Analysis of Structural Dependencies & Geopolitical Pressures in the Automotive Value Chain

Synthesis - Summary of Key Findings from EY-Study

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This paper examines how the European automotive sector is evolving as vehicles become more electric, digital, and software driven. It identifies critical materials, components, and industrial capabilities, highlights key supply chain vulnerabilities, and assesses how geopolitical or logistical disruptions could affect the automotive value chain. The analysis combines evaluations of selected critical inputs, disruption scenarios across major regions, and strategic priorities for strengthening Europe's resilience and reducing dependency risks. This document was prepared between April 2026 and July 2026.

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1 The vehicle is changing, and so is its related value chain

For decades, Europe's automotive competitiveness has rested on **world-class engineering, advanced manufacturing, strong supplier networks** and the ability to build high-quality vehicles at scale. What is changing is the foundation beneath them. As the industry moves toward **electrification, digitalisation, software-defined vehicles and connected mobility**, the critical dependencies behind vehicle production are shifting further upstream, into materials, processing capabilities, semiconductors, electronics and specialised components. The centre of gravity of competitive advantage is migrating away from the assembly hall and toward the parts of the chain where Europe has historically had least control.

Shifting dependencies increase supply-chain exposure: Electric vehicles need greater volumes of critical materials such as **copper, silicon and rare-earth magnets**, while driver-assistance systems, connectivity and autonomous functions increase reliance on **semiconductors, displays, sensors and high-performance materials** such as gallium and germanium. Many of these inputs are not only technically complex; they are also produced, refined or manufactured in **highly concentrated supply chains**, frequently outside Europe. As a result, Europe's automotive resilience is increasingly shaped by access to capabilities that sit well beyond final assembly.

Geopolitics amplifies existing supply-chain vulnerabilities: The COVID-19 pandemic, Russia's invasion of Ukraine, escalating US-China trade tensions, export restrictions on critical technologies and raw materials, and disruptions to key shipping routes have exposed the vulnerability of highly interconnected supply chains. For automotive manufacturers, these events have highlighted that access to critical inputs is increasingly influenced not only by market dynamics, but also by **political decisions, security considerations and international relations**. Export controls, trade restrictions, regional conflicts, localisation policies and competition for critical materials can reshape access to key inputs quickly, and often faster than markets can adjust. They amplify weaknesses that already exist in concentrated, slow-moving supply chains. The result is that **a policy decision taken in one part of the world can translate, within weeks, into a production constraint on a European assembly line**.

Competitiveness depends on managing end-to-end dependencies: The challenge is broader than securing raw materials. Europe's future competitiveness will depend on managing dependencies across the full value chain, from extraction and refining through processing, component manufacturing and system integration. The biggest issue today is that the most critical risks do not sit evenly across this chain: they concentrate in specific bottlenecks, especially refining, processing and highly specialised component capabilities, where alternatives are limited, capacity takes years to build, and disruption can quickly translate into constraints for European vehicle production

Resilience is becoming a source of competitive advantage and a geopolitical necessity: In this context, resilience stops being a defensive cost and becomes a competitive capability. The ability to anticipate supply-chain stress, absorb disruption, secure alternatives and

coordinate responses across industry, supported by policy measures or trade partnerships, increasingly influence production continuity, cost position and investment decisions. Europe's automotive sector remains strong, but the nature of that strength is changing, and the industry's ability to adapt to that change is now a strategic question rather than a purely operational one.

2 How we Assessed Automotive Supply-Chain Exposure

Indicative risk comparison, not a forecast: The assessments, rankings and disruption situations in this report are analytical tools designed to compare relative levels of risk within the defined scope. They are indicative rather than definitive, and they are not probability-weighted forecasts of what will happen. Describing a material or a value-chain stage as critical or constrained is an analytical classification for the purposes of this study; it does not imply that disruption is inevitable, nor that the same level of risk applies uniformly to every carmaker, supplier or product. The value of the analysis lies not in precise numbers but in showing, consistently and comparably, where EU car industry structural weaknesses concentrate and where action would have the greatest effect.

Focused scope of ten critical inputs: The study deliberately looks at a focused, strategically relevant slice of the automotive value chain rather than the sector as a whole. The analysis concentrates on a set of inputs chosen because they combine genuine importance to vehicle production with meaningful exposure to supply risk. It assesses ten selected materials and components and traces where the most important vulnerabilities emerge, from mining and extraction, through refining and processing, to component manufacturing and integration into the vehicle. The ten inputs assessed are rare-earth (NdFeB) magnets, semiconductors, wiring harnesses, displays, silicon, copper, gallium, germanium, palladium and wolfram.

Selection based on strategic relevance: They were filtered on three criteria: their relevance to electrification and the shift toward software-defined vehicles, the degree of supply risk attached to them, and their relevance to policy and strategic-autonomy considerations. The result is a portfolio that spans both raw materials and more complex assembled components, and that appears across a wide range of vehicle systems, electric traction motors, power electronics, battery systems, driver-assistance and autonomous-driving systems, connectivity modules, displays, wiring, sensors, catalytic converters and vehicle structures.

