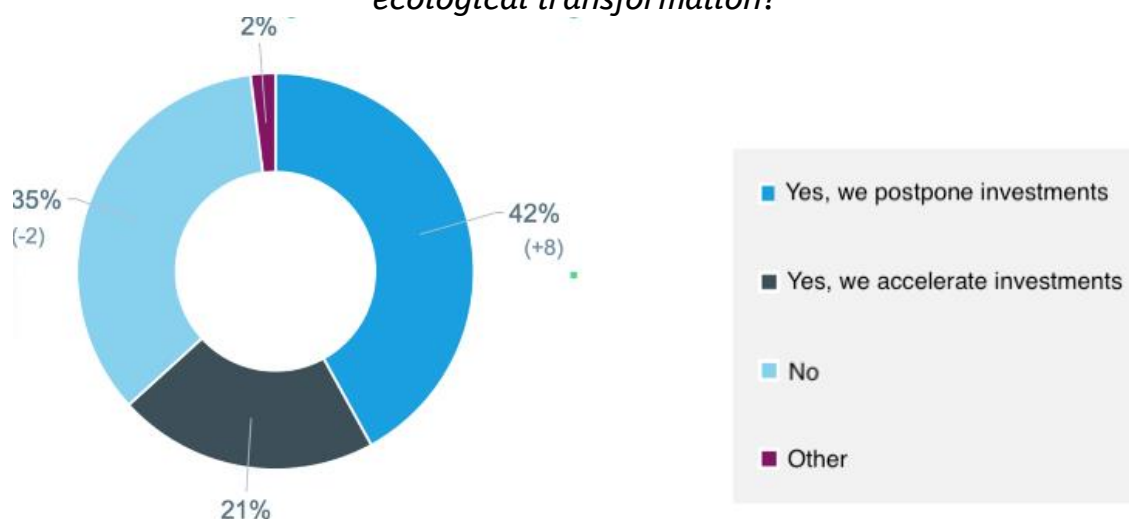
How does the increase in energy and raw material prices affect your company?



According to the data, over 90 percent of companies believe that the rise in energy and raw material prices has a significant (58%) or even extreme (34%) impact. This contrasts with the data from February 2022, when only 23% of companies considered this issue as extreme.

The price dynamics for energy carriers are forcing more than 40 percent of companies to postpone investments in ecological and digital transformation, which is 8% more than in a survey conducted six months ago.

Does the current price development affect your company's planning regarding ecological transformation?



The Eurometaux Association also highlighted **the ecologically driven motivation for supporting European businesses**. The production of 1 out of 4 megatons of aluminum in the EU/EEA was shut down in less than a year (including 50% of capacities within the EU

itself), and equivalent capacities were launched outside Europe, leading to significantly higher emissions. Chinese production, which is imported against the backdrop of reduced local production volumes, is 2.5 times more carbon-intensive than European zinc production; 2.8 times more for aluminum, and 3.8 times more for silicon. Calculations suggest that the substitutive import of aluminum to Europe has already resulted in an increase in CO₂ emissions by 6 – 12 million tons in 2022.

The industry body also calls for consistent financial aid under the CO₂ emission compensation scheme. The scheme allows national governments to award compensations to energy-intensive industries, assisting them in offsetting some of the costs related to high carbon prices they must pay due to the Emissions Trading System (ETS). The measure should foster the continued ramping up of the production of non-ferrous metals, battery metals, and others required in large volumes for European grid infrastructure, electric vehicles, solar panels, wind turbines, and hydrogen electrolyzers.

Meanwhile, substitutive imports from China are increasing. This is particularly striking considering that China imposes export tariffs on aluminum. Nevertheless, in the first five months of 2022, according to the International Aluminum Institute, primary aluminum production in Europe in May declined by 14% compared to the same period last year. In other parts of the world, it grew by 1.2%. Concurrently, the level of aluminum reserves in Europe is at historical lows, leading to a sharp increase in the price of this metal in the region.

As the production of aluminum in China increases, so do the emissions of carbon dioxide. Aluminum production in China grew by 5% in 2020, emitting more than Indonesia. Given that primary aluminum production in China largely relies on coal-powered electricity, it leads to CO₂ emissions (667 million tons in 2020). [98]

According to the International Aluminum Institute [99], the power consumption for primary aluminum smelting in China for 2021 showed that the share of coal in energy output for the power consumed in primary aluminum smelting stood at 82% (426.5 GW), which is 2% more than in 2020. Hydroelectric power and other renewable sources accounted for 16% and 1.3% respectively.

In the EU for 2021, the share of coal in energy output for power consumed in primary aluminum smelting was 1.1%, while hydroelectric power accounted for 92.6%.

Meanwhile, many members of Eurometaux, whose productions maintain higher environmental standards, face production crises.

ArcelorMittal is shutting down two plants in Germany. The disproportionate rise in energy carrier prices significantly affects the competitiveness of steel production. This is compounded by weak market demand, negative economic outlooks, and consistently high

CO2 emission costs in steel production, rendering EU trade protection measures less effective.

Alcoa announced on its website in 2022 a reduction of production capacity at its Lista plant in Norway by one-third to mitigate high energy expenses. The Lista plant operates three production lines with an annual nominal capacity of 94,000 metric tons. The reduction of one line, or about 31,000 metric tons, will commence immediately and is expected to conclude within 14 days. The plant currently experiences fluctuating energy prices, surpassing \$600 per megawatt-hour. However, the energy situation is anticipated to improve in the fourth quarter of 2022, due to an agreement with energy company Statkraft, which will provide more predictable energy costs for the remainder of the year and into 2023.

Speira has decided to reduce primary aluminum production at its Rheinwerk plant in Neuss by 50% until further notice, scaling back the annual output to 70,000 tons of primary metal. This decision was instigated by the surge in fuel prices in Germany.

In response to the declining demand for aluminum billets in Europe, Hydro has decided to partially reduce aluminum production at its Hydro Karmøy and Hydro Husnes plants in Norway.

“The extraordinary situation in the European economy and the energy market is causing market uncertainty and a decrease in demand for our aluminum products. Even though 50 percent of the primary aluminum production capacities in Europe were reduced last year, the recent drop in demand is leading to stockpiling, forcing us to take decisive measures,” commented Eivind Kallevik, Executive Vice President and Head of **Hydro Aluminium Metal Division**.

The largest aluminum plant on the continent is owned by **Aluminum Dunkerque Industries France**. According to an official announcement, there will be a 22% production cut starting next Monday. This is in response to the relentless rise in electricity prices. This move is part of an overall trend of reductions in this industry. CEO Guillaume de Goys emphasized that the process of shutting down part of the production boilers is planned to be completed by October 1st.

The current challenges of **lzchem Group AG** in Trostberg remain consistent and signify substantial issues for the company. High energy prices and complications in regulation and registration by the European Commission and its agencies, including the European Chemicals Agency (ECHA), continue to be significant factors that can have grave and long-term repercussions. Another major aspect exerting pressure is the European Union’s excessive bureaucracy, including its comprehensive ‘Green Deal’. Excessive regulation in the chemical industry, as well as the inefficiency and complexity of registration processes, often result in avalanches of legal uncertainty and massive financial barriers.

Alzchem Group AG produces carbide, the foundational material upon which the company's vertically integrated production is built. Calcium cyanamide, derived from this base component, also forms the foundation for a multitude of highly specialized chemical products. These products are crucial across several critical industries, such as pharmaceuticals and automotive manufacturing, playing an integral role in their seamless operations. This is the sole vertically integrated production in Europe following the NCN chain, and with it under threat, there's an increasing reliance on Asian suppliers, a dependency that has recently come under political scrutiny.

On November 22, 2022, **Glass Alliance Europe** issued a written appeal, urging the EU to take immediate and decisive measures in support of the glass industry. The cause for the sector's significant challenges, as mentioned in the appeal, is the energy crisis in Europe, which poses a grave threat to the glass industry and its value creation chains.

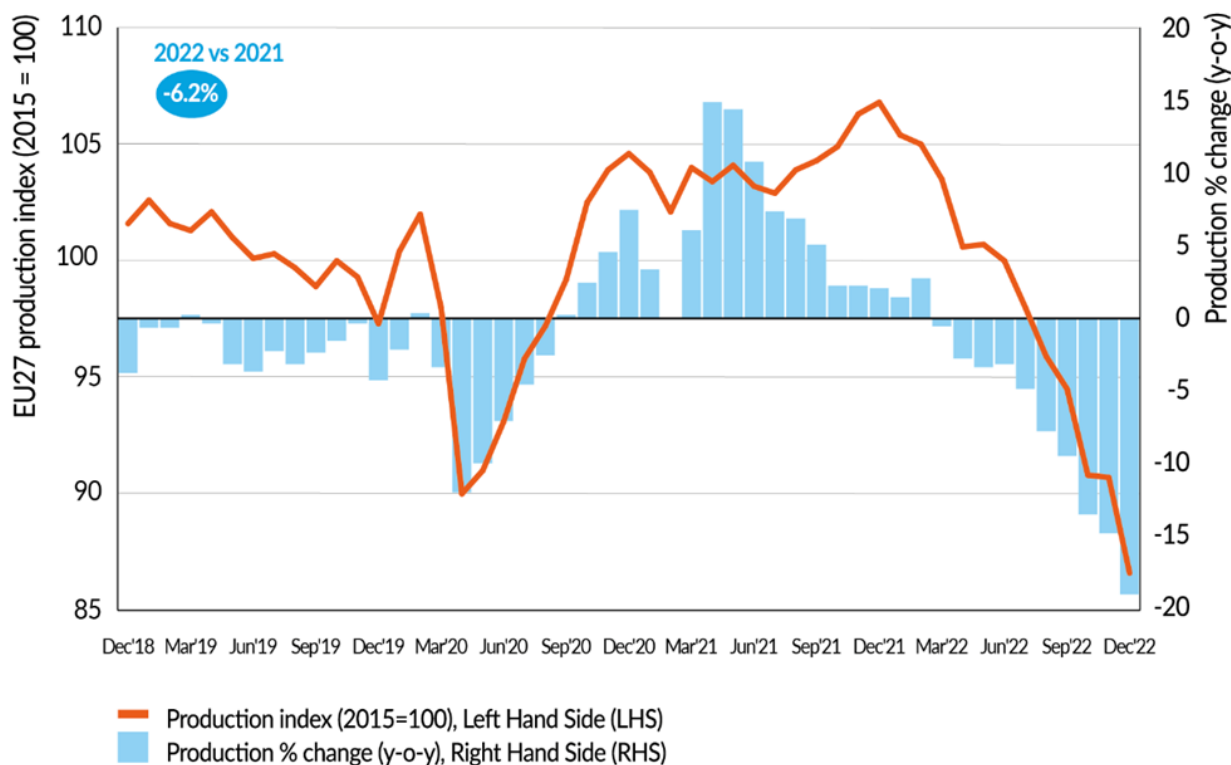
The glass industry annually consumes 4.5 billion m³ of natural gas. This accounts for 70 – 80% of the total energy required for glass production, with the remaining being sourced from electricity.

Glass manufacturing is a continuous high-temperature process. Furnace temperatures range between 1000°C to 1600°C and are maintained for durations spanning 10 to 20 years. Halting energy supply to these furnaces is not an option due to the risk of equipment damage.

The energy costs in glass production typically represent 20% to 35% of the production costs. However, during the current energy crisis, this figure has seen a significant surge, gravely affecting the global competitiveness of European glass manufacturers. The targeted support measures currently implemented by the EU for sectors like the glass industry are insufficient in addressing this situation.

The production of chemical products is the most energy-intensive process, followed by metal production and processing, coke-chemical production, mineral oil refining, and the production of glass, glassware, ceramics, paper, and cardboard.

EU27 chemical industry production



Source: Cefic Chemdata International

A paradoxical situation has emerged. The EU aims to reduce its dependence on Russia and its energy resources, leading to rising energy prices in Germany in 2022. This, in turn, made fertilizer production in the EU too expensive, leading to a partial halt of fertilizer production in Europe. This deficit was partly compensated by imports, with the EU increasing the import of Russian fertilizers fivefold compared to the previous year. Russia's share in EU fertilizer imports is 19%.

