Resilience in the Chemical, Pharmaceutical, and Raw Materials Extraction Industries

Critical Vulnerabilities and Strategic Options

Executive Summary

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Resilience in the Chemical, Pharmaceutical, and Raw Materials Extraction Industries: Critical Vulnerabilities and Strategic Options – Executive Summary

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Foreword

This executive summary is based on the study "Resilience in the Chemical, Pharmaceutical, and Raw Material Extraction Industries." It demonstrates why these industries are indispensable for value creation, security of supply, and quality jobs in Germany and Europe. For us at the IGBCE Foundation, one thing is clear: Economic stability does not happen on its own. It needs strong industrial hubs, a stable political environment, and secure, well-paying jobs.

The chemical, pharmaceutical, and raw materials extraction industries each face their own challenges and all are under increasing pressure due to global dependencies, high costs, and policy failures. Risky import dependencies have developed in the areas of semiconductor chemicals and pharmaceutical raw materials. In the chemical industry, energy prices and local conditions are weighing on production. In the domestic mining industry, a lack of data, lengthy approval processes, and a lack of public acceptance are holding back necessary projects. Each of these three industries requires its own specific strategies to strengthen its resilience in a targeted manner.

Resilience means more than just stable supply chains. It is about industrial capacity to act, democratic governance, and the active role of employees. This means that we need to invest in local communities, strengthen worker participation, and adopt a long-term approach to industrial policy. It is only in this way that value creation, social security, and social cohesion can be ensured.

I hope you enjoy reading this, and I look forward to hearing your thoughts!

Dr. Regina Weber
Head of Industrial Transformation

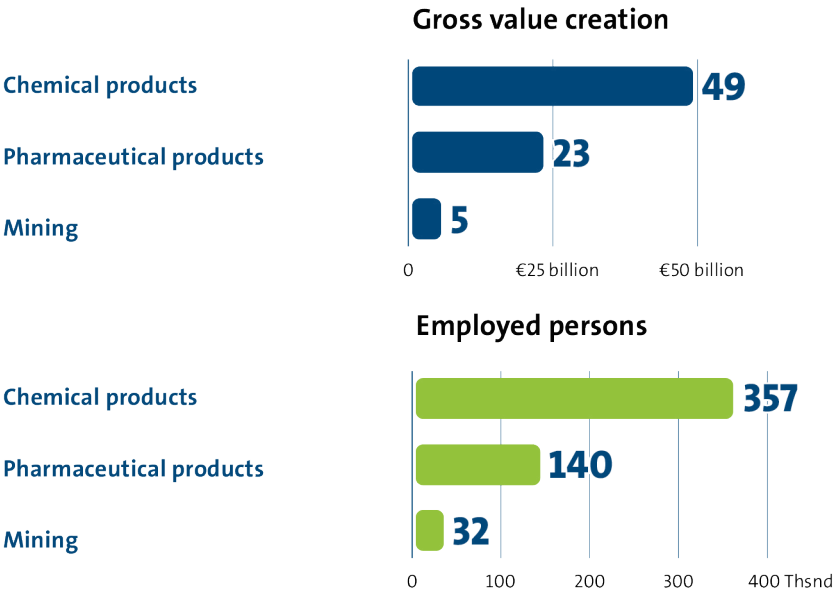
1 Resilience in the chemical, pharmaceutical, and raw materials extraction industries

Recent years and crises have revealed the vulnerability of German industry to global crises. The halt in Russian gas supplies led to a sharp rise in energy prices, disrupted supply chains brought production processes to a standstill. Geopolitical tensions exposed the risks of one-sided dependencies. These developments raise a fundamental question for Germany: From an economic perspective, how can key industrial sectors be positioned to withstand future shocks without endangering competitiveness and employment?

The chemical, pharmaceutical, and raw materials industries are at the centre of this challenge. They support hundreds of thousands of jobs, generate significant value creation, and supply other industries with essential raw materials and finished products. Two-thirds of the chemical and pharmaceutical industries' sales is generated on the global market. These industries are thus at the centre of geopolitical uncertainties. Their significance also extends far beyond the economic sphere: They ensure the security of supply for healthcare services, facilitate energy transition, and form the backbone of the digital transformation. The consequences for the economy and society are immediately felt when these industries falter.