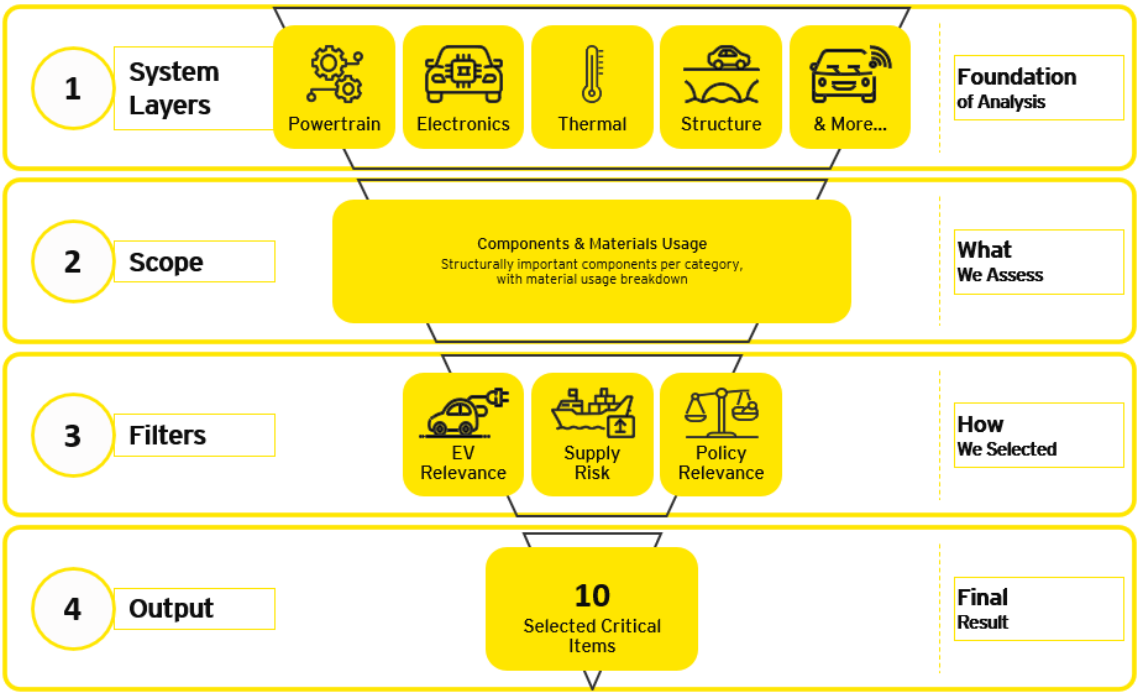
Six structural constraints assessed consistently: Each input was then assessed against a consistent set of structural constraints. Those constraints are the concentration of supply across countries and suppliers, dependence on specialised technology and skilled labour, the difficulty of substituting one material or component for another, the time it takes to build new capacity, competition for the same inputs from other industries, and the reliability of logistics. Assessing every input against the same six constraints is what allows the study to

move beyond isolated material stories and identify the patterns that recur across the portfolio.

Regional disruption scenarios test the vulnerabilities: The analysis then moves from structure to disruption. It examines how geopolitical and trade developments could amplify the mapped vulnerabilities, disrupt established trade flows and create new pressure points, and it groups these into illustrative situations covering the regions of Asia-Pacific, the Americas and Africa. For each region the study identifies the specific triggers most likely to matter and traces how they would feed through to particular materials and components.

Global lessons are adapted to Europe: Finally, it turns outward, reviewing how other economies have responded to comparable industrial and supply-chain challenges, and asking which of those lessons could realistically strengthen European resilience given Europe's own regulatory, industrial and market realities.

Graph 1 - Selection Logic Critical Component Filtering



*Shows how the study narrowed thousands of automotive inputs down to 10 critical materials and components. The selection was based on EV relevance, supply risk and strategic importance.
*Source: Developed by the authors based on research and analysis of internal and external data sources.

3 Structural Dependencies Define Europe's Risk Exposure

Concentrated dependencies define Europe's exposure: The analysis reveals a consistent set of structural patterns across the automotive value chain. Dependencies on a limited number of countries, suppliers, processing hubs and critical technologies have

become defining characteristics of the sector and represent a growing source of strategic vulnerability. Understanding where these concentrations exist, how they shape risk exposure, and which resilience measures have proven effective is essential for strengthening the competitiveness and long-term stability of the European automotive ecosystem.

3.1 Concentration is the fault line running through every value chain

Critical supply is concentrated outside Europe: Many critical inputs depend on a **small number of countries, suppliers and processing hubs**, particularly in the upstream and midstream stages of the chain. The pattern is visible across rare-earth magnets, gallium, germanium, semiconductors and **several electronics-related value chains**, where mining, refining, processing or manufacturing capacity is often concentrated well outside Europe. **China plays a dominant role** in rare-earth refining and NdFeB magnet production, as well as in gallium and germanium processing. Semiconductor manufacturing is concentrated in East Asia, particularly Taiwan and South Korea, while several upstream mineral supply chains rely heavily on resource-rich regions such as Africa and Latin America.

Qualified alternatives are scarce in a disruption: Concentration matters because it directly **reduces the number of realistic alternatives available during a disruption**. If a critical processing step or component category depends on a handful of regions, then a policy change, an export restriction, a logistics shock or a local production problem can quickly affect everything downstream. The **automotive sector is especially exposed** here because it relies on highly qualified, certified inputs that cannot be replaced through spot-market purchasing alone. Even where alternative suppliers exist on paper, they may lack the capacity, the automotive certification, the cost competitiveness or the technical capability required for large-scale vehicle production. A supplier who can make a material is not the same as a supplier who can make it to automotive grade, at volume, at an acceptable cost.

Diversification matters more than self-sufficiency: Across several critical value chains, Europe relies on external actors not only for raw materials but also for refining, processing and component manufacturing capacity. Building domestic alternatives is possible, but requires substantial investment, long development timelines and sustained industrial commitment. In the near and medium term, resilience will therefore depend less on self-sufficiency and more on securing access through diversified suppliers, geographies and trade relationships.

The takeaway is clear: concentration turns otherwise local disruptions into sector-wide risks because the automotive chain has limited qualified alternatives. Europe's resilience challenge is therefore to reduce single-point exposure while recognising that full self-sufficiency is neither realistic nor necessary.