Evonik, based in Essen and specializing in chemical production, reported a significant decline in profits in the second quarter of the year, related to the ongoing challenging economic situation. Germany and the entire European continent are in recession, and China's economy is not recovering as expected. The group's sales fell 19% to 3.89 billion euros in the second quarter compared to the previous year. Volumes decreased by 9% and prices dropped by 5%. To protect profits from the second half of 2022, Evonik implemented cost-saving measures, including not filling vacant positions, reducing the use of external service providers, and limiting business trips. [101]

Due to high gas prices in Europe, the Norwegian company **Yara** decided to reduce production at several of its plants. These plants have an annual capacity of 1.7 million tons of ammonia and 0.9 million tons of finished fertilizers. The fertilizer supply crisis in Europe continues to worsen, especially after Yara International ASA announced a cut in ammonia production in

the third quarter due to soaring natural gas prices. This exerts additional pressure on food inflation. [102]

High natural gas prices and the introduction of a gas tax from October 1, 2022, have significantly impacted the production of agrochemicals by **SKW Stickstoffwerke Piesteritz GmbH**. As one of the largest energy-intensive companies in Germany, the fertilizer manufacturer SKW Piesteritz faced exceptionally high gas prices. This led to a temporary halt in portions of production, and the company anticipates additional challenges in the nearest future. [103]

Due to the sharp increase in natural gas prices and, as a result, a significant increase in fertilizer production costs, the company **Achema** decided to temporarily halt its plant operations from September 1, 2022. The plant continues to produce resins and technical gases. Achema CEO, Ramūnas Miliauskas, notes that such market conditions force many Western fertilizer manufacturers to halt their production as well. High natural gas prices significantly increase production costs, making Achema's products less competitive compared to products from American and Russian manufacturers. [104]

Due to record natural gas prices, which is the primary raw material for the Polish agrochemical company **Grupa Azoty Zakłady Azotowe Kedzierzyn**, the company's board decided to reduce plant operation to a minimum, reducing its load to 43% from August 23, 2022. This emergency situation is due to exceptional events on European stock exchanges and historically high natural gas prices. [105]

Due to the high cost of electricity and economic factors, the special chemicals manufacturer **Lanxess** is considering closing two production plants located in Krefeld-Uerdingen. In particular, the production of hexane oxidation, known for its high energy intensity, is expected to be phased out by 2026. The M-Dax group from Cologne announced this on August 4, 2023. It is also worth noting that the production of chromium oxide in the same location has also been scaled down over several months. In the second quarter, sales dropped, reaching 78.11 billion euros, while the profit (EBITDA) decreased by almost 58%. The group attributes this to the ongoing low demand in many customer sectors where stock reductions are currently observed, as well as to declining sales prices. China, the world's largest chemical market, also did not provide support in stimulating demand. [106]

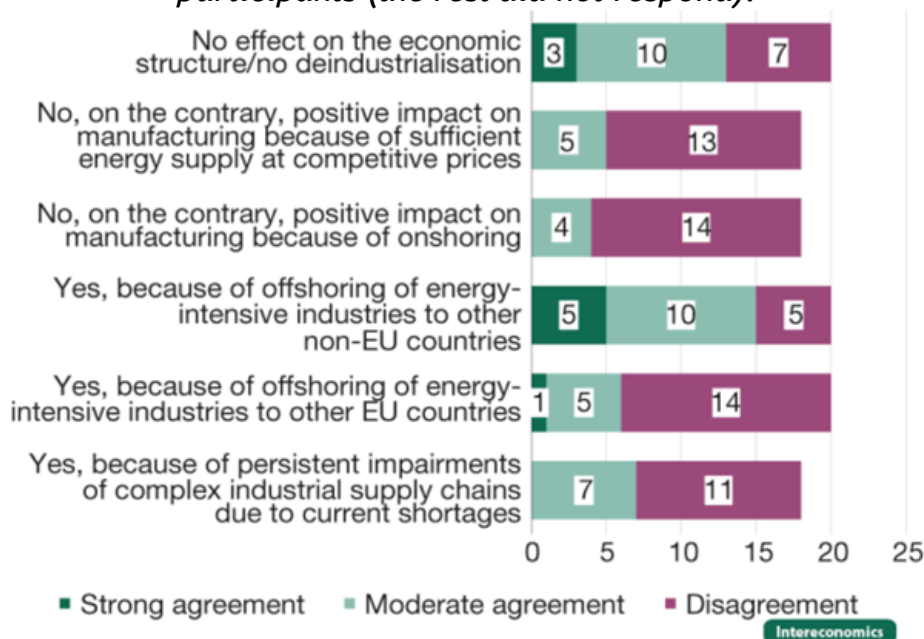
Trends in the Relocation of the EU Enterprises

Facing the escalating economic competition from China and an increasingly protectionist United States, European leaders are openly sounding the alarm about the proliferation of ‘deindustrialization’, affecting the entirety of the continent’s manufacturing sector. Thierry Breton, the Commissioner for the European Internal Market, has prioritized efforts to bolster Europe’s global competitiveness. He believes that the soaring energy prices are having a detrimental impact on both household economies and industrial supply chains. Such dynamics are catalyzing the migration of industrial capacities to the USA, China, and other countries, concurrently diminishing Europe’s potential for job creation and export opportunities. The adverse repercussions of the European Union’s economic conditions on energy-intensive industries and their relocation outside of Europe may lead to a decline in the manufacturing sectors.

The ongoing crisis is only partially reflected in statistics as companies employ survival strategies, forgoing long-term competitiveness. The true extent of the damage will become apparent in the coming years.

A survey among members of AIECE – Association of European Economic Research Institutes regarding the risk assessment of deindustrialization in Europe revealed that over half do not believe that the current energy issues and the associated price effects will have a lasting impact on the economic structure of their own countries. Seven out of 20 institutes from countries with a high proportion of industry: Austria, Germany, the Netherlands, Belgium, and France see a threat in deindustrialization. [108]

Assessment of the risk of deindustrialization in Europe, number of AIECE participants (the rest did not respond).



Fifteen institutes from Austria, Belgium, Denmark, France, Germany, Italy, the Netherlands, Slovenia, Hungary, and Norway recognize the threat of structural changes in a scenario of massive relocation of European companies. The majority of the surveyed institutes do not anticipate reindustrialization in their own country.

The factor of energy security is not the only one, but it is a key element in the decision to relocate production. As gas prices in Europe, despite a recent decline, still remain about six times higher than the average prices over the previous 10 years and are more than four times higher than in competitor countries, such as the USA, there are concerns that major manufacturers will move their operations outside of the EU, while smaller businesses might cease to exist.

Warnings from the business community, represented by chambers of commerce, contain calls for coordinated actions at the EU level to rescue the manufacturing base. France demanded the introduction of a new all-encompassing 'Made in Europe' strategy. In response to the calls from industry associations, at the height of the energy crisis, Germany, as the largest manufacturing hub, allocated 200 billion euros for a business and household support package and capped the prices that industrial consumers pay for gas and electricity. France announced a new bill aimed at stimulating the restructuring of 'green' industrial sectors.

However, despite the support measures, the competitiveness of EU companies collapsed with energy accessibility in 2022 due to the record surge in energy carrier costs resulting from the volatility of gas prices following Russia's military invasion of Ukraine. Continuing business in Europe became significantly more complicated for the majority of energy-intensive industries, as well as for small and medium-sized businesses, which were unprepared for the exponential increase in costs. Against this backdrop, an extensive US subsidy package for the American 'green' industry stimulates business relocation, primarily influencing sustainable development and the transition to green energy.

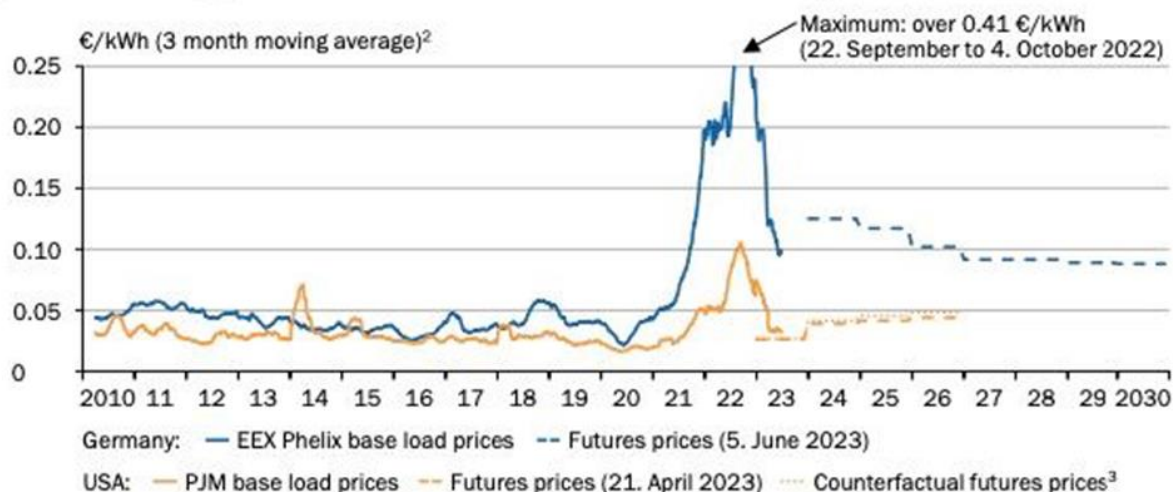
Many French companies have chosen to place their operations outside of Europe in order to maintain competitiveness. The energy crisis is particularly felt in sectors such as glass, chemicals, metals, fertilizers, pulp and paper, ceramics, and cement. These industries employ 8 million people. [109]

In France, there has been a recorded increase in the number of jobs abroad, while employment figures in the industrial sector within France itself are declining compared to other European countries. France has been more severely impacted by the relocation of manufacturing sites to the extent that employment in the industrial subsidiaries of French groups abroad corresponds to 68% of employment in the industrial sector of France, compared to 44% in the UK, 35% in Germany, 27% in Italy, and 10% in Spain. [110]

According to a study by the Observatoire des territoires, in 2017, only 13.4% of France’s working-age population was employed in the industrial sector. This shows a decrease of 17 percentage points from 1999 (when the figure stood at 30.2%) [111].

The United States is adopting a protectionist economic policy that potentially could lead to a further shift of energy-intensive European companies out of the EU. A central initiative contributing to this dynamic is **the Inflation Reduction Act (IRA)**. This act alone accounts for between a quarter to two-thirds of the cumulative economic benefits resulting from the expansion of shale gas production, which accrued approximately 1.4 trillion USD between 2008 and 2017. At first glance, the reduction in energy costs due to the IRA might seem to have a relatively minor impact on US production and the relocation of industries. However, when combined with the existing disparities in electricity prices between the US and Germany, the collective impact becomes determinative [112].

Comparative Dynamics of Gas Prices in the USA and Germany:

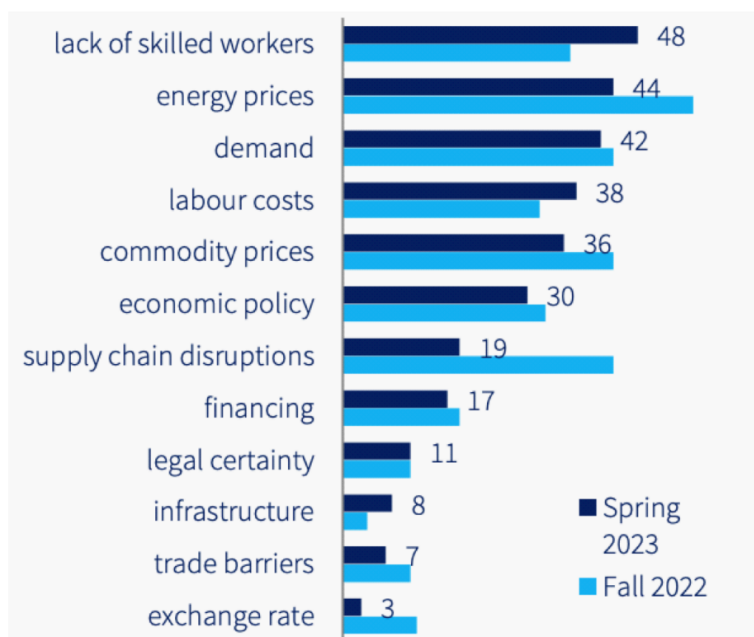


The American Chamber of Commerce in Germany (AmCham Germany) aims to expedite the relocation of industries to the American domain and supports the intentions of many European companies to relocate, seek additional suppliers, alternative markets, and locations.

AmCham Germany notes that in North America, companies predominantly anticipate economic growth in their regions (a balance of twelve points after previously being negative at minus 21 points). Despite persistently high inflation rates and rising interest rates, the US economy remains resilient. Against this backdrop, economic expectations in Europe continue to be in negative territory.

Reasons for relocation include uncertainty regarding energy supply, high energy prices compared to the rest of the world, and restrictive monetary policies that limit economic prospects (a balance of minus six points after previously being minus 41 points). [113]

Risks for German companies in the Eurozone in percent, multiple answers possible



In the EU countries not part of the single currency zone, as well as in Norway, Switzerland, and the United Kingdom, pessimistic expectations are even more pronounced (a balance of minus 27 points, up from minus 70 points previously). Consequently, as in the previous survey, companies based there have the lowest expectations on a global comparison. Here too, high energy prices are weighing heavily on the economy. In Eastern and South-Eastern Europe (excluding the EU, but including Turkey), the economic impacts of the Russian war in Ukraine are particularly noticeable (a balance of minus seven points, up from minus 61 points previously). In Turkey, the repercussions of the February earthquake hinder economic development.

The search for locations with suitable infrastructure for new branches or production sites poses challenges for most companies facing diversification issues. Key locational factors include, for instance, the availability of skilled workers, the framework conditions of economic policy, legal certainty, and the cost of electricity. Identifying appropriate sales or procurement markets is a complex task for 29 percent. [114]

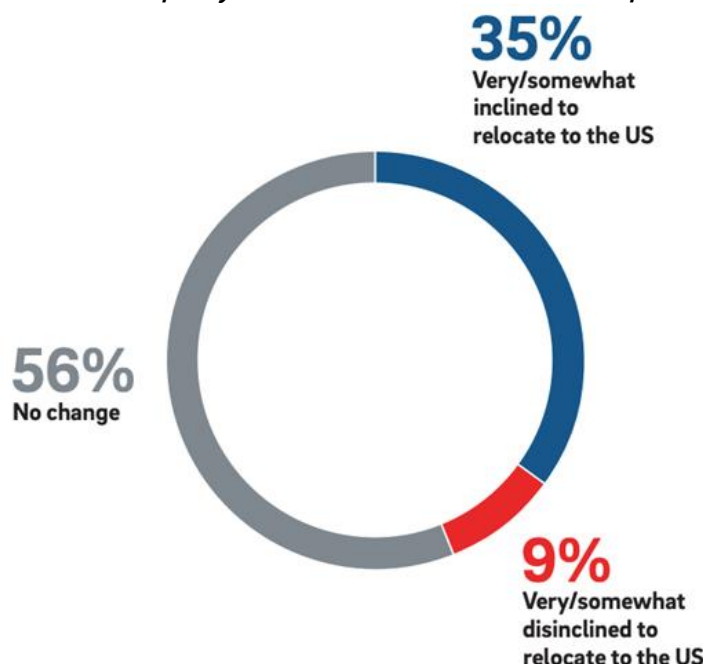
In China (53 percent), North America, and the euro area (51 percent each), companies are confronted with the challenge of finding suitable suppliers and business partners.