This publication uses three specific examples to examine the vulnerability and resilience of these three industries. It analyses the dependencies associated with semiconductor chemicals, pharmaceutical raw materials, and domestic raw material extraction, and identifies which strategic responses are required. Rather than focussing on technocratic optimisation, it considers how industrial policy must be shaped so that it combines economic stability with social justice and environmental sustainability.

Figure 1 **Value creation and jobs in the chemical and raw materials industries**
Gross value creation at factor cost in billions of euros and number of employed persons in thousands in selected economic sectors, 2022



Source: Kostenstrukturerhebung im verarbeitenden Gewerbe [Key data of enterprises in manufacturing], Destatis 2024.

In this context, resilience must be understood comprehensively. As a guiding principle of sustainable industrial policy, it encompasses the ability of industrial systems to respond to external shocks and adapt, and in doing so, maintain their production and innovation capacity. This includes diversified procurement structures as well as the availability of skilled workers, social acceptance of industrial projects, and political governance. Resilient industrial structures do not emerge spontaneously, but rather through targeted economic policy in which co-determination and social standards play a key role.

The three examples highlight where the greatest vulnerabilities lie and the resulting options for action. The objective is to identify ways in which security of supply, competitiveness, and economic sovereignty can be secured for the long term through a forward-looking industrial policy.

Figure 2 **Foreign sales in the chemical and pharmaceutical industries**
Share of foreign sales in total sales as a percentage, 2023

Source: Persons employed and turnover of local units in manufacturing, Destatis 2025.

2

Example

Process chemicals in the semiconductor industry

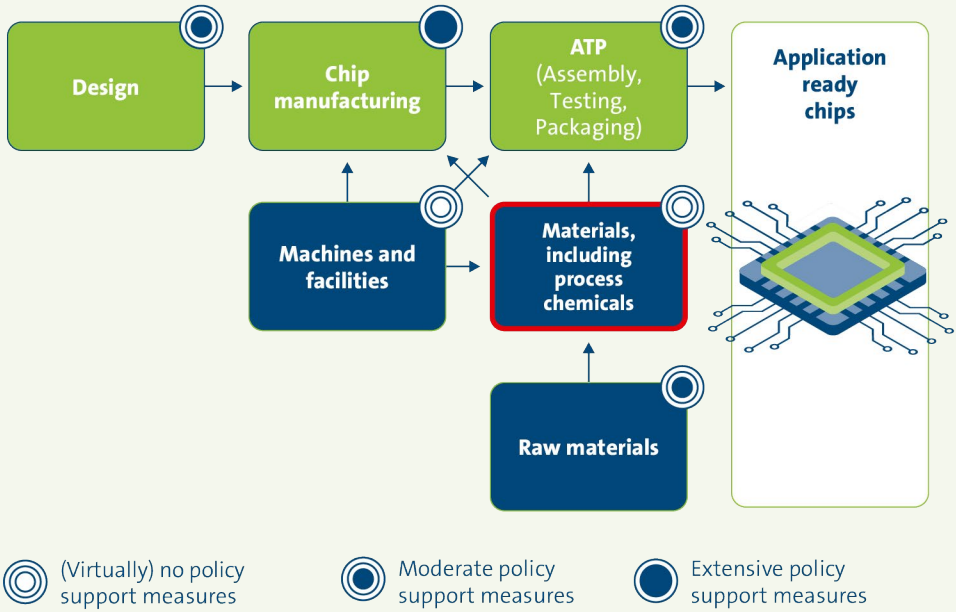
Resilience in the semiconductor industry

The semiconductor industry plays a vital role in technological and digital transformation. It forms the basis for numerous future-oriented industries such as IT and medicine. Its internationally integrated production chain has a multitude of vulnerabilities. While the expansion of European chip manufacturing capacity is already high on the political agenda, there is one resilience factor that has thus far received little attention: The heavy dependence on a small number of international producers of highly specialised process chemicals. High-purity sulphuric and hydrofluoric acids, hydrogen peroxide, and perfluorinated and polyfluorinated gases are required at every stage of production. The material requirements are high; even the slightest impurities can cause production disruptions. This market is highly concentrated: East Asia, particularly China, Taiwan, South Korea and Japan, dominates manufacturing and exports. While Europe has capacity in the basic chemicals, it largely lacks production facilities for electronic and process chemicals. This high dependence on imports can jeopardise the security of supply. This vulnerability is particularly evident in the context of geopolitical tensions, trade conflicts, or export restrictions that can quickly lead to shortages. As a result, a key part of the value chain remains inadequately protected.