3.2 The real bottleneck is industrial know-how, not raw materials

Processing capability is the main bottleneck: A common assumption is that supply risk is fundamentally about whether the raw materials exist. The study's evidence points firmly elsewhere. **Refining and processing emerged as the highest-risk stage for six of the ten inputs assessed**, more often than either mining and extraction or final manufacturing, each of which was the highest-risk stage for only two of the ten. This is a striking result, because it means **the problem is not scarcity in the ground but capability in the factory**.

Know-how and qualification take years to build: The industrial capabilities underpinning these stages are difficult to reproduce for reasons that go well beyond funding. They depend on specialised know-how, complex process technology, qualified labour, heavy capital investment and long approval and qualification timelines. Building capacity is not simply a matter of financing new assets; it also requires industrial experience, permitting, technical validation, supplier qualification and integration into automotive-grade supply chains. It becomes useful only once it has proven it can produce to the required purity and reliability, and once carmakers have qualified its output, a process that can itself take years. That is why capital alone rarely closes these gaps quickly.

Resilience strategy must target the midstream: Securing supply is less about locating deposits and more about controlling, or securing reliable access to, the processing capability that sits between the mine and the vehicle. It also explains why some seemingly obvious responses disappoint. Announcing a new mine or discovering that a material is available from an alternative country does little if the capacity to refine and process that material at automotive grade still sits in the same concentrated hands. The lesson is that resilience strategy has to target the midstream, the least visible but most decisive part of the chain, rather than fixating on raw-material access, which is where public attention most often lands.

Graph 2- Value Chain Overview

*Illustrates where risk concentrates across the value chain. Refining and processing emerge as the most vulnerable stages, representing the main bottleneck for six of the ten inputs assessed.
*Source: Developed by the authors based on research and analysis of internal and external data sources.

The strongest vulnerability is not the physical availability of resources, but the processing and industrial capabilities needed to make them usable at automotive grade. Strengthening resilience therefore means building or securing access to specialised midstream capacity before disruption exposes the gap.

3.3 A small group of inputs decides where the danger really sits

Five inputs carry disproportionate risk: Risk is not spread evenly across the ten inputs. It concentrates in a limited group that combines high supply risk with strong automotive dependence: **semiconductors, wiring harnesses, rare-earth (NdFeB) magnets, silicon and wolfram**. These inputs, excluding wolfram, are also particularly critical for the transition to electric and increasingly digital vehicles, underpinning applications such as electric drivetrains, traction motors, power electronics, battery systems and advanced vehicle electronics. For these inputs, a disruption would feed directly into **vehicle output, the cost base and competitiveness**, because they are both difficult to source and genuinely hard to do without. Several of them also sit at the intersection of concentrated supply and rising demand from other industries, which worsens their exposure further still. Automotive manufacturers face an additional challenge because these inputs are embedded in highly qualified systems with **long development cycles**, making rapid redesign or supplier switching difficult. As a result, even a disruption affecting a relatively small number of materials or components can create disproportionate consequences for vehicle production, delaying launches, constraining output and increasing costs across the value chain.

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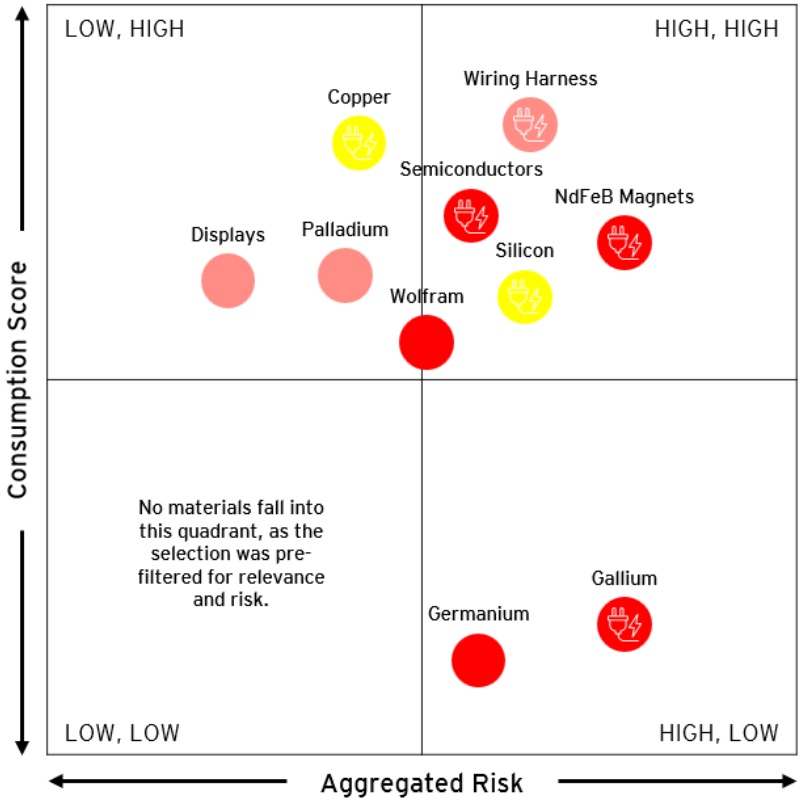
Targeted action makes the agenda manageable: This uneven distribution of risk is, in fact, good news, because it makes the problem tractable. Resilience effort does not have to be spread thinly across every material to be effective. By focusing first on the handful of inputs where the consequences of disruption are greatest, Europe can concentrate scarce attention, capital and policy support where they will most effective. The study's priority-mapping reinforces the point. A subset of inputs stands out because **disruptions would have particularly severe consequences while few viable alternatives exist** and dependence on external suppliers remains high. These inputs should be prioritised for diversification, strategic stockpiling, supply-chain partnerships and targeted policy support. Others carry genuine exposure but have a more contained system-level impact and can reasonably be monitored and selectively mitigated rather than treated with the same urgency.