Regarding the main question of the IHK energy barometer conducted in Germany at the beginning of 2023: ‘How do you assess the impact of the energy transition on the competitiveness of your company?’ – about 3,500 companies responded with an unprecedented negative result. In the industry, plans for departure are intensifying. **Almost a third of industrial companies (35%) are planning, executing, or implementing capacity**

relocations abroad or production limitations at home as a response to the framework conditions of energy policy. This is twice as much as last year. [119]

Data from the Transatlantic Business Barometer 2023 [115] also indicate numerous factors of a complex economic environment. Only about half of the American companies in Germany expect revenue growth in 2023.

Considering the recent surge in energy prices in Germany, does the U.S.'s energy security make your parent company more inclined to relocate production to the U.S.?



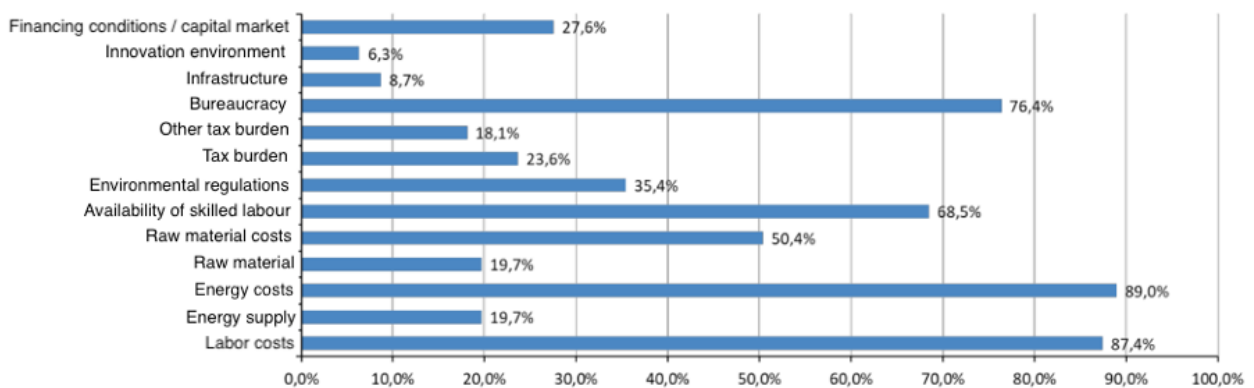
Only one-third of American firms continue to view Germany as a conducive location for business operations, with approximately one quarter of respondents foreseeing a further decline in the country's business environment. In a recent survey, a significant fraction, constituting one-third of German enterprises, indicated an inclination to shift portions of their manufacturing to the U.S., attributed largely to the latter's enhanced energy security and favorable pricing dynamics.

In the economic assessment published by the Bavarian Economic Association, Vereinigung der Bayerischen Wirtschaft [116] in the summer of 2023, the findings resonate with the sentiments captured in the winter iteration of the Transatlantic Business Barometer. **The deteriorating macroeconomic conditions in the region are perceived as a looming threat to Bavaria's industrial landscape.** Remarkably, 17.5% of businesses, acknowledging this adverse trend, have already transitioned parts of their production overseas in the preceding twelve months. An additional 36% are deliberating similar strategic realignments. This negative trajectory notably impacts domestic investment vigor: a substantial 58% of firms, particularly in the mechanical and electrical engineering sectors, echo this sentiment.

This primarily affects new investments. A significant 82% of enterprises are retrenching their investment commitments in light of the evolving challenges, with 11% choosing to abstain from new investments entirely. 45 percent of companies are instead investing abroad, while 55 percent have no investments at all.

Causes of deteriorating on-site conditions

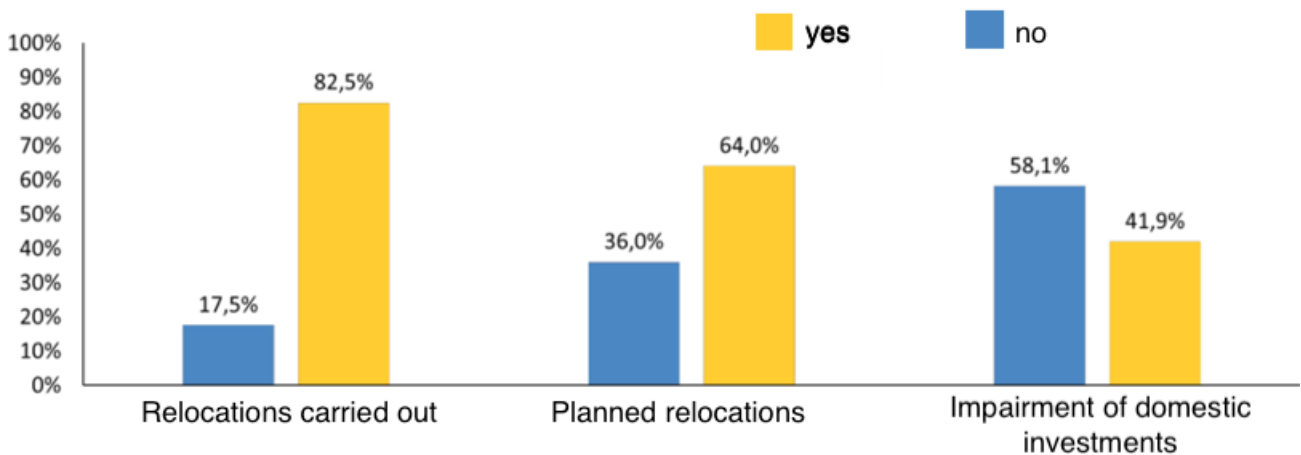
Areas in which the on-site conditions have deteriorated. Response share, multiple answers possible



In discussing the challenges of operating in Germany, beyond the predominant factor of high energy costs, experts highlight **the cost of labor, an underdeveloped digital infrastructure, and a shortage of skilled personnel.**

Reaction to deteriorating on-site conditions

Response share; companies believing that on-site conditions have deteriorated



A complex regulatory environment for business is another factor driving companies to consider relocation. Hanns Peter Spaniol notes that decision-making processes in China are swift and streamlined. [117]

IndustriALL emphasizes the inadequacy of the support measures, pointing out that European industry, both in energy-intensive and advanced sectors, is undergoing an existential crisis, posing a severe threat to 8 million jobs. The steelmaking sector has been

severely affected due to a sevenfold increase in costs and raw material shortages. Europe has become a net importer of chemicals in both volume and cost due to rising energy prices. [120]

The broader impact beyond the energy-intensive sectors was highlighted in November 2022 when **Volkswagen** warned that Europe is no longer economically competitive in many areas, especially concerning electricity and gas costs. This was a significant blow to the automotive sector, which employs 13 million people across the continent. Moreover, Volkswagen scrapped plans to build a battery plant due to high electricity prices and announced a \$2 billion plant construction in South Carolina in March. Companies like BMW, Panasonic, and Enel are also responding to the IRA, expanding their operations in the American market. [121]

Amsterdam-based chemical company OCI has announced plans to invest in its ammonia production plant in Texas. Tesla halted its battery production plans in Germany, influenced by the benefits of the IRA.

The German group Merck plans to invest \$110 million in expanding production capacities for disposable technology products in Wuxi, China, over the next six years. The company also intends to invest over 1 billion yuan in semiconductor base development.

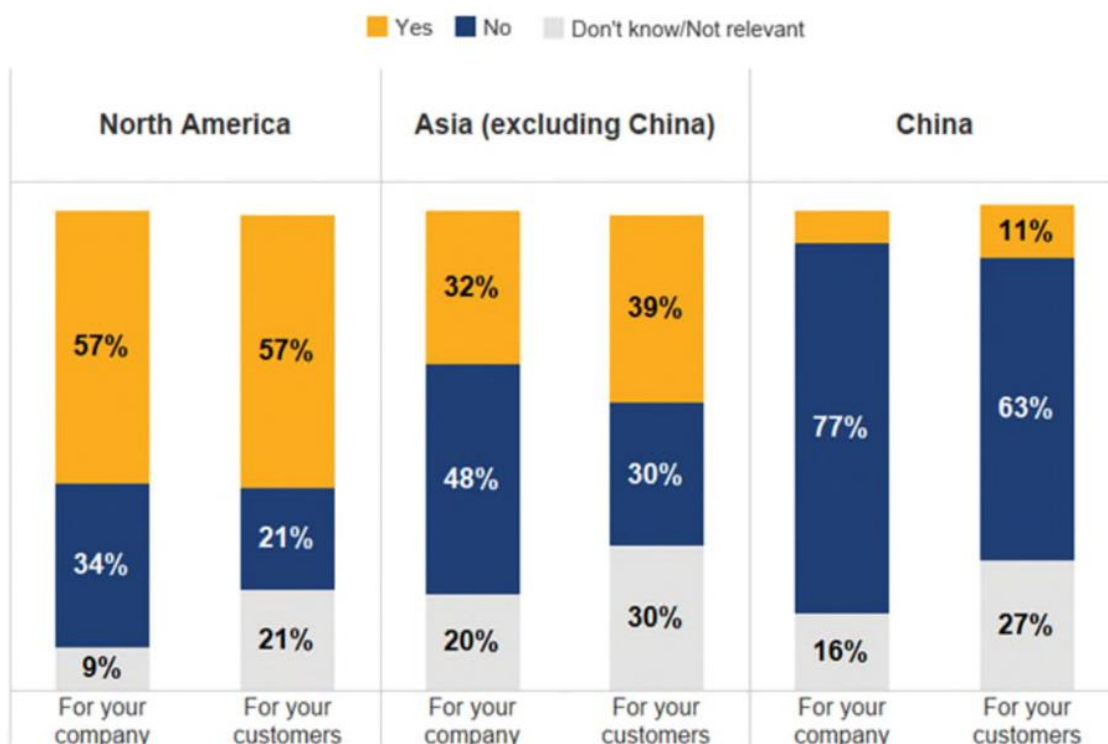
Many companies view China as an attractive venue for further expansion, largely due to the stability in energy supplies and their reasonable cost. In the foreseeable future, this country will become the world's most significant economy. China possesses the most robust resource positions in critical raw materials and production capabilities in various sectors. However, China's industrial policy suggests that these capabilities can primarily be realized only if the respective company maintains a local presence.

At present, China, alongside the United States, has signaled its readiness to optimize the business environment to support European industries with the intent of bolstering investments. In August 2023, China's State Council published a collection of views on stimulating direct foreign investments into China. The document, titled 'State Council Opinions on Further Optimization of Conditions for Foreign Investments and Intensifying Efforts to Attract Foreign Investments' [118], encompasses 24 proposals aimed at drawing foreign investments. These proposals range from enhancing intellectual property rights to facilitating cross-border data flows.

In 2022, there was **an unprecedented surge in investments from European companies into China**. According to the deputy director of the Chinese Academy of International Trade and Economic Cooperation's Institute for International Market Studies, this is not a direct consequence of the energy crisis in Europe, given that supply chain alterations often take years to manifest. Nevertheless, the trend suggests that these companies are penetrating the Chinese market in an effort to stabilize their supply chains.

The results of an ERT survey conducted in May of this year indicate the attractiveness of IRAs in the eyes of industrial companies. Around 57% are willing to consider the U.S. as a relocation destination while some are willing to relocate their investments to China. However, most companies are cautious about the prospect of such a move. More than 80% of companies have no intention to entrust their future to the Chinese market. Geopolitical tensions are perceived by business as the most important factor threatening competitiveness. [13]

Do you expect shifts in investments and/or operations away from Europe to these regions within the next two years?



Note: 56 CEOs responded to this question.
Source: The Conference Board Measure of CEO Confidence™ for Europe by ERT, 2023 H1

In 2023, **BASF** announced its plan to shut down one of its two ammonia production plants at its Ludwigshafen site. This move is part of the company’s cost-cutting initiatives, as it grapples with elevated electricity expenses. By 2030, BASF is set to invest up to 10 billion euros in constructing an integrated base in Zhanjiang. The realization of the company’s plans will lead to increased production in China, culminating in the loss of 2,600 jobs.

Additionally, the **BMW Group** has expanded its manufacturing presence in China with the inauguration of the Lydia plant in Shenyang. This project, with a cost of 15 billion yuan, currently stands as BMW’s most significant investment in the Chinese market.