Solution approaches for the semiconductor industry

To strengthen Europe's resilience and technological sovereignty, an industrial policy strategy must systematically incorporate the chemical bases of semiconductor production. This includes the targeted expansion of European production capacities for high-purity specialty chemicals, the streamlining of approval processes, and the

Figure 3 Policy support measures at the individual stages of semiconductor manufacturing value creation

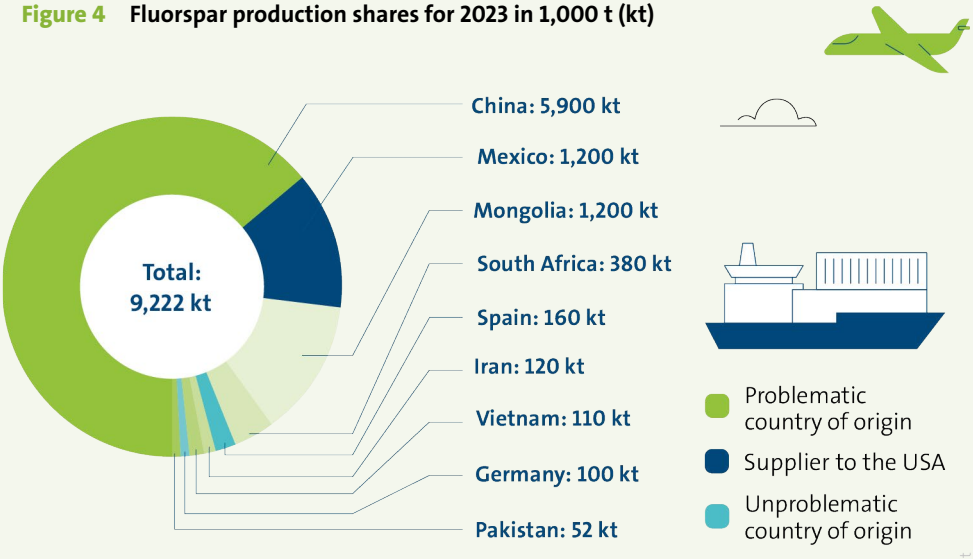


* This analysis takes the concentration of supply and the reliability of supplier countries into account. Both raw material extraction and raw material processing are included in the analysis

Source: Author's own representation.

creation of predictable investment conditions. Another lever lies in promoting research and development to establish resource-efficient and innovative production processes. Equally important here are measures to diversify supply chains and promote European partnerships throughout the entire value chain. In addition, recycling and circular economy approaches for chemical substances should be strengthened in order to reduce dependence on imports. In the long term, only an industrial policy that views the chemical, machinery, and semiconductor industries as an integrated system can ensure competitiveness and crisis resilience. Such strategic integration would not only increase the stability of supply chains but also sustainably strengthen the technological independence of the European semiconductor industry.

Figure 4 **Fluorspar production shares for 2023 in 1,000 t (kt)**



The United States is not listed as no data is available for privacy reasons.
Source: Author's own representation based on USGS 2025, p. 73.

3

Example

Raw materials and active ingredients in the pharmaceutical industry

Resilience in the pharmaceutical industry

The pharmaceutical industry is essential to a functioning healthcare system. However, a large proportion of the raw materials, active ingredients, and excipients used in pharmaceutical production come from just a few countries, primarily China and India. This concentration poses significant risks. The COVID-19 pandemic has shown how quickly shortages of antibiotics, painkillers, and other vital medications can arise as soon as transport routes are disrupted or exports are restricted. Geopolitical tensions, rising energy prices, and production disruptions in other countries further jeopardise the security of supply. There is a particular dependence on the US for innovative active ingredients, for example, radionuclides for cancer treatments. These ingredients can be sourced there, but alternatives are scarce. At the same time, the declining competitiveness of European manufacturers has exacerbated the situation. High energy costs and strict regulations have led to production being moved abroad. Consequently, Europe has only a few facilities for complex and high-purity substances, which further weakens crisis resilience. Europe is heavily dependent on East Asia, particularly for the import of critical chemical raw materials, some of which cannot be produced within the European Union (EU) due to stricter regulations. At the same time, there are close dependencies on the US in research and development as well as in access to key markets.