Focused priorities avoid fragmented investment: A list of every material that could conceivably create disruption is paralysing; a focused view of the highest-risk segment of the value chain is something industry and policymakers can realistically act upon. More importantly, the exercise highlights that many of the most critical vulnerabilities stem from a common set of bottlenecks: concentrated supply chains, limited substitution options, long capacity-build timelines and rising competition from other strategic sectors. It also guards against a common failure mode, in which effort and funding are scattered across too many initiatives to reach critical mass anywhere.

Prioritisation makes the resilience agenda manageable by focusing on the inputs where disruption would matter most. A targeted approach allows Europe to concentrate capital, policy support and management attention on the bottlenecks that create the greatest system-level risk.

Graph 3 - Risk Matrix – materials prioratisation



*Compares supply risk with automotive dependence. Semiconductors, wiring harnesses and NdFeB magnets stand out as the most critical inputs due to their high risk and high importance to vehicle production
*Source: Developed by the authors based on research and analysis of internal and external data sources.

3.4 Going electric trades one dependency for a tougher one

Electrification replaces diffuse risks with concentrated ones: Electric vehicles cut reliance on some traditional components, but they increase dependence on **semiconductors, power electronics and critical materials produced in concentrated, slow-to-expand value chains**. The trade is not neutral: the dependencies being shed tend to be more diffuse and easier to source, while the ones being taken on are more concentrated and harder to build. Key electrification-critical inputs include semiconductors, silicon, copper, NdFeB magnets and selected critical minerals used across EV traction motors, battery systems, power electronics, charging infrastructure and advanced vehicle software and connectivity functions. As EV production scales, demand for these inputs is expected to grow significantly, with electrified vehicles requiring substantially higher volumes of semiconductors, copper and rare-earth-based materials than conventional internal-

combustion vehicles. Crucially, for these electrification-critical inputs the dominant constraint becomes competition from other industries. **Carmakers increasingly compete with artificial-intelligence infrastructure, data centres, consumer electronics, defence and clean-energy sectors for the very same supply, and the shift to electrification raises exposure to competition-related supply risk by roughly 15%.**

Price volatility signals tightening supply: The consequences are already visible in prices. Gallium, a material important for high-performance power electronics and radar and radio-frequency applications, **rose from around US$197 per kilogram in 2016 to about US$2,269 per kilogram by 2026**, an increase of more than tenfold. Price moves of that scale are an early-warning signal: they show how quickly concentrated supply, meeting rising cross-sector demand, can translate into real cost pressure on vehicle production long before an outright shortage appears. If such volatility becomes more widespread across critical automotive inputs, the effects will ultimately extend beyond manufacturers and suppliers to end customers, **increasing vehicle costs and potentially slowing EV adoption**.

EV supply chains remain geographically concentrated: For many of the inputs most critical to electrification, supply-chain exposure is also concentrated in a small number of regions. Rare-earth processing and magnet production remain heavily concentrated in China, advanced semiconductor manufacturing for EVs is centred in East Asia, and several critical mineral supply chains depend on politically and logistically sensitive regions across Africa and Latin America. As EV production scales, these geographic concentrations increase the automotive sector's exposure to geopolitical disruption, export restrictions and logistics bottlenecks.

Other industries increasingly shape automotive access: Securing supply is no longer only a matter of negotiating with established automotive suppliers; it increasingly requires understanding broader industrial demand, competing policy priorities and how capacity is allocated across sectors. Inputs that once looked manageable from an automotive perspective can become constrained when demand from energy, defence, electronics or digital infrastructure accelerates at the same time, and a supplier facing that competing demand may simply prioritise a faster-growing or higher-margin customer. The automotive sector must watch what the AI, defence and energy sectors are doing, because those industries are increasingly setting the price and availability of the inputs cars now depend on.

Electrification does not remove dependency; it changes its form. It reduces some legacy exposures but increases reliance on more concentrated, technology-intensive inputs, making Europe's EV transition dependent on whether the supply base for semiconductors, power electronics and critical materials can expand fast enough.

3.5 Trucks run the same risks with a thinner margin for error

Trucks share the risks but absorb shocks less easily: Compared with passenger cars, trucks do not face a fundamentally different set of supply-chain vulnerabilities. The upstream structure behind truck production largely mirrors that of passenger vehicles, relying on many of the same mining, refining, processing and manufacturing hubs, as well

as similar by-product dependencies and patterns of geographic concentration. Larger material requirements, higher-performance specifications and longer platform lifecycles mean that **supply disruptions are harder for trucks to absorb**, and that the same shock that a passenger-car programme might weather can be materially more damaging for a truck programme.

Truck substitution options are narrower: Exposure is more severe for trucks across substitutability, specialised technology and labour, lead time, and competition from other sectors. Alternative technologies being tested in cars, such as rare-earth-free motors or new power electronics, tend to carry performance trade-offs in weight, efficiency or heat resistance that are far harder to accept in trucks, where continuous heavy loads, tougher operating conditions and stricter reliability requirements dominate. The exit routes that exist for cars are therefore often simply not transferable to trucks. Europe also has a thinner base of specialists and suppliers for heavy-duty electric powertrains, which slows how quickly capability can be built and how easily its cost can be spread across platforms.