Challenges of Transitioning to Renewable Sources amid the Industrial Production Crisis

IRA Impact on the Prospects of Renewable Energy Development in the EU Countries

The 2022 United States Inflation Reduction Act (IRA) not only cast doubt on Europe's image as a leader in green energy but was also perceived by the international community as a **significant step in demonstrating the U.S.'s readiness to disregard World Trade Organization (WTO) rules**. This is reflected in the subsidies conditioned by Local Content Requirements (LCR), which are prohibited by WTO rules, and as a result, the multilateral trading system and the WTO may be weakened in the long term. Much like China, the U.S. adheres to an industrial policy strategy solely oriented towards its own interests. Many political experts and European leaders perceive actions by American authorities as undermining transatlantic solidarity. The U.S. push to edge Europe out of the renewable energy market directly impacts the EU's energy sovereignty and its prospects for reindustrialization in the foreseeable future.

The primary aim of the IRA is **to make the U.S. the favored location for new investments**, promoting productivity growth through technology investments, thereby increasing the disparity with the EU. Other objectives of the industrial policy are to ensure U.S. hegemony as the top energy producer in the long run, support the reindustrialization of the U.S. economy, especially in distressed rural communities, and provide social and labor protection. [122] The U.S. has a greater capital import need compared to the EU, and the motivation to attract European investments could largely stem from the higher savings rate in the EU relative to investments.

Access for German companies to the U.S. investment and grant market, which is highly dependent on energy price volatility, necessitates a partial relocation of production to the U.S. Enhanced U.S. cooperation with German firms would have adverse implications for Germany as an industrial hub, as it would lead to job losses and migration of specialists. Industry accounts for approximately 27% of Germany's economy and 18% of the U.S. economy. Over the past 15 years, Germany's economy has grown by 19%, reaching \$4.1 trillion, whereas the American economy expanded by 76% to \$25.5 trillion. The expertise and technologies of German industry combined with the developed American investment market and predictable energy supply represent both an opportunity and a threat to Europe's industrial development.

Preferences for clean energy manufacturers are substantially more significant and accessible. Tax credits for wind, solar, and other clean energy in the United States include the Investment Tax Credit (ITC), covering 30% of the costs for investing in new clean energy production, and the Production Tax Credit (PTC) provides a credit of \$26 USD per MWh for all clean energy production from new installations.

All iron and steel utilized as construction materials in projects must be manufactured in the United States. At least 40% of the components produced for the project are sourced and manufactured in the U.S., a figure set to rise to 55% by 2026. The lack of focused attention on these sectors in the development of renewable sources in the EU also represents a strategic oversight.

The **steel and aluminum markets of the EU**, which exhibit signs of deindustrialization, are also under pressure due to the IRA, as these products are crucial raw materials to produce clean energy and vehicles. They account for 2% of the total EU exports to the U.S. The local content requirements incorporated in the IRA are likely to result in a domestic steel deficit, and certain U.S. market segments may become inaccessible for steel and aluminum exporters from the EU.

If a recession doesn't curtail demand for emissions-reducing policies, the ETS (Emissions Trading System) and CBAM (Carbon Border Adjustment Mechanism) will drive up the cost of steel and aluminum in Europe. Consequently, this might make investments in clean energy power plants and vehicles more expensive, rendering the EU less competitive.

According to the Rhodium Group [123], the total climate-related investment in the IRA (Infrastructure Reinvestment Act) will range between \$355 billion to \$552 billion from 2022 to 2031. The Recovery and Resilience Fund (RRF) offers an alternative industrial policy tool for green and digital transitions. With a budget of €800 billion – €200 billion earmarked for the green transition – the RRF is roughly comparable in size to the IRA. [124] The European Commission introduced the Strategic Technology for Europe (Step) platform in June, aiming to channel a non-comparable €10 billion towards digital and green transitions and to simplify regulatory procedures for the Net Zero Act and the Critical Raw Materials Act, both of which streamline the regulatory environment.

Nederlandsche Bank NV's [125] estimates suggest that the EU's total climate policy expenses are four times higher than the IRA's investment capabilities for 2023-2027. However, despite the more targeted nature of the European package, subsidy procurement procedures are more bureaucratic, whereas **the IRA's tax incentives expedite funding access.**

Thus, **the US's strategic advantage lies in the comprehensive amalgamation of the IRA**, supply chain independence, and energy security. These conditions contrast with the high uncertainty level facing the European industrial sector and the volatility of the EU energy market.

IRA subsidies might **impact competition in the EU's renewable fuel market** through direct and indirect subsidies. Between 60 – 80% of clean hydrogen production costs are attributed to electricity, implying a substantial indirect subsidy effect. The IRA subsidy will likely lower

costs in the US below the production costs of most EU countries. There are theoretical scenarios where hydrogen produced in the US could be sold at competitive prices in the European market, despite transportation costs. However, the real impact might be on refined electric fuel, which could become extremely competitive in the EU market.

BusinessEurope (Confederation of European Business) in its Reform Barometer study points to two long-term issues that deter investment in the EU: the regulatory burden and a long-term prospect of energy price dynamics rising faster than its major competitors. Notably, wholesale gas prices in the EU in the summer of 2025 are more than four times the pre-Covid level, while in the United States, it's less than twice the pre-Covid level. According to BusinessEurope surveys, the IRA serves as a significant factor attracting investments away from the EU. [126]

In a survey conducted by FTI Consulting, two-thirds (67%) of the investors feel that both the EU and the UK haven't done enough to remain competitive in transition technology sectors. 42% of respondents stated they would be more inclined to redirect capital to the United States from other regions following the introduction of the IRA. [127]

The IRA might influence the automotive industry to a larger extent, where the transition from internal combustion engines to electric vehicles is perceived as risky in the European context due to low-profit margins. Additionally, the US boasts more diversified supply chains, including for critical raw materials.

The IRA incorporates substantial financial incentives, like tax breaks for purchasing electric vehicles (EVs) and investments in renewable energy equipment, contingent upon specific domestic content requirements. In the EU, particular concern regarding the IRA arises from tax incentives for electric vehicles, which require the final assembly to take place in North America, and a significant portion of battery components and minerals to be manufactured or assembled in North America (components) or in a country with a US Free Trade Agreement (minerals). For renewable energy development investments, the IRA provides an additional tax credit if a certain proportion of components are produced in North America.

The Centre for Economic Policy Research (CEPR) has constructed non-linear effects of increased trade barriers and examined the endogenous response of producers and consumers in an interconnected global economy, focusing on the consequences of the IRA (Infrastructure Reinvestment Act) in supporting the electric vehicle (EV) market. 'Shocks' from domestic content requirements and from trade costs leading to reduced EV prices were analyzed, as well as from the external Total Factor Productivity (TFP).

The studies are based on four fundamental scenarios for the pace of the green transition. Global trade losses range from 0.2% (conservatively) to 0.9% (net-zero). However, sector-specific losses can be substantial in sectors targeted by the IRA, especially in the electro-

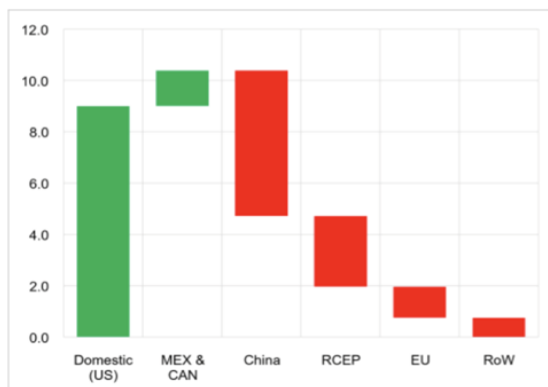
technical and optical equipment sector, where global trade losses reach 6% in the net-zero scenario.

US trade partners may lose access to the US market, and opportunities to redirect their production to other destination countries may become more restricted. According to calculations, the EU will lose between 10% and 45% of exports of electric and optical equipment.

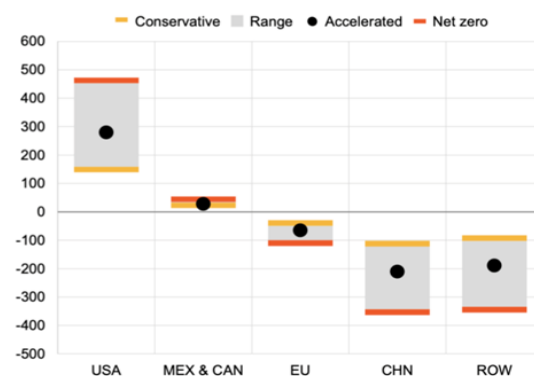
Due to the incentives of the IRA, there will be distortions in sectoral trade flows and a redistribution of production in ‘green’ sectors. Analyzing the consequences of relocating production capacities to the US, production losses for the EU are estimated to range from -0.5% to -3%. In the rest of the world, countries with a higher impact level of the USMCA, such as Malaysia and Vietnam, face larger production losses (with production losses of up to -18% and -13%, respectively, in the net-zero scenario). According to the authors, symmetrical countermeasures to the IRA, by increasing domestic production, will accompany a slowdown in the transition to a ‘green’ economy. [128]

Consequences of the IRA for US Trade Partners:

A) Market share of US electrical and optical equipment (percentage point changes from steady state, accelerated scenario)



B) Output (USD billion change from steady state, all economy)



The influence on deindustrialization in critical sectors of the ‘green’ transition has been highlighted by the competition of the U.S. in the market of critical raw materials (CRM). The encouragement and diversification of their extraction are among the stipulations set out in the IRA. This legislation effectively restricts a significant portion of the U.S. market from metals exported from the EU, marking a distinct contention for CRM given the anticipated future deficits, raising concerns. While the U.S. is not currently among the major producers of vital minerals essential for the transition to a ‘green economy’, imports from China play a relatively minor role in the overall structure of American supplies. It is these CRMs that will shape the future of high-tech industries and renewable energy, and consequently, the industrial potential of nations in the coming decades.

CRM's Significance for the Future of the EU's Industry

Wind power and solar energy are the prevailing technologies driving Europe's energy transition. There is a pressing need to expand the share of renewable technologies in the energy supply matrix by 2030. Nevertheless, if the EU aims to achieve a net-zero energy footprint by mid-century, rapid technology deployment is essential. However, the question of resource availability for the transition to green energy faces geopolitical complexities and fragile supply chains heavily reliant on China.

To meet the growing demand for 'green energy' technologies, the EU has legislatively identified a strategic priority for consistent supply of essential materials required for a carbon-neutral energy transition – Critical Raw Materials (CRMs).

Growing concerns about ensuring a resource base were officially reflected in the EU's CRM list published in September 2020, which highlighted 30 elements. The list includes rare earth elements (REEs) such as lanthanum, cerium, praseodymium, neodymium, promethium, samarium, europium, gadolinium, terbium, dysprosium, holmium, erbium, thulium, ytterbium, lutetium, scandium, yttrium, etc. Notably, neodymium, praseodymium, dysprosium, and terbium account for about 90% of the market value of rare earth elements indispensable in electric vehicles and wind turbines, hard drives, and smartphones. The significance of REEs for the green transition lies in their capacity to enhance material properties, add new attributes, extend product lifespan, and improve equipment energy efficiency. [129]

CRMs are also indispensable for high-tech industrial applications, including defense and aerospace industries. REEs are vital raw materials for a broad array of applications, ranging from metallurgy (metal refining and alloying), automotive and petrochemical catalysts, glass/ceramic coloring, phosphors (LEDs, compact fluorescent lamps, flat-panel displays), lasers, rechargeable solid-state batteries (Ni-MH), fiber optics, and more.

For the EU, **the supply of CRMs** is central to the future of industry due to severe energy resource shortages, low energy security, and the objective of decarbonizing the economy. REEs are essential elements in emerging technologies like solid-state fuel cells, superconductors, magnetic refrigeration, hydrogen storage, and high-efficiency permanent magnets. These magnets are crucial for various high-tech applications, from wind turbines and hybrid vehicles to HD-drives, speakers, and microphones for mobile phones. [130]

The European Green Deal aims to make Europe climate-neutral by 2050 by accelerating the transition to clean energy, among other measures. The EU's program to enhance resilience to critical raw materials is focused on ensuring access to the raw materials crucial for these transitions.

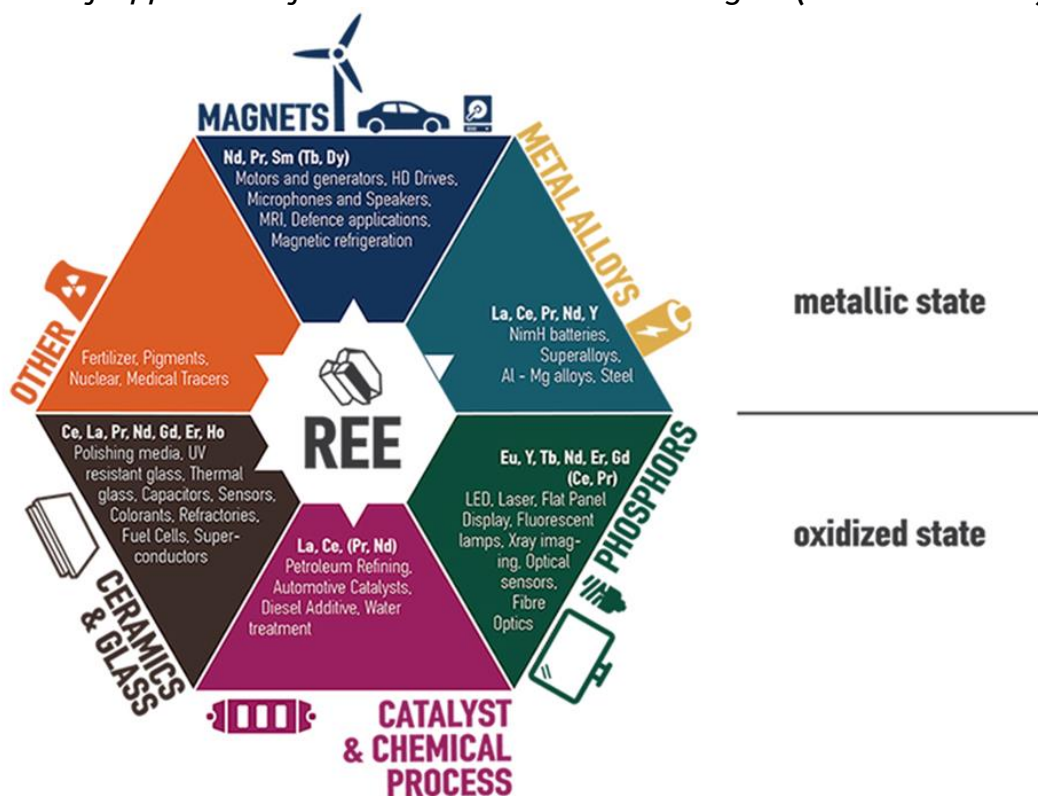
The COVID-19 pandemic underscored the EU's vulnerability regarding its dependency on global supply chains, especially concerning critical raw materials. This situation threatens to undermine the standard of living within the bloc and its commitments to emission reduction targets. As a result, the Commission has opted to promote import diversification, invest in waste processing technologies, and develop domestic mining, processing, and manufacturing capacities.