Solution approaches for the pharmaceutical industry

Several measures to strengthen the resilience of the European pharmaceutical industry are necessary. First, the diversification of supply chains must be driven forward to reduce dependencies on individual countries. In parallel, production capacities for critical medicines and active pharmaceutical ingredients should be built up in Europe in a targeted manner. Public investment programmes, simplified approval processes, and guaranteed purchases can provide effective incentives for this. Equally important here are investments in research and development to promote alternative synthesis processes, more efficient production methods, and substitution options for scarce raw materials. Sustainability and innovation criteria in pharmaceutical procurement can also strengthen European manufacturers. Furthermore, closer international cooperation is needed. European and global agreements to secure supply chains and facilitate the exchange of critical goods can help to avoid shortages in the event of a crisis. A coordinated policy that links industrial, health and foreign trade strategies, thereby strengthening the security of supply in the long term, is crucial here. The industry's resilience depends on a combination of strengthening regional production, global cooperation and technological innovation.

Figure 5 **Key dependencies in pharmaceutical raw materials and active ingredients**

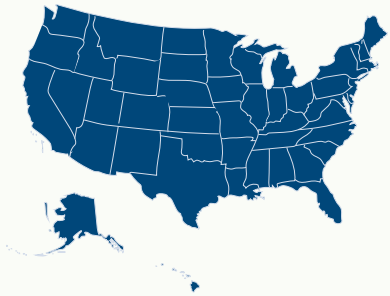
Dependence on China/Asia

High dependence on the import of critical basic materials with few alternatives within the EU.

Reason:

- Import of critical basic chemicals such as acetonitrile and phosgene precursors.
- Production under environmental and health conditions that are not permitted in Europe.
- The limited substitutability of these substances in European production, particularly in the case of generic drugs.
- Strategic cost advantages, faster approval processes, and a flexible regulatory framework in Asia.

Dependence on the USA



Particular dependencies regarding innovative active substances, the R&D industry and the sales market.

Reason:

- Supply of innovative active ingredients (e.g., radionuclides for cancer treatments) due to infrastructure for radioactive materials.
- Close transatlantic R&D collaborations, particularly in oncology. The U.S. market is the largest sales market for pharmaceuticals, with higher profit margins.
- FDA approvals are regarded as a global benchmark and influence market access in other regions.

Source: Author's own representation.

4

Example

Domestic production of lithium potash, and salt

Resilience through domestic raw material extraction

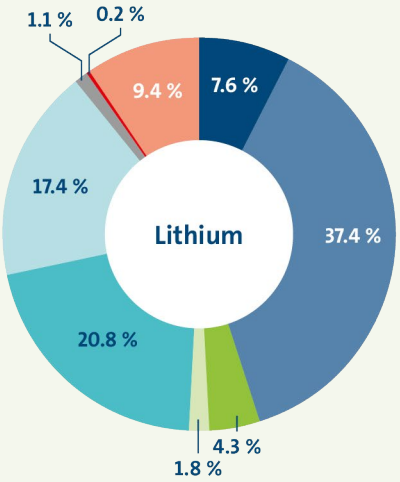
The raw material extraction industry is the basis of numerous value chains and is therefore indispensable for nearly all production processes, for example, in the chemical or mechanical engineering industries. Raw materials such as lithium are essential for batteries, solar cells, and other key technologies driving energy transition. Without a stable supply of these materials, the transition to a climate-neutral industry would be virtually impossible. However, the global supply of raw materials is highly concentrated and therefore vulnerable. Lithium, for example, primarily comes from Australia, Chile, and Argentina, while China dominates the processing industry. The supply of potash salts is essential for food security. German producers are currently the only relevant suppliers to the EU, but they face significant international price pressure and struggle with high energy costs. The global market situation creates dependencies on unstable countries such as Belarus or Russia, which can have a direct impact on the security of supply in the current war situation, during trade conflicts, or in the event of natural disasters. Restrictions in producing countries during the COVID-19 pandemic led to severe shortages and price volatility. A further risk arises from the environmental and social consequences of the mining of raw materials. High water consumption, environmental pollution, and landscape destruction are leading to local conflicts and international

pressure to develop more sustainable mining methods. A raw materials strategy focused on environmental and social sustainability is therefore also a key requirement for long-term resilience.