Heavy-vehicle resilience must start earlier: Because alternatives are harder and slower to deploy, the measures that build resilience, supplier diversification, capability development and strategic sourcing, need to start earlier for trucks than for passenger cars. Trucks also face the steepest decarbonisation path in road transport, which adds urgency on top of the supply-chain constraints. The underlying weaknesses are shared with the rest of the sector; what changes is that trucks have thinner margin for delay and fewer ways out once a disruption hits. For any resilience programme that spans both cars and trucks, this argues for treating the heavy-vehicle segment as the pacing item, the part that has to move first, rather than assuming a single timeline can serve both.

For trucks, the same dependency structure becomes more difficult to manage because there is less tolerance for substitution, delay or performance trade-offs.

4 A small number of geopolitical hotspots account for most automotive exposure

Four hotspots capture most global exposure: Rather than being distributed across the globe, automotive supply-chain exposure is concentrated in a small number of strategically important regions, each playing a distinct role in the value chain. **Taiwan remains a critical hub for advanced semiconductor manufacturing; Asia dominates processing and refining; the Americas form a deeply integrated automotive network; and Africa is a growing source of minerals essential to electrification.** The following four scenarios illustrate how shocks originating in these key geographies could propagate through the automotive value chain and amplify Europe's existing structural vulnerabilities. We chose these exact scenarios because they cover the main global hotspots where disruption would have the greatest impact on Europe's automotive supply chains, from semiconductors and critical materials to trade routes and mineral exports. This concentration makes it possible to identify **a limited number of geographies where disruption could have disproportionate consequences** for the automotive value chain.

Taiwan electronics shock. Taiwan occupies a uniquely important position in the global semiconductor ecosystem and is responsible for a significant share of advanced chip manufacturing capacity. A Taiwan-related disruption would fall first on semiconductors and electronics, where global supply is highly concentrated and deeply embedded in the vehicle. Modern cars depend on chips for power electronics, electronic control units, driver-assistance systems, connectivity, displays and safety-critical functions, so a shock here would not stay confined to one component category. It would propagate across many vehicle systems at once, and the effect grows as electrification and software-defined architectures raise the number and strategic importance of chips per vehicle.

Asian resource nationalism. Asian economies play a central role not only in mining, but particularly in processing, refining and manufacturing many of the materials required for advanced automotive technologies. Export controls and local-processing requirements imposed by key Asian producing countries would tighten access to critical minerals, processed materials and export-controlled inputs. This is especially relevant for rare earths, NdFeB magnets, gallium, germanium and selected battery-related inputs, where supply is concentrated in a limited number of countries and processing hubs. The risk is not only reduced availability but growing uncertainty around export licensing, local-processing rules and policy-driven allocation, all of which make forward planning harder.

Americas trade-corridor strain. North and South America together form a highly interconnected industrial and logistics system that supports vehicle and component production across borders. Tariffs, local-content rules, security disruption or transport bottlenecks across North and South American trade routes would mainly hit the integrated cross-border flows on which the sector depends. Because North American supply chains rely on parts and components moving efficiently across borders, friction there can quickly reshape sourcing strategies and production costs. For European players, disruption in one major production region radiates outward through supplier reprioritisation, cost pressure and delayed investment decisions across global platforms.

African mineral-corridor shocks. Africa is becoming increasingly important as a source of several minerals required for batteries, electrified drivetrains and other advanced automotive applications. Instability along Africa's mining-to-export corridors would weaken the reliability of upstream mineral supply. Several critical raw materials depend on resource-rich regions where mining output, transport corridors, smelting capacity and export infrastructure are exposed to conflict, policy shifts, infrastructure outages or state intervention. The central question here is not only whether the resources exist, but whether they can move reliably from mine to market, which is often where the disruption actually bites.

Different shocks expose the same weaknesses: Two features stand out when these situations are considered together. First, geopolitical risk concentrates in a relatively small number of strategic geographies, **trade routes and industrial chokepoints**, which means resilience planning can be targeted rather than unlimited in scope. Second, although the triggers vary considerably, ranging from semiconductor disruptions and resource nationalism to **trade frictions and mineral-corridor instability**, they tend to expose the same

underlying structural weaknesses. Across the four scenarios, the most affected inputs repeatedly include semiconductors, copper, NdFeB magnets, gallium, silicon, battery-related materials and selected electronic components because they sit within supply chains characterised by high concentration, long qualification cycles and limited alternatives. Many of these inputs are also fundamental to electric vehicles and software-defined vehicle architectures, meaning that the industry's transition toward electrification increases exposure to precisely those materials and technologies where geopolitical dependencies are most pronounced.

Structural dependencies are the core challenge: The implications therefore extend beyond individual events or regions. The central challenge for Europe is to address the structural dependencies that make disruptions consequential in the first place, particularly in the technologies, materials and processing capabilities that will underpin the next generation of electric and software-defined vehicles.