The European Critical Raw Materials Act (CRMA) is a natural extension of the climate objectives and was largely adopted in response to the IRA (International Raw Materials Act, presumably). The US's determination in the CRM sphere was viewed with concern by Europe. The CRMA aims to strengthen every phase of the European critical raw materials value chain and diversify EU imports to reduce strategic dependencies.

According to forecasts by the World Bank, global demand for critical raw materials is expected to show a 500% increase by 2050, therefore, creating a mismatch between the demand and the extraction of rare earth metals and other critical materials. Environmental issues, restrictions, and overall regional instability will adjust decarbonization plans.

Some automotive industry leaders warn that in the future, the most significant value-add will occur in raw-material-rich regions. Mercedes CEO Ola Källenius recently stated the urgency for trade agreements and raw material partnerships to ensure resource accessibility. This dynamic, combined with the evolving electric vehicle market, indicates a risk of further shifting European automotive production to China and the US. [131]

Areas of Application for REEs in Future Technologies (Source: Eurare):



The challenges of combating climate change necessitate profound socio-economic transformations. In these circumstances, **the European Union’s industrial sector is in dire need of expanding its energy capacities to address existential development challenges and avoid stagnation, especially amidst the transition of the European continent to renewable energy sources.** The attainment of technological sovereignty will hinge significantly on skilled professionals and the enhancement of capacities within Europe’s metallurgical and chemical industries. Achieving a balance between environmental objectives and the needs of domestic industries largely determines Europe’s ability to become a self-sufficient region in producing end-use equipment for power generation and precision machinery products. Otherwise, Europe’s current efforts to achieve energy independence from Russian gas could result in total dependency on China and the US for supplies.

Features of the International Rare Metals Market Development and the Intensification of International Competition

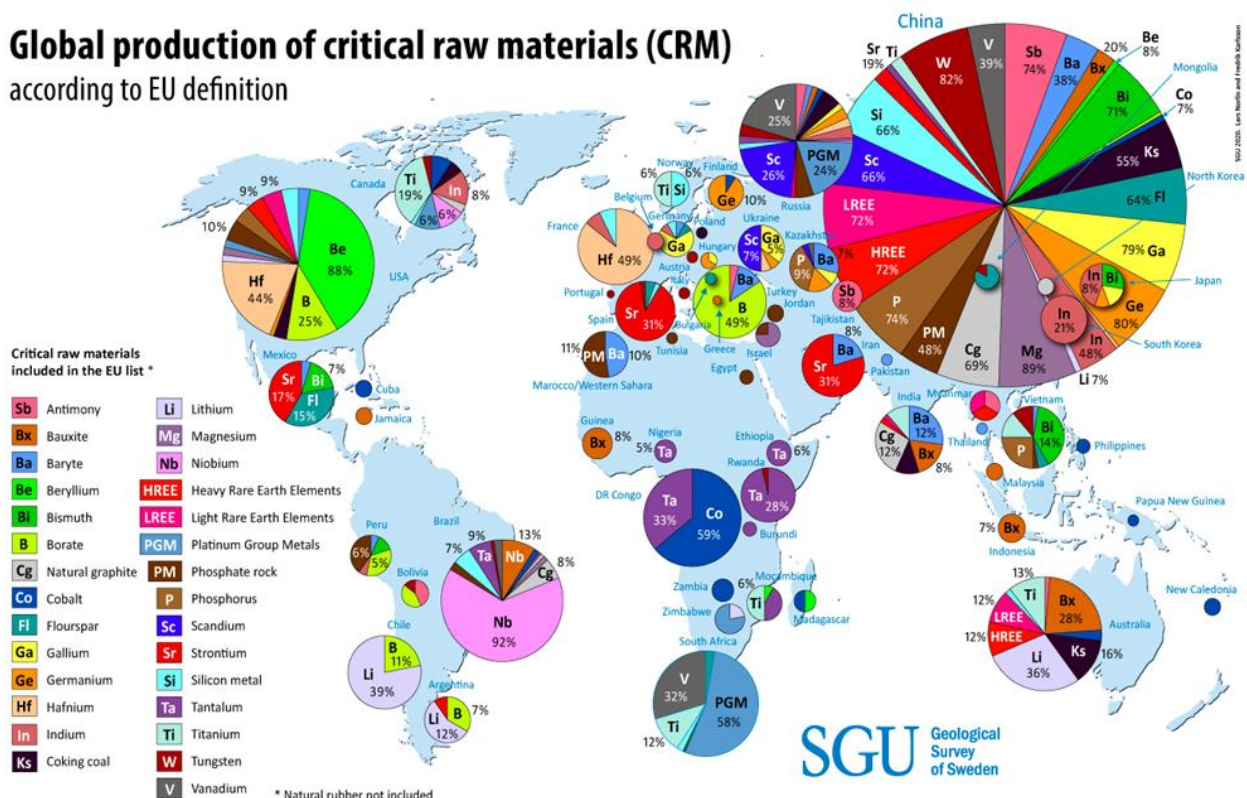
The tightening of markets and increasing instability of CRM supplies is the new reality in the era of transitioning to renewable energy sources. Solar power and wind generation, to meet the EU’s growing energy demand without critical deficits, are projected to increase their energy production volumes by sevenfold and threefold respectively by 2050. [132]

Based on current assessments, global demand for CRM could surge sixfold by 2040. Demand for lithium and cobalt may experience a ten to twenty-fold rise by 2050 due to electric vehicles. Estimates suggest that the demand for dysprosium and neodymium will increase from seven to twenty-six times over the next 25 years, attributed to the advent of electric vehicles and wind turbines. [134]

The United States Geological Survey (USGS) and the European Commission’s raw materials department are compiling and updating a map of rare metal production zones. According to the USGS data for 2022, China accounted for 70% of the world’s rare earth metal production, making it the primary producer. An infographic from the Geological Survey of Sweden is provided below. [133]

At the epicenter of the competitive struggle for resources of the new energy and technological cycle are China, the EU, the US, and Japan. Economic shifts, driven by the rising demand for CRM – particularly for rare earth elements – will have far-reaching consequences. They will alter supply chains and trade routes, fostering new geopolitical rivalries and alliances. Ultimately, these shifts will determine the EU’s global industrial share and geopolitical influence.

Global production of critical raw materials (CRM) according to EU definition



Two main regions can be identified where the interests of China, the US, and the EU clash, and where there are internal players and communities in the countries of CRM extraction, including rare earth metals:

Latin America. The International Resource Agency (IRA) has designated the strategic priority of the US to develop lithium and copper extraction in this location. China has been most successful in the region, thanks to investments in geological exploration, infrastructure development, and political partnerships. Chile and Peru are also among the free trade countries for the US and are major suppliers of copper. Chile supplies 78% of lithium. There may be further intensification of competitive confrontation with the EU, which is weaker among investors in this direction. China has also established a favorable position in Argentina, Chile, and Bolivia. The complex environmental situation related to the drying up of the Andes might lead to restrictive measures and intensification of the struggle for resources in the future. [135] An opportunity for development may arise from partnerships in utilizing green hydrogen.

Africa. Tensions in trade relations with China and the ongoing war of Russia in Ukraine prompted Western countries to turn to Africa for investment opportunities in 2022. The US, Australia, Canada, Finland, France, Germany, Japan, South Korea, Sweden, the United Kingdom, and the European Commission discussed the benefits of investing in clean energy in areas that already have the skills and experience to process rare earth elements within the country. This led to discussions on partnerships involving African regions. [136]

Top Green Mineral Country	Main Critical Mineral(s) Extracted
Democratic Republic of Congo	Lithium, Cobalt, Copper
Botswana	Copper, Nickel
Gabon	Manganese
Ghana	Bauxite, Manganese, Lithium
Guinea	Bauxite
Madagascar	Nickel
Mali	Lithium
Morocco	Cobalt
Namibia	Lithium
Nigeria	Lithium, Cobalt
South Africa	Copper, Nickel, Manganese
Zambia	Cobalt, Copper
Zimbabwe	Lithium

Sources: Mining Digital Magazine, Supply Chain Operations (2022); Statistica, Mineral Production in Africa (2022)

The Democratic Republic of Congo, being the most unique country in Africa, possesses more than 60% of the world’s cobalt reserves, which are essential for the production of electric vehicles. It has become a sought-after supplier for the automotive industry. In 2018, the government succeeded in raising the tax on cobalt production, citing the metal’s classification as ‘strategic’. This resulted in costs of \$180 million for the Swiss mining group Glencore.

For many years, the mining industry has been focused on obtaining a social license to operate as a measure to mitigate dissatisfaction and other social tensions at the operational level, primarily from local communities and other stakeholders. The exploitation of African labor becomes a ground for local conflicts with reputational damage in the eyes of end consumers

and determines the tension in trying to establish cooperation in increasing the extraction of REEs between the EU and African countries. The social approach to these issues will determine the quality and prospects of cooperation between regions. For instance, according to a study by the anti-slavery public organization Human Trafficking Search, thousands of artisanal miners, including children, are involved in manual labor in extracting toxic cobalt in the Democratic Republic of the Congo (DRC) under life-threatening conditions.

South Africa produces 71% of platinum, which is essential as a catalyst for hydrogen energy technologies. The IRA provides the US, coupled with cheap energy, ample opportunities to compete in electrolyte fuel for the EU domestic market and justifies the motivation for further expansion of the platinum market.

Currently, Canada and UK are leading in planning the development of alternative supplies to Chinese ones (about 80% market share) for the extraction of African neodymium. Although checks are currently underway, possible alternative sources are already known: the Gakara mine in Burundi, operated by the London-registered Rainbow Rare Earths, and the Songwe Hill mine in Malawi, operated by the Canadian Mkango Resources. [137]

Africa's potential in the field of CRM and REEs is largely untapped and is only subject to development, considering the low level of exploration, opening opportunities for European interests. However, conditions for geological exploration and investment are complicated by local bureaucracy. There are precedents where local authorities have revoked mining permits. And despite these complexities, numerous restrictive local policies, and rules that currently make project implementation extremely difficult, for the EU, partnership on the continent plays a strategic role, considering the global need for rare earth element reserves.

In 2022, a long-term European-African partnership for renewable energy sources (LEAP-RE) was launched—a 5-year program co-financed by the European Commission under the Horizon 2020 program, aimed at developing a long-term partnership between Europe and Africa in the field of research and innovation (R&I) in renewable energy sources. The program's total budget is relatively small and amounts to about 32 million euros, including 15 million euros from the European Commission for research projects. The African Union, with its company Africa Mining Vision (AMV), promotes the goals of local processing, striving to promote conflicting goals: creating added value and resource-saving industrialization, which can ultimately limit raw material exports.

Potential partnership with European companies in extraction faces a lack of capacities for processing, production, and industrialization. As a result, mined minerals are exported in their raw form or as concentrates to create added value in other countries outside the continent. This increases economic, logistical, and environmental costs. [139]

The factor of increasing political instability in the region determines the difficulties of long-term planning and high risks for investors. At present, spheres of influence of countries on the continent are undergoing revanchist attacks by Russia in alliance with China on democratic governments. In the past two years, there have been 7 revolutions on the African continent: in Gabon, Niger, Sudan, Chad, Mali, Burkina Faso, and Guinea.

While EU and US relations are already transitioning to a competitive phase in renewable energy, a ‘transatlantic raw material partnership’ was formed between them in March of this year to counter China’s dominance in the global market. This partnership aims to create joint supply chains for minerals, metals, and rare earth elements, using the combined resources and influence of both sides.[140]

China, with which European nations maintain a complex relationship, accounts for 98% of the European Union’s supply of rare earth elements and approximately 62% of its 30 designated Critical Raw Materials (CRMs). Numerous rare earth metals (REEs) are irreplaceable, and combined with the intricacy of their refinement process, this escalates the potential risks associated with their supply. These factors underscore the importance of diversifying these elements for the EU and exploring alternative agreements.