Solution approaches for the raw material extraction industry

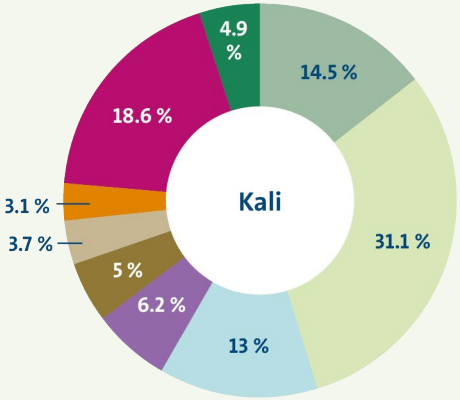
Measures at various levels are necessary to strengthen the resilience of raw materials supply. A key requirement is the diversification of mining areas and supply chains in order to reduce dependence on individual countries. Europe has untapped potential, for example in Scandinavia or Portugal, where projects for lithium and graphite extraction are becoming increasingly significant. Public acceptance of mining projects is essential. Partnerships between businesses, governments, and local communities can promote higher environmental and social standards and help secure long-term supply relationships. Political support is needed to provide financial backing for the higher costs resulting from stricter standards. At a global level, political agreements are needed to enshrine transparency, fair competition, and sustainable production practices. The development of a circular economy is equally essential here. Recycling lithium, nickel, and rare earths from used batteries and electronic waste allows secondary sources to be tapped into and reduces the strain on primary raw materials. Only a strategically integrated raw materials policy can ensure the security of supply and lay the foundations for a resilient, climate-neutral industry.

Figure 6 **Global production of lithium and potash by country in 2024**



- Argentina (18,000 t)
- Australia (88,000 t)
- Brazil (10,000 t)
- Canada (4,300 t)
- Chile (49,000 t)
- China (41,000 t)
- Namibia (2,700 t)
- Portugal (380 t)
- Zimbabwe (22,000 t)

The USA also has a small production volume, but is not included as the data is not available.



- Belarus (7 million t)
- Canada (15 million t)
- China (6.3 million t)
- Germany (3 million t)
- Israel (2.4 million t)
- Jordan (1.8 million t)
- Laos (1.5 million t)
- Russia (9 million t)
- other countries* (2.37 million t)

*Other countries refers to all countries with an annual production of less than 1 million t each.

Source: Author's own representation based on USGS 2025, pp. 151 & 139.

5 Resilience as a guiding principle for a sustainable industry

Resilience is the result of conscious decisions in politics, economics, and technology. The three examples show that resilience can only be achieved if industrial policy is strategically conceived and takes global dependencies as well as the economic consequences of those dependencies into account. This involves identifying risks in a timely manner, ensuring supply chain transparency, and making the crisis resilience of key industries an integral part of both business and policy planning.

A key starting point lies in diversification – of both supply and sales markets as well as technological foundations. Companies can reduce dependencies by expanding their procurement networks, distributing their production sites, and building partnerships with friendly nations. However, such efforts will have little effect without a reliable policy framework. Stable energy prices, expedited approval processes, and predictable investment conditions are requirements for companies to remain capable of acting at all.

Research and development play a key role. They create alternatives to critical raw materials, increase resource efficiency, and enable sustainable production processes. Real-world laboratories, pilot projects, and close collaboration between science and industry can reduce technological dependencies and specifically guide innovation toward crisis resilience. Resilience also means building industrial capacity

in places where it is economically, socially, and environmentally sustainable. Increased trade and cooperation with partner countries, as well as the expansion of European production, can combine security of supply with sustainability if they are linked to securing a skilled workforce, modernising infrastructure, and coherent energy and raw materials strategies.

And finally, resilience is inconceivable without international cooperation. Rules-based trade structures, fair raw materials and investment agreements, and joint research initiatives are indispensable for mitigating global risks. Resilience policy is therefore foreign, structural, and social policy. It combines economic strength with innovative power, environmental responsibility, and the capacity for political action. A resilient industry emerges when competitiveness, sustainability, and social responsibility are not pitted against one another, but rather are viewed as complementary objectives. Industrial transformation must strengthen stability, employment, and social cohesion. Only then can it make a social contribution to all who depend on it.