4.1 When goods stop moving, everything breaks at once

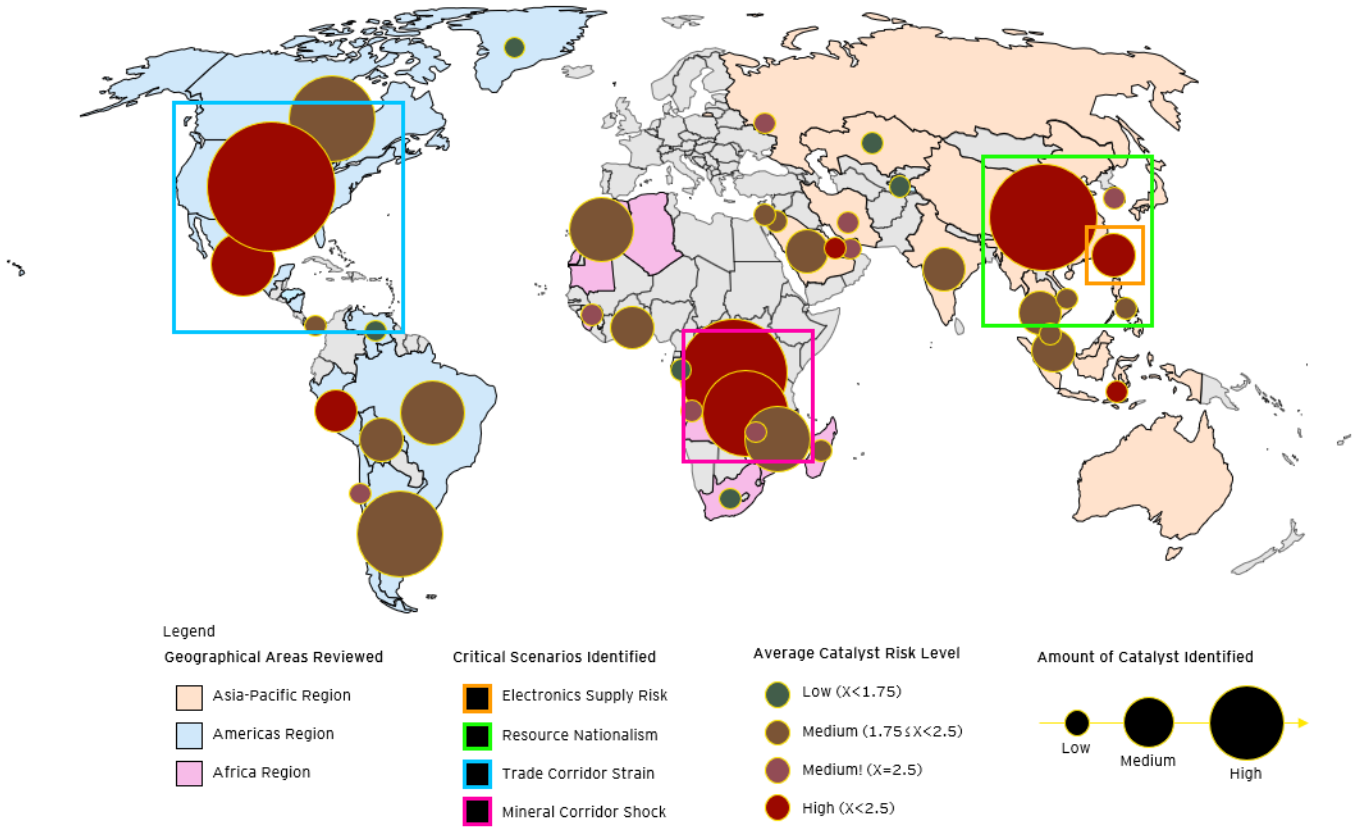
Logistics shocks can hit many chains at once: Although each region carries its own distinct triggers, one constraint recurs across all of them: **the reliable movement of goods**. Recent years have repeatedly demonstrated how vulnerable global supply chains can be to disruptions in transport networks, whether caused by geopolitical tensions, trade restrictions, pandemics, infrastructure bottlenecks or regional conflicts. Where a shortage of specialised labour or a lack of substitutes typically affects one specific value chain, **a logistics disruption can hit many materials and components at the same time**, because inputs travel through a limited number of strategic corridors, ports and transport routes. A single blocked corridor or contested shipping lane can therefore affect a wide range of otherwise unrelated supply chains simultaneously, turning a local incident into a broad industrial one.

Reliable transport is a system-level requirement: This makes **logistics a system-level exposure rather than a material-specific one**, and it is the common thread running through otherwise very different regional risks. In the study's regional comparison, logistics appears as a **critical bottleneck** across Asia-Pacific, the Americas and Africa alike, even though the triggers in each region differ completely. It also reframes the resilience challenge. The task is not only to **secure critical inputs** at their source, but to **ensure they can reach European production reliably,** across trade routes that are themselves exposed to tariffs, export-licensing frictions, security incidents and infrastructure fragility.

Routes must be diversified alongside suppliers: For a region as dependent on imported inputs as Europe, the resilience of the routes matters as much as the resilience of the sources. A perfectly diversified set of suppliers is of little help if the goods they produce all must pass through the same handful of chokepoints. This argues for treating logistics as a first-order strategic concern, worth investing in route diversification, alternative corridors and buffer capacity, rather than as an operational detail to be managed after the sourcing decisions have been made.

Logistics acts as the connective risk that can turn separate material exposures into a simultaneous production problem. Resilience therefore must cover both where inputs are sourced and how reliably they can move through global trade routes to European factories.

Graph 4 - Geopolitical exposure map



*Highlights the regions that account for most automotive supply-chain exposure. The largest dependencies are concentrated in Asia, the Americas and Africa, creating potential geopolitical and logistics risks. *Note: Risk catalysts affecting multiple countries are counted per origin and may therefore result in partial double-counting across geographies.
*Source: Developed by the authors based on research and analysis of internal and external data sources.

5 Resilience is built in clusters, not in isolated plants

Integrated ecosystems outperform isolated projects: Turning from the nature of the risk to the shape of an effective response, the clearest lesson from other economies is that **resilience is built through integrated ecosystems rather than standalone investments**. The most successful approaches connect manufacturing, suppliers, talent and research into dense industrial clusters, where each element reinforces the others. Korea's semiconductor mega-cluster illustrates how co-locating fabrication plants, suppliers, utilities and research capabilities can create scale efficiencies and deepen domestic supply-chain depth**. Taiwan's science parks show how close integration between manufacturers, research institutes and**

skilled talent can sustain global leadership in critical technologies over decades, not years. Isolated initiatives, a single plant here or a research programme there, rarely reach the critical mass needed to compete, because they lack the surrounding supplier base, infrastructure and talent pool that make an ecosystem productive. **Fragmentation is the enemy of scale.** Strong research that never connects to industrial production, or capacity that is built without the suppliers to feed it, tends to underdeliver, and the study identifies exactly this pattern, an innovation gap between research and industrial scale-up, as a recurring reason why well-intentioned initiatives fail to build lasting competitiveness.