Beijing has set its sights on achieving dominance in green energy and electronics. To this end, China secures a competitive advantage through lax environmental mining standards, and export controls concerning rare earth elements and their semi-finished products, such as rare earth magnets.

Following the 2022 merger of three major mining conglomerates and two research institutes into the China Rare Earth Group, China is anticipated to amplify its stake in global supplies. The recently established state-owned enterprise, directly overseen by the State Council, is expected to bolster China’s influence over the prices of primary REEs, potentially causing disruptions to the global supply chain. [141]

China’s predominant, verging on monopolistic, share in the extraction and processing of 17 rare earth elements poses a significant supply risk for many countries. The European Centre of Excellence for Countering Hybrid Threats (Hybrid CoE) has noted an increasing trend of China resorting to economic coercion as a geopolitical power tool.

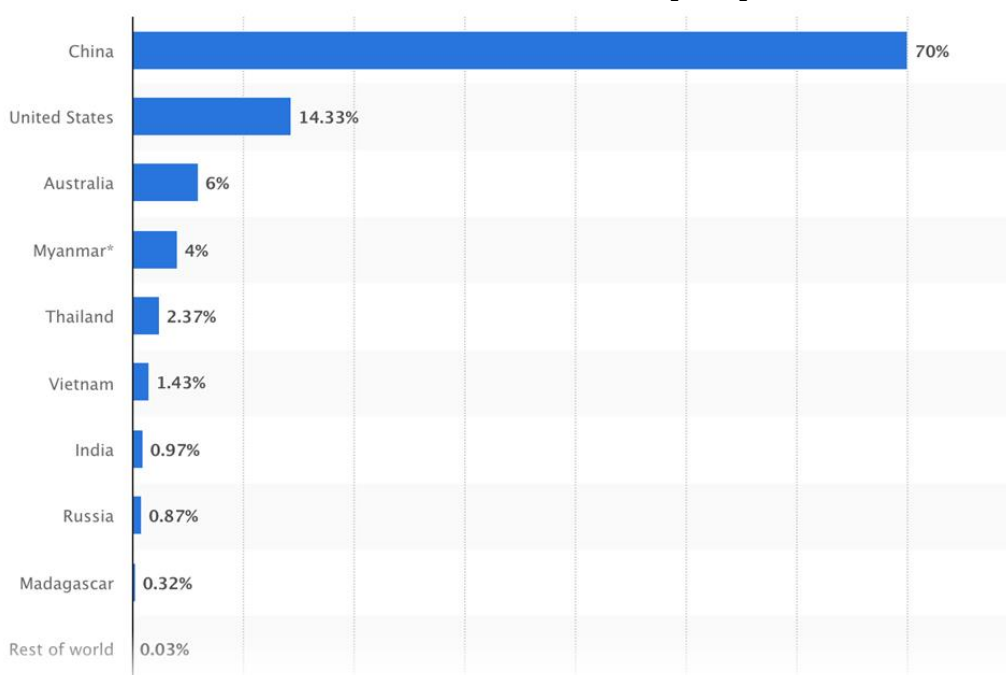
Governments, driven by national interests, are likely to limit other countries’ access to certain mineral resources in the future. Initiatives from the EU and the US are underway to enhance supply chain resilience by diversifying sources, substituting Chinese imports with supplies from alternative nations, boosting domestic production, and stockpiling crucial minerals.

In 2022, China increased its annual rare earth extraction quota for the fifth time, raising it to 210,000 metric tons, which is 25% higher than the previous year. Concurrently, the import of

rare earth elements, primarily from Myanmar, Malaysia, and Vietnam, reached 47,000 tons. These measures are in response to China’s efforts to shield itself from new US trade sanctions, but they also reflect the rapidly growing domestic demand for high-tech products. Remarkably, 94% of Australian lithium mineral production is exported to China for processing.

Alongside producing 80% of the world’s rare earth elements and conducting over 90% of the refining processes, China supplies 68% of global nickel, 40% of copper, 59% of lithium, and 73% of cobalt. [143]

The distribution of rare earth element production worldwide, as of 2022, broken down by countries, is as follows: [142]



Moreover, China accounts for 78% of the world’s capacity for electric vehicle battery production, a significant portion of global solar cell manufacturing, and three-quarters of the world’s lithium-ion battery factories. [144] It is the only country to position itself so prominently across the entire supply chain of clean technologies, known as cleantech.

Against a backdrop of increasing extraction, China’s rare earth element exports have declined. Chinese customs data indicates that during the first five months of 2023, the country exported 20,987 metric tons, which is 4.4% less than the corresponding period the previous year. High demand and disruptions in the import of rare earth elements from Myanmar resulted in prices for these scarce materials in China increasing by approximately 14% in 2022 due to supply shortages.

US research concerning REEs reveals **concerns about limited supply**. According to the report, the methodology and technical materials for the review and revision of the US Essential Minerals List in 2021 identified the place and significance of each rare earth metal for industrial production and the new wave of zero-emission technology development. The US's reliance on Chinese imports is not seen as a critical challenge for the green and digital transition, whereas Europe's plans might be jeopardized. [145]

The greatest supply chain risks for Europe, in descending order of significance, include gallium (risk coefficient 4.8), niobium (4.4), rare earth magnets (4.0), other REEs, boron (3.8), platinum group metals (2.7), Light Rare Earth Elements (LREE), phosphorus (3.3), scandium (2.4), vanadium (2.3), and others. [146]

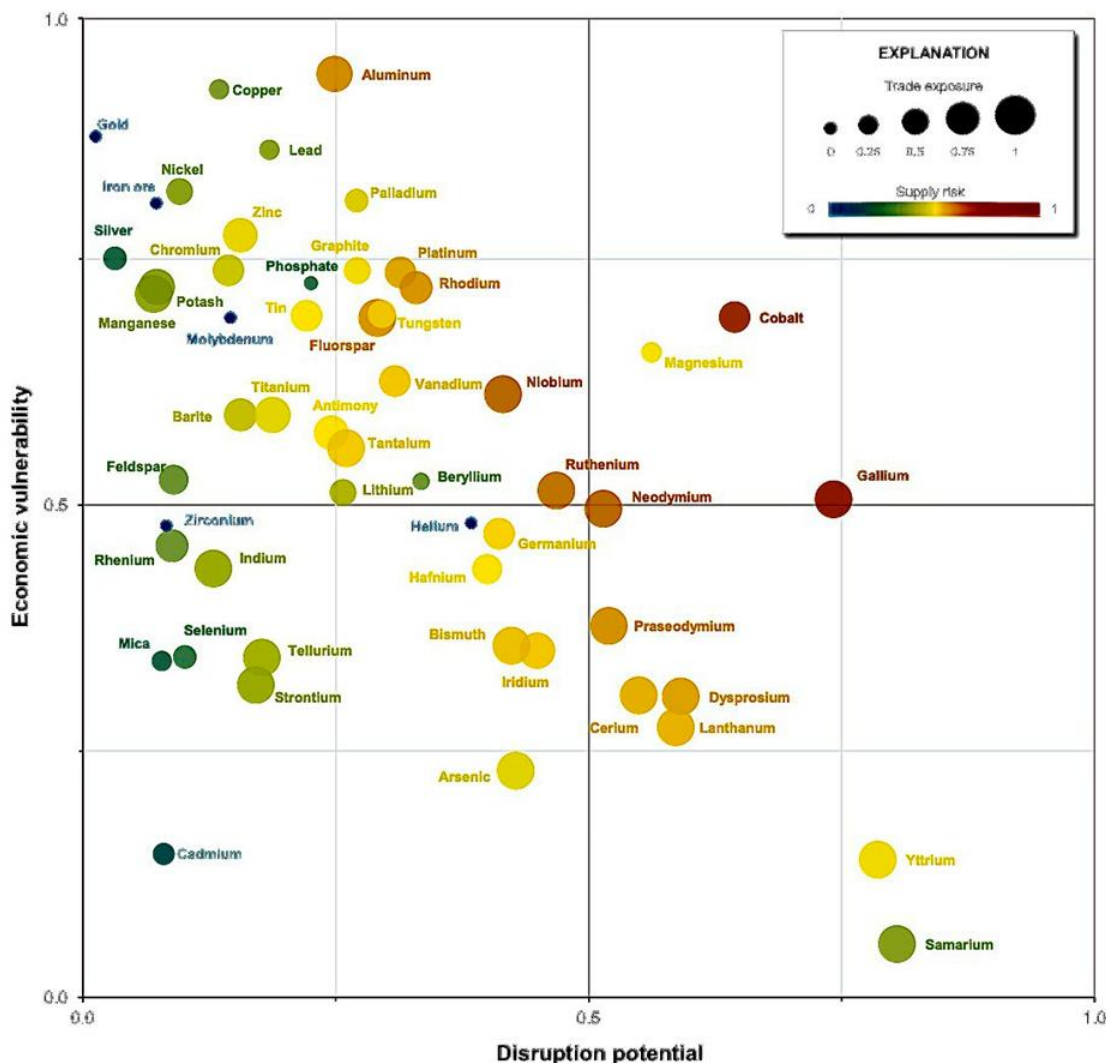
From the perspective of its impact on US economic vulnerability and potential supply disruption risks, **gallium** is also deemed to be the most problematic. It is one of the most sought-after future rare earth metals, around which particularly intense international competition is expected to revolve. [147] Gallium is not mined within the EU, although imported ores are processed, though metallic germanium is exported. The EU is heavily dependent on imports from China. Following price increases in 2020 and 2021, Germany announced the resumption of primary gallium production.

According to a special CSIS report [148], trends suggest a 25% annual growth in the global GaN chip market until 2030. Roughly half of this growth will cater to US defense applications. **The rising demand for this metal is also driven by escalating geopolitical instability and a universal surge in defense expenditures.** Gallium-based semiconductors are vital for next-generation missile defense systems and radar systems, as well as electronic warfare and communication equipment. This underscores the prospects of intensified cross-industry competition for this resource with green technologies.

A 2022 analysis conducted by experts from the United States Geological Survey (USGS) revealed that a 30% disruption in gallium supplies could trigger cascading effects leading to a contraction of approximately \$600 billion in the US economy, or 2.1% of the GDP. Consequently, a protectionist stance from the US concerning gallium supplies and competitive relations with the EU over the exploration of new deposits are anticipated.

Gallium production is marked by a high market concentration. China's dominant position in gallium supplies (accounting for 98% of refined metal) is juxtaposed with a limited pool of alternative high-quality raw material suppliers: a modest amount of primary gallium, around 10 metric tons in 2021, is produced by Japan, Russia, and South Korea, while additional volumes also come from recycled material. Germany and Kazakhstan had also produced it in the past.

Supply chain vulnerabilities and the significance of CRMs (Source: USGS).



China announced that it is introducing restrictions on exports in retaliation to US bans on the export of certain semiconductor technologies to China. The restrictions took effect from August 1, 2023, and pose a serious blow to the supplies of this element, considering most of it comes from China. The metal is also widely used in fast-charging systems, including for electric vehicles. Beijing’s efforts in developing gallium chips aim to technologically outpace the United States, Europe, and Japan.

The unique properties of **germanium** offer multiple performance possibilities for chips compared to silicon and high efficiency for solar panels. The primary sources of germanium are waste from zinc plants and fly ash, so increasing its production depends on the motivation of zinc plants and coal-fired power stations to enter the market. The price of germanium has already risen by 22.01% since the beginning of 2023, according to CFD trading data that tracks the base market for this commodity. [149]

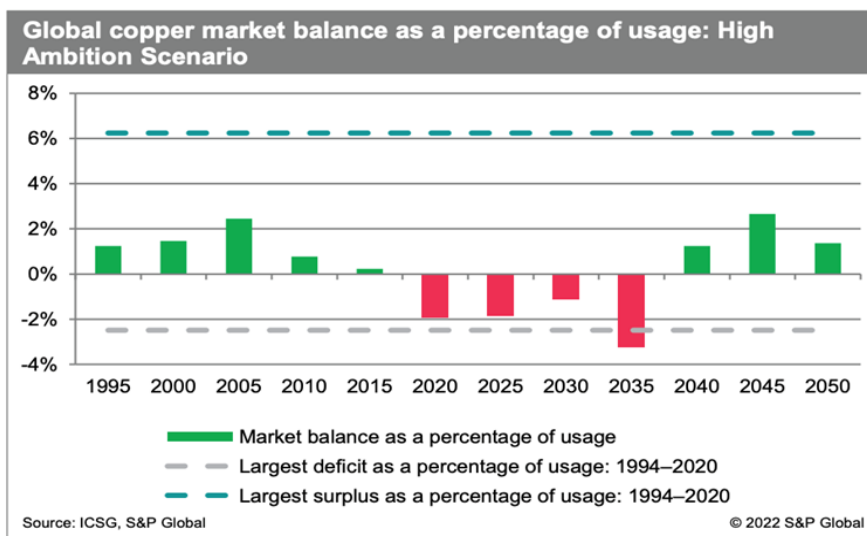
There's a significant **problem with investments in rare earth element extraction projects**—they don't meet investors' short-term return on investment expectations. Meanwhile, governments cannot provide significant financial support due to current complexities and attempts to balance country priorities at the moment, expedite extraction, despite the potential contribution of rare earth elements to achieving climate change goals. However, environmental considerations related to technological specifics are a significant reason for hesitations in supporting REE extraction projects.