Coordination multiplies the value of investment: Resilience will depend not only on how much is invested but on how well the pieces are connected, so that suppliers, manufacturing, research and infrastructure develop together rather than in isolation. This is harder for Europe than for a single-government system, because coordination must happen across borders and competing national priorities. The evidence suggests that the same money, spent in a connected way, buys far more resilience than when it is scattered across unlinked national projects. Connecting what already exists may matter as much as building something new.

The practical lesson is that resilience is strongest where capabilities are developed as connected ecosystems rather than isolated projects. Europe's opportunity is to link its suppliers, research base, infrastructure and manufacturing assets into clusters that can achieve scale and reduce fragmentation.

5.1 Private capital follows demand signals and shared risk

Public risk-sharing can unlock strategic investment: Strategic value-chain projects typically face **high upfront costs, long payback periods and uncertain future demand**, a combination that makes investors reluctant to move first. Two levers repeatedly prove decisive in overcoming this. The first is public risk-sharing. The **United States' CHIPS and Science Act** is the clearest example: by combining direct incentives, tax credits and a long-term policy commitment, it helped trigger **hundreds of billions of dollars in announced semiconductor investment**, in a sector defined by exactly the high costs and long paybacks that deter private capital acting alone.

Credible demand makes projects bankable: The second lever is credible demand. Without visible, durable demand, suppliers are reluctant to commit to new capacity, however attractive the strategic rationale looks on paper. Tools such as regional content rules, procurement commitments and long-term industrial strategies can shape or guarantee that demand, turning resilience objectives into projects that are genuinely bankable. The study points to measures that create **predictable regional demand for automotive production**, and to **market-visibility mechanisms for critical materials**, as **examples of how demand can be anchored rather than left to chance.**

Long-term certainty matters more than grants alone: Reducing investment risk, and giving suppliers confidence that demand will be there, is frequently what turns a strategic priority into real industrial capacity, and it mobilises private capital into sectors it would otherwise avoid. The corollary is that grants alone are rarely enough. What moves private

investment is a credible, durable signal, on both demand and shared risk, that the commitment will outlast the current political cycle.

Private investment follows projects where demand is visible and risk is shared. Public policy can therefore unlock industrial capacity most effectively when it provides both long-term market certainty and credible support for high-risk strategic investments.

5.2 In a multi-year race, the first mover takes the prize

Early execution creates lasting advantage: The final conclusion concerns timing, and it ties the others together. Many of the most constrained automotive inputs require **multi-year timelines for permitting, qualification and capacity expansion, often stretching beyond five years**. Europe can map alternative sources, announce new projects and support recycling and recovery initiatives, but none of these removes exposure immediately. Capacity must be built, proven, scaled and integrated into automotive supply chains before it can meaningfully improve resilience, and every stage of that process adds time that cannot be compressed at will. Leading regions secured their positions not only through the scale of their investment, but through decades of consistent, fast ecosystem development that scaled capacity, suppliers, talent and research ahead of global demand rather than in reaction to it. Their advantage came from moving early and executing quickly, so that capacity was already in place when demand arrived. The implication for Europe is direct: **the advantage often goes not to the region with the best strategy on paper, but to the one that executes first and scales fastest**.

Action after a shortage is already too late: Because building and qualifying new capacity takes years, resilience measures need to begin well before disruption occurs. Once a shortage materialises, the available response options are already narrow, and the lead times involved mean that anything started at that point arrives too late to help with the disruption at hand. In a race measured in years, hesitation is itself a decision, and usually the wrong one.

Timing is itself a resilience constraint because new capacity takes years to build, qualify and scale. Europe's competitive position will depend on acting before shortages appear, not after they have already constrained production.

6 Europe can't eliminate dependency, but it can manage it

Full self-sufficiency is neither realistic nor immediate: Europe cannot afford to stand still. The EU needs a response that matches the geopolitical and industrial challenges reshaping the automotive value chain. **Full self-sufficiency is not realistic in the near to medium term.** Europe lacks scale in refining and parts of upstream mining, and these gaps cannot be closed fully, and certainly not quickly. Any credible strategy must therefore recognise that **some reliance on global supply will remain**.

Dependency must be managed deliberately: The goal is not to eliminate dependency, but to manage it deliberately by **reducing exposure to the weakest points** while accepting a degree of interdependence as a permanent feature of a globalised industry.

Success means reducing the most consequential exposures: This changes the definition of success. Rather than pursuing complete autonomy, Europe should focus on managing exposure: identifying which dependencies are acceptable, which are risky and where targeted action can most effectively reduce disruption. This turns a broad concern about supply chains into a practical set of priorities. Within this framework, five sequenced priorities stand out.

6.1 Five priorities for action

Accelerate permitting, qualification and scale-up. Resilience is also a question of speed. Strategic projects can be delayed by permitting, financing, construction, certification and automotive qualification. Because building and qualifying new capacity takes years, measures must begin before disruption occurs. Europe should better align public approvals, funding instruments, technical validation and OEM qualification requirements. Faster execution will not remove dependency overnight, but it will shorten the time between identifying a bottleneck and bringing credible alternative capacity to market.

Prioritise critical bottlenecks, not the full value chain. Europe should concentrate policy and investment on the stages where disruption risk is highest and replication is slowest: refining, processing, high-purity materials, specialised components, magnets and selected semiconductor-related capabilities. The deepest vulnerabilities sit in the midstream and are among the hardest to replicate, making selective local capacity most valuable in these areas. Attempting to localise entire value chains would be prohibitively expensive and spread resources too thinly.

Build diversified supply partnerships. Diversification is Europe's primary near-term lever. Europe will continue to rely on global supply chains, but it can reduce exposure to individual countries and corridors by building long-term partnerships across allied, resource-rich and strategically relevant regions in Asia, the Americas and Africa. This means securing alternative sources of critical materials, supporting non-dominant processing routes and qualifying suppliers before disruption occurs. Although duplicated supply chains and buffer inventories carry costs, diversification helps prevent a shock in one region from halting European production.

Create an automotive resilience capability. Dependency management should become a core strategic capability across OEMs, suppliers and policymakers, rather than a task left to procurement. This requires visibility beyond the immediate Tier-1 supplier base because many critical bottlenecks sit upstream and midstream in mining, refining, processing, purification, specialised manufacturing and logistics corridors. Europe should strengthen supply-chain mapping, supplier transparency, early-warning indicators, scenario planning and coordinated response mechanisms. The objective is to identify, monitor and mitigate hidden dependencies before they disrupt production.

Anchor demand to unlock investment. New capacity will not scale without credible demand. Europe should use offtake structures, coordinated procurement signals, industrial partnerships and long-term demand visibility to give investors confidence that strategic projects will have a viable market. This is particularly important for processing, recycling, magnets, battery-related inputs and semiconductors, where capital costs are high and payback periods are long. Anchoring demand turns resilience priorities into bankable industrial projects.

Making the priorities count through the three C's

Three principles turn priorities into action: Reducing strategic dependencies requires more than identifying risks. It requires coordinated industrial action. Successful approaches to supply-chain resilience reflect three recurring principles: Compete, Connect and Commit.

Compete, connect and commit: First, Europe must compete by scaling industrial capabilities quickly enough to secure a meaningful position in critical value chains, particularly those linked to electrification, digitalisation and future mobility. Second, it must connect industrial ecosystems by strengthening links between suppliers, manufacturers, research institutions and enabling infrastructure. Third, it must commit through long-term investment, predictable policy frameworks and coordinated public-private action that provide the certainty needed to develop new capacity.

Europe needs its own implementation model: These principles are not a blueprint for replicating another country's industrial model. Europe has a distinct institutional and market environment, characterised by fragmented governance, diverse national priorities and different investment dynamics. The objective is therefore to apply the underlying lessons of coordination, credible demand, risk sharing and faster execution in a way that reflects Europe's economic and industrial realities.

The three C's provide a practical framework: Applied consistently, the three C's provide a practical framework for translating the study's findings into action and strengthening the resilience and competitiveness of the European automotive value chain.

6.2 A competitive capability, not a back-office concern

Resilience is now a strategic capability: Resilience is no longer a procurement issue to be managed in the background. It is becoming a strategic capability that will increasingly determine **production continuity, costs, investment decisions and market position**. The ability to anticipate disruption, secure critical inputs, develop alternatives and coordinate responses across industry, supply chains and public institutions will become a source of competitive advantage.

Competitiveness increasingly depends on resilient value chains: Europe's automotive sector continues to benefit from world-class engineering, manufacturing and system-integration capabilities. However, the foundations of competitiveness are evolving. Success will depend not only on activity inside factories and development centres, but also on the resilience of the global value chains that make modern vehicle production possible.

Concentrated dependencies magnify disruption: Europe's greatest vulnerability is not a lack of resources, but a concentration of dependencies. These dependencies do not automatically cause disruption, but they increase its consequences. The challenge is therefore not to eliminate dependence, which is unrealistic in a globally integrated industry, but to reduce concentrated risk and strengthen Europe's capacity to respond to shocks.

Managed interdependence is the realistic choice: The choice is not between dependence and autonomy, but between vulnerabilities that are understood and managed and those left unaddressed until they become crises. As the industry moves towards electrification and software-defined vehicles amid growing geopolitical uncertainty, resilience is becoming a prerequisite for competitiveness. The organisations and regions that recognise this shift early will be best positioned to shape the future rather than react to it.

7 Paper disclaimers

Important Notice & Disclaimers

Indicative analysis, not a forecast.
The assessments, rankings and risk classifications in this report are analytical tools intended to compare relative structural risk within a defined scope. They are indicative and are not probability-weighted forecasts. The designation of any input as "critical" is a classification adopted for the purposes of this study and does not imply that disruption is likely or inevitable.

Point-in-time information.
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Forward-looking statements.
This report contains scenarios and forward-looking statements that involve inherent uncertainties and assumptions. Actual outcomes may differ materially from those described. The scenarios presented are illustrative and are intended to explore how risks could propagate, not to predict specific events.

Sources and relationship to the original study.
This document is an extract of the full ACEA market. All sources, references, underlying data and methodological details supporting the findings presented herein are contained in the original study. Readers should refer to the full study for complete source information, analysis, context and limitations.

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8 Glossary of abbreviations

Abbreviation	Full form and explanation
ACEA	European Automobile Manufacturers Association
COVID-19	Coronavirus Disease 2019
EU	European Union
EV	Electric Vehicle
NdFeB	Neodymium-Iron-Boron
US	United States
AI	Artificial Intelligence
OEM	Original Equipment Manufacturer
Tier-1	First-tier supplier (direct supplier to the OEM)
US$	United States Dollar

9 Lists of Graphs, Images, and Tables

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