Prices for rare earth elements, REEs, and CRMs are likely to rise and remain high in the coming years [150], as demand will grow faster than supply, considering the EU's ambitious target to achieve net-zero emissions. [151]

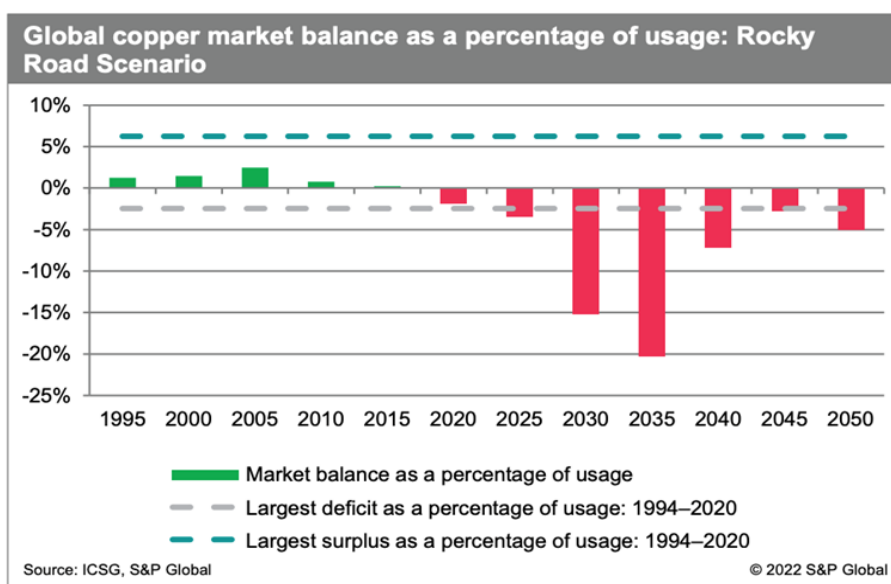
The future deficit problem caused by decarbonization goals is reflected in the copper market. A significant resource deficit, which will impact the pace and cost of the green transition, is forecasted in the copper market. The S&P Global study titled 'Future of Copper: Will the impending supply deficit short-circuit the energy transition?' (2022) focused on this metal because the energy transition is geared towards electrification, and copper is the electrification metal without comparable alternatives in terms of characteristics and cost. The study looked at the 2050 goals set by the US administration and the EU and evaluated what is needed to achieve these goals in specific applications – for instance, in various components of offshore wind energy systems or electric vehicles. The conclusion of this analysis is that copper demand needs to double by the mid-2030s to meet the 2050 targets.

The demand for copper due to the energy transition will be distributed unevenly. It will stem from four key players: China, Europe, the US, and to a lesser extent, India. China, in this context, also stands as the center of market influence and a consumer.

The study looks at two possible scenarios. In the optimistic (High Ambition) scenario, a higher utilization rate assumes that efficiency improvement tasks are addressed, regardless of obstacles such as declining ore grades, water access, supply challenges, and other production difficulties. This scenario requires a multiple increase in the growth rate of copper processing. According to this scenario, the peak annual deficit will be observed in the mid-2030s and will amount to 1.6 million tons in 2035.



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The ‘Rocky Road’ scenario reflects the average trend of the past decade. Even as demand grows and prices signal the need for increased supply, pressures everywhere restrain production growth, including pressures on supply chains and declining ore quality at existing mines. The utilization rate of production capacities remains at the previous level – 84.1%, which is the global average load of production capacities from 2012 to 2021. The processing level remains unchanged at 17%.

According to estimates by the International Energy Agency (IEA), it takes 16 years from discovery to the first mining at a new site. Some mining companies say it’s more than 20

years. Permit issuance and environmental protection are the main barriers to restraining mining rates globally. [152]

At this stage, for the first time in a long period of progressive increase, the copper production trade balance in the EU has shifted to a negative value of almost 2 billion euros, a difference of more than 3 billion compared to the previous year. [153]

Copper imports are well-diversified, but domestic production, considering the anticipated global demand, requires expansion due to the strong import needs of the US and China. According to the Eurometaux report, **copper production requires more energy and, even though it emits significant amounts of CO₂, needs support due to its high significance in the context of future global warming challenges.** [154]

Since 1990, the industry has improved its energy efficiency in Europe by 60 percent. Emissions from copper production in Europe are currently minimal and account for 0.1% of total EU emissions. Copper products now provide a CO₂ savings 20 – 1500 times greater than the emissions required for their production. Further emission reductions in the industry require much larger investments and political support. The current policy adversely affects the industry's competitiveness in the EU.

The challenges of supplying the EU industry with clean energy at the intersection of China's and the US's interests come with further geopolitical, social, and environmental complexities, as well as intensification of international competition in high-tech fields. Geopolitical dynamics and the desire of many governments to be self-reliant in the production of strategically important products will complicate cross-border supply chains. Resource-rich countries will increase state control over extraction, limiting exports.

Resource nationalism will have financial implications for mining companies. Governments of some key mineral-rich markets are likely to introduce new taxes and profit taxes or increase consumption taxes and royalties – or, at least, enforce existing tax laws more strictly. These policy shifts will result in higher taxation for mining companies operating in these countries. Governments might also alter contract terms, affecting companies' investment activities in affected countries. The mining companies themselves may review contractual agreements under which projects are implemented and assess contract breach risks.

To mitigate the effects of supply chain disruptions, the EU has adopted a law on Critical Raw Materials. However, the quality of the proposed solutions does not significantly advance the goal of securing a resource base for energy security.

Substantive Aspects and Shortcomings of the European Law on Critical Raw Materials (CRMA)

The CRMA was adopted in March 2023 in line with the terms of the European Climate Law. The strategic goals of the European Green Deal and the expansion of renewable energy sources depend on broader use and a reliable supply of CRM. Europe lacks such rich mineral deposits as the USA.

The EU, Germany, and other member states have strategically begun addressing the CRM supply issue. Their efforts are limited because the European Commission lacks the cohesion that would allow Europe to compete more effectively with China. Consequently, it remains unclear whether CRM mining can expand in Europe or if it will be hindered by strict regulations, environmental concerns, and public opposition.

Approaches to solving the EU's strategic autonomy problems in critical raw materials are defined within the framework of establishing a local European value creation chain, expanding internal mining, diversifying import routes, broad implementation of reuse and waste recycling (circular economy), and reducing unsecured imports.

The law establishes a benchmark for achieving sustainable mineral supply goals. By 2030, the objectives for Critical Raw Materials (CRM) regulation include:

- A domestic approach to mineral extraction aims to meet at least 10% of the demand for Strategic Raw Materials (SRM), provided that the EU reserves allow for it.
- 40% of SRM refinement and processing should occur within the EU.
- Waste recycling should account for no less than 15% of total consumption.
- By 2030, no more than 65% of the EU's annual consumption in each country should be attributed to the processing industry. [155]

The legislation mandates member states to identify major firms with significant resource needs and to oversee and coordinate audits and stress-testing of their supply chains. Reporting for smaller firms remains voluntary.

Some sectoral analytical agencies and experts highlight the unattainability of these diversification requirements for European companies and point out inconsistencies and shortcomings in the adopted document. Below you can find some of them.

The document lacks material support and a clear supply road map. Predominantly, the law focuses on optimizing the permit issuance processes without allocating funds from the EC budget. Resource needs to support projects in third countries are also not guaranteed.

Amidst a slow recovery from the shocks of COVID-19 and the energy crisis, unprecedented capital flight from industrial Germany, and additional initiatives, there is a demand for

adequate-scale financial support and strategic external trade agreements. The document does not provide a consistent schedule or roadmap for leveraging new supply sources. [156] Current trade policy tools have limited potential for import diversification, even though the EU boasts the world's largest network of trade agreements, covering 72 countries.

Mining industry constraints. According to the objectives, 10% of strategic raw material consumption should be met through domestic mining by 2030. In Europe, progress in mineral extraction advances slowly. European reserves of key raw materials are limited, mineral extraction has been declining for decades, and building internal capacities will take time and significant investment.

In Europe, new mining projects undergo increasingly rigorous environmental impact assessments. Metal production, essential for minimizing environmental harm, significantly pollutes the atmosphere. Ore processing and purification technologies are far from eco-friendly, requiring ore fractionation, followed by extended treatment with chemicals like sulfuric and nitric acid. To obtain pure samples of rare earth metals, these operations must be repeated dozens of times.

According to experts, for manganese and natural graphite, extraction targets are attainable due to reserves in Eastern Europe, Austria, Germany, and Scandinavia. Europe could potentially meet 20% of its demand for these battery components over the next decade.

The chances of achieving the set goals are slim for boron and highly unlikely for rare earth elements and titanium. Europe has titanium reserves, especially in Norway, but they are rapidly depleting. Transforming titanium mineral reserves is a complex challenge. Titanium production equipment, undergoing a rolling process, is currently unavailable in Europe.

Although Europe has several deposits of rare earth elements, [157] they are potentially exploitable. Rare elements have extraction potential in Finland, Spain, Greece, and France, and notably in Sweden, where LKAB's reserves are estimated at over a million tons. Extraction projects demand significant capital investments over an extended period with an uncertain return rate at the time of investing. Moreover, many minerals are not present in sufficient quantities in Europe.

However, the timeline for bringing these deposits online exceeds the required 7 years; approximately 10-15 years are needed to develop a position in line with LKAB. The proposed measures can only marginally reduce the supply deficit, given that regulatory rules for environmentally friendly projects are essentially at odds with CRM extraction.

Economic Limitations of CRM Extraction. The increasing demand factor necessitates the expansion of extraction horizons. However, extraction rates matching the demand for REEs are practically unattainable: it typically takes between 10 to 15 years to operationalize new

production chains – from opening mines to constructing processing and refining facilities. Despite the significance of rare earth metals in the global transition to renewable sources, researchers highlight a serious issue of investment shortages and the unwillingness of potential stakeholders to await returns from the technologically complex and risky extraction of REEs over decades.

According to a detailed report by the Boston Consulting Group (BCG) on the demand for rare earth metals to produce environmentally friendly devices and equipment, a significant supply deficit is looming for the stated carbon emission targets by 2050. This deficit is largely attributed to a combination of the technological complexity of the projects, substantial investment volumes, and a prolonged financial return horizon.

By estimates, global demand for rare earth magnets will reach 466 kilotons by 2035, compared to 170 kilotons in 2022. This is a threefold increase, equating to an aggregate annual growth rate of 8%. Reducing the rare earth element deficit by 2030 will only be achievable with the accelerated launch of over 20 new rare earth element extraction projects, with an additional 10 projects needed by 2035. However, even these projects cannot fully satisfy demand by 2030 as they are still under justification and have not been invested in. Hundreds of other smaller and medium-sized projects are at various stages of planning or construction but can't guarantee adequate quality.

Researchers point out a low regional diversity of prospective CRM extraction projects. Most of these are implemented in China, with significant suppliers represented by MP Materials in the U.S. and Lynas Rare Earths in Australia, both of whom have projects in the extraction phase. Their capacities are limited, primarily aimed at the U.S. market, and cannot meet the EU's import needs. The scheme reveals that the EU's share in the extraction and processing of rare earth metals is minimal. Moreover, equipment production is entirely dependent on external supplies, the diversification of which is severely limited.



The impending scarcity of rare earth elements is fundamentally rooted in the so-called **'tragedy of the horizon'**: a pressing issue that current leaders and investors seem to disregard, primarily because its ramifications will predominantly affect future generations. To adequately meet the demand from 2022 to 2035, an investment of approximately 100 billion dollars in the production and supply chain of rare earth elements will be necessary. Currently, the planned and approved investments for new and existing projects stand at about 5 billion dollars.

Domestic mining of minerals in the foreseeable future might become considerably more intricate and costly than importing. There is a pronounced capital deficit, and currently, there's even a lack of expertise and risk-ready companies. Since the former mine operator, Preussag, a diversified German conglomerate of the "old economy", transitioned into TUI, a company primarily focusing on tourism and logistics, Germany has lacked major raw material transnational corporations. No major firm was willing to undertake such risk, as operations would be perceived as too environmentally harmful, too expensive, and too unreliable. [158]

Despite the escalating demand for rare earth metals for wind turbines and batteries to meet the European Union's ecological ambitions, projects of this nature seem to have limited appeal to green investors. This challenge necessitates a substantial increase in state involvement from quasi-governmental entities, development banks (such as IFC and the European Bank for Reconstruction and Development), and development agencies (like the German Agency for International Cooperation), which could leverage their credit instruments to offer investments, loans, or guarantees to new projects.

Recycling. According to EU regulations, 40% of the Critical Raw Materials (CRM) production and supply chain must be recycled by 2030. The escalation of rare earth metals processing in the EU faces the acute challenge of a qualified workforce. In the intermediary stage, establishing a pure oxide form of each rare earth element is exceptionally complex and time-consuming since each element must be separated from surrounding materials and other elements with similar chemical properties. Enhancing qualifications or recruiting personnel already adept at this intermediary stage can be expensive and yield profitability over a prolonged duration. Based on an expert's estimate from the University of Bayreuth, it might take up to 20 years before over 50% of the demand for lithium and rare earth elements can be met through secondary processing. [159]

The Critical Raw Material Alliance (CRMA) does not offer a solid economic rationale or incentives for investments in the European value-creation chain due to already low trade barriers. New trade agreements under these circumstances won't provide added incentives for European firms to diversify their supplier base.

The declarative nature of import diversification. Even under the most favorable scenarios, the European production and supply chain will cover only a minor proportion of the EU's critical raw material needs.

The EU's import reliance on the extraction process of minerals is a core issue for CRM, necessitating international collaboration, further complicated by protectionist sentiments. The situation is further exacerbated by the indirect impact of CRM bottlenecks in Europe through global supply chains not being mitigated by domestic mining and processing.

Risks associated with export restrictions on CRM implemented by countries such as China, India, Argentina, Democratic Republic of Congo, Senegal, Vietnam, or Kazakhstan underscore the importance of strategically anticipating politically planned supply disruptions.

Environmental standards. Raw materials sourced from third countries are often characterized by low environmental standards or lack them altogether. The essential raw materials mined and processed in the EU would adhere to high environmental and labor standards. For these reasons, the Critical Raw Material Act indeed should make the European production and supply chain an urgent priority. However, it fails to consider the need for significant temporal and financial investments.

Acceleration of new projects brings environmental risks and paves the way for mass protests against mining in Europe. The idea of developing domestic deposits faces hurdles in achieving consensus within certain political circles in the EU. Environmental-oriented organizations and Green parties cannot overlook the risks associated with mineral extraction in the euro area, even if it contributes to global efforts to reduce carbon emissions. Such conflicts might impede the European Commission's attempts to expand internal REEs mining.

Compared to the extraction of other minerals, re-extraction has a much more significant environmental impact, leaving behind large open pits and tailings.

China, where the rapid expansion and financial benefits overshadow environmental concerns, has already showcased the horrors of local rare earth metals processing. For instance, in the raw material capital, Baotou, cancer rates have surged significantly, and waste in the form of fluorides and heavy metals is directly dumped into the Yellow River. [160]

Large-scale mining in Germany could be met with substantial dissatisfaction from residents. The same applies to other tourist and biodiversity-rich regions in Europe, like Portugal's Algarve or Italy's Po Valley.

To achieve its ambitious goals related to the adoption of renewable energy sources, the EU also requires an additional policy explicitly aimed at mitigating the adverse effects of specific

natural resource utilization. This includes political rent-seeking, corporate interests aiming for rent capture, and a lack of economic incentives for diversification. [161]

The distribution of financial risks lies with a subcommittee under the Council for Critical Raw Materials, which mainly consists of executing partners of InvestEU, primarily the European Investment Bank Group, offering recommendations on project preparation and financial assistance. The law includes provisions for buy-back agreements that set a price at which organizers of strategic projects can sell their resources over a specific period.

For the stated purposes, capital investments of no less than 500 million euros are required. Moreover, on average, developing a deposit from exploration to completion takes 15.3 years, with the exploration and feasibility study phase lasting 11.9 years, planning – 1.5 years, and construction – 2.3 years. Furthermore, once projects are operational, raw material prices may fluctuate due to energy costs and market conditions. These risks are compounded by specific territorial conditions and resource profiles.

External diversification will depend on European investment financing in infrastructure in countries through programs like Global Gateway (the EU's foreign investment policy) and export credits to facilitate private investments abroad. This will require significant investments not only from the EU but also from national governments, many of which may be unprepared. The law on critical raw materials does not clearly define the flows and ratios of financing.

Geoeconomic risks in project criteria are weakly elaborated. Export restrictions on critical raw materials introduced by countries like China, India, Argentina, the Democratic Republic of the Congo, Senegal, Vietnam, or Kazakhstan highlight the importance of strategically anticipating politically planned supply disruptions.

Alliances for resource-sharing and partnership relations with third countries, such as the establishment of a Critical Raw Materials Club, could foster international cooperation. At the G7 summit in Japan, heads of state and government failed to agree on the creation of the 'Club' proposed by the European Commission, although a plan was developed to identify and exploit sources of critical metals and minerals.

The inadequacy of CRMA measures complicates the competitive production of green energy end-products and does not address the EU energy system's reliance on external suppliers.

The cost of imported solar panels was 13 times higher than that of imported silicon, and for imported lithium batteries compared to imported lithium, it was 75 times higher. This not only reflects the increased added value of goods higher up in the value creation chain but is also largely due to the fact that the EU does not produce many of these goods domestically.

For instance, only about 10% of the EU's demand for solar panels is met through domestic production. [162]

To sustain high wages in Europe, the difference between input and output costs must also be high. **As long as the extraction or processing of CRMs is concentrated in specific countries, even indirect exposure still poses risks emanating from such concentration.** Therefore, addressing CRM dependency requires an international approach aimed at diversifying CRM supplies directly entering the EU, as well as reducing the exposure of the EU's primary trade partners to CRM concentration. In this arena, China possesses strategic advantages, necessitating appropriate constraints and measures to support domestic production.

Thus, the dual problem associated with rapid demand growth and market concentration cannot be resolved within the next decade and is complicated by geopolitical challenges. Transitioning to a 'green' economy will demand massive investments in new production capacities for clean technologies and essential minerals. Substantial investments in domestic production within the EU, especially in batteries, indicate that an increase in production and direct raw material utilization can be anticipated. [163]

Future Risks Associated with the Development of Renewable Energy Source

The generalized risks associated with the EU's green transition, considering deindustrialization trends, must be examined collectively to understand the constraints of resource availability and the magnitudes of uncertainties businesses face when planning operations amid energy deficits. This information summarizes factors that significantly impede the recovery of energy stability through renewable sources, the adoption rates of which need to be accelerated. While this list is not exhaustive, it suggests that the scenario of expanding renewable energy capacities by 2030 likely won't sustain businesses' pre-crisis operational levels through green energy, which is now urgently needed. The EU authorities must preserve the capacities of energy-intensive metallurgy and chemical industries at all costs so that they can serve as a foundation to propel Europe into a new phase of independent development.

Financial and investment risks that could potentially reduce the pace and private financing of the transition to the EU's new energy model include:

- Despite the high demand, the return on investment in projects related to REEs (Rare Earth Elements)—the resource base for the transition to green energy, is associated with extremely high expenditures in the development of new deposits, bureaucratic and technical difficulties, and a long payback period from investments, measured in decades. The volume of current investments is many times lower than the values needed to overcome the impending deficit.
- The likelihood of an intensified financial crisis could trigger a reduction or absence of funding/subsidies for resource development projects and final production. The euro area has a high level of debt and low economic growth. One potential source of a renewed financial crisis in Europe is the banking sector. Additionally, the unity of the EU and the euro area is threatened by the rise of extremist parties opposing the EU in many countries. [164]
- China may engage in price manipulations, periodically flooding the market with cheap REEs, rendering alternative European extraction projects unprofitable.
- Solar energy faces a fundamental problem that could halt the rapid growth of the industry. The more solar energy that's added to the grid, the less valuable it becomes—a phenomenon known as solar energy deflation. Solar panels produce a lot of electricity during peak sunlight hours, often more than is needed, leading to a drop in prices—sometimes even turning them negative. There's a risk that investments may be deferred in anticipation of further solutions to counteract this trend, and to increase battery storage.

- Since photovoltaic plants produce electricity mainly simultaneously, the more expensive electricity generated from a plant built today may, in the future, become non-competitive due to the higher efficiency of new panel modifications (an ousting effect).
- Older photovoltaic power plants produce considerably more expensive energy because of previously high investment costs. New power plants with MW capacity produce photovoltaic energy at a price of 3.1 – 5.7 carats/kWh, and for small rooftop installations, the range is from 11 to 13 carats/kWh. These cost estimates always assume that the variable electricity is also fully purchased. In the long run, a further reduction in current electricity costs should be expected if the capacities provided by older models are replaced by newer modifications, which also necessitates large-scale investments. [165]

The risks of resource deficits associated with the scaling up of solar energy and wind generation in the EC are as follows:

- Aluminum plays a crucial role in most parts of a wind turbine, especially in the nacelle where wind energy is converted to electricity. While the EU has diversified imports of this metal (from 18 different countries), its European production is declining. Consequently, the dependence on foreign supplies is increasing as the export share grows.
- The production of steel and iron, essential for wind generation in the EU, is decreasing. This decrease is reflected in the negative shifts in trade balances due to increasing exports. High energy prices affect the viability of EU enterprises, and there's a potential for Europe to lose strategic autonomy in the long run.
- There's a significant dependence on China for the supply of CRM and REEs, as well as industrial deliveries of renewable energy equipment. Even under optimistic scenarios meeting most of the CRMA targets, this dependence remains. This poses energy and economic security risks. In the future, China might continue to drastically reduce quotas to focus REEs on producing goods for end consumers. The pricing of solar panels and wind generators is also heavily influenced by China's political decisions and quotas, making the EU's expenses for achieving net-zero goals unpredictable.
- The anticipated price rise of gallium, one of the most demanded metals due to its energy efficiency enhancing properties.[166] Used in thin-film solar cells, gallium aids in producing stable solar batteries more resistant to degradation, making energy cheaper. China dominates the market with minimal shares from alternative suppliers. The U.S. recognizes its economic significance and has expressed intentions to vie for market influence. The overall market anticipates intensified international and intersectoral competition, especially between the defense and green lobby. The cost of gallium threatens to increase multiple times, particularly considering China's export restrictions and their ambition to monopolize solar panel production. China's gallium production is largely a

byproduct of its aluminum industry. As Europe's aluminum industry is experiencing a downturn, it accentuates the importance of retaining chemical industry potential.

- The increasing prices and demand for germanium. Germanium-based solar cells are widely used in satellites. As of 2021, about 67% of germanium is produced by China. [167] This metal is used in infrared systems, fiber optics, polymer catalysis, electronics, and solar cells. Its use in solar panels greatly enhances energy absorption efficiency. The demand for it is projected to rise due to the absence of suitable substitutes, growing demand for solar batteries and 5G networks, and the consistent trend of increasing germanium demand over the next 20 years.
- There could be a decline in battery production due to growing public discontent over the exploitation of cobalt mines in the Democratic Republic of Congo. China's strong foothold in the country heightens the risks for Glencore's extraction operations.
- A bottleneck in the development of hydrogen energy technology, which is expected to progress thanks to dual-purpose gas terminals, is the high demand for platinum and iridium, utilized as catalysts. Currently, PEM electrolyzers constitute merely 24% of the global electrolyzer market. However, according to BofA projections, by 2030, this figure could escalate to 70%. The demand for platinum from electrolyzers might reach 2.4 million ounces (68 tons) by 2030, leading to an annual platinum supply deficit of up to 1 million ounces (28 tons). [168]
- Climate change poses challenges for the transition program and, specifically, the mining industry. Drought, for instance, will intensify competition for water resources among heavy industries, farmers, and households. Consequently, several nations may likely implement stricter regulations on water usage. This issue is particularly acute in the Andean Basin, Lithium Triangle, where the colossal evaporation of groundwater leads to river desiccation. The increasing extraction and demand for lithium exacerbate this situation annually. Protests triggered by environmental issues continue to spread globally and will impact miners with frequent disruptions in freight and transport.
- New multilateral frameworks might lead to stricter regulations on mineral extraction, establish targets for electric vehicle usage, and carbon emission reductions. These might hinder the use of non-decarbonized supply chains and introduce new restrictions for operations in ecologically sensitive areas.
- China aims to undermine Taiwan's independence. Territorial disputes, the risk of which intensifies with geopolitical tensions, can also halt major CRM supplies outside of China.

Challenges related to **operational complexities** of placement and servicing:

- Prolonged administrative procedures and inconsistent application of these procedures across different EU member states. Moreover, especially in smaller EU member states, bureaucratic processes, overlapping authorities, and slow response times can halt projects. In some cases, up to 30 governmental bodies are required to greenlight a project. This is exacerbated in many member states by a low level of digitization and standardization of procedures, which slow down the process. [169]
- Initial installation costs for solar panels are high (though they are offset later by lower operational costs and increased energy output).
- There is an issue of land scarcity and growing competition in land use (especially with sectors like agriculture, construction, and infrastructure). New sustainability standards set by the EU's 'farm to fork' strategy, combined with a deficit and reliance on increasingly expensive fertilizer exports, might lead to a decrease in agricultural production within the EU. This could subsequently increase global food prices, exacerbating food insecurity in African countries dependent on food imports. While most projects require smaller land parcels (less than 5 hectares), the strategic battery sector set to expand in the coming years often needs plots around a hundred hectares. Furthermore, in countries like France, the duration needed to secure administrative permissions to open a plant is excessively long compared to neighboring countries: average real completion time is estimated at 17 months compared to 4 months in Germany.
- Access to strategic minerals might infringe on the rights of miners and their communities. They are trying to counteract regulations on conflict mineral extraction implemented since 2021. This also leads to cascading public unrest and risks of contract violations by European companies in African territories.
- There are legitimate concerns regarding pollution associated with solar panel waste. [170] Separating panel components and recycling them is a complex and expensive process. Additionally, the National Renewable Energy Laboratory (NREL) found that recycling costs between \$15 – \$45 per module, while landfill disposal is only \$1-\$5 per module. Due to these significantly higher recycling costs, most photovoltaic panels end up in landfills. [171]
- Europe's renewable energy sector lacks skilled workers. To meet its energy security targets, by 2030, the continent needs to employ over 1 million solar energy workers, which is double the number in 2021. With a more ambitious scenario, by 2026, there would already be a need for 1 million solar energy jobs. [172]

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The mission of the NSC is to craft an alternative perspective.

The aim of the NSC is to assist our partners in perceiving events from a different viewpoint.

We endeavor to introduce an alternative understanding into the discourse, providing our own assessment of the emerging threats and opportunities associated with these events. The methodologies employed by our experts grant us a substantial informational advantage, allowing us to view a single event from multiple perspectives.