

Look Forward

Supply Chain

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S&P Global

Look Forward: Supply Chain 2024

Foreword

During the COVID-19 pandemic, the world realized that supply chains are fragile and can have significant national strategic implications, especially at a time when geopolitical competition is on the rise.

Recent attacks on shipping in the Red Sea further show that the pre-pandemic world, where supply chains were largely undisrupted and efficient, is unlikely to return. These developments have enabled a widespread reevaluation of the global wave of outsourcing that began in the 1990s. Today, the term "supply chain" is an all-encompassing catchphrase spanning international trade, logistics and manufacturing in the context of both corporate operations and national economic security.

It is a broad topic, but S&P Global has the advantage of drawing on deep expertise across the enterprise to frame major themes and offer a glimpse of the future.

For this inaugural issue of *Look Forward: Supply Chain*, we tapped into the knowledge of multiple specialists in areas such as labor, mobility, geopolitics, decarbonization, shipping and international trade to present a series of articles that delve beyond the headlines and provide critical insights to our customers worldwide. Our deep dive into electric vehicles and batteries is a great example of how technology and geopolitics are reshaping global supply chains.

At S&P Global, we recognize that the world is in a state of transition and growing increasingly complex every day, which is reflected in the new risks associated with supply chains. We aim to go beyond what is expected and seek new levels of understanding to help companies, governments and individuals make an impact on tomorrow. This report is a product of that commitment, and we hope it will be of value to our readers.

Edouard Tavernier,
President, S&P Global Mobility

Introduction

The COVID-19 pandemic has transformed the concept of supply chains from narrowly defined operational systems within companies to a new framework for the manufacturing and distribution of goods defined less by operational and cost efficiencies and more by alignment with national interest and geopolitical competition.

The post-World War II paradigm of globalization based on comparative advantage, shared prosperity, agreed-upon rules and efficiency is waning. As a result, costs are growing due to decisions that need to be made based on nonbusiness considerations. In some cases, this includes decisions to diversify manufacturing away from China after decades of reliance on the country. Governments are intervening in supply chains, and their policies are continuing to shift toward national security priorities while some economic aspects become less important. This has led to nation-state cooperation and competition for access to critical supply chain inputs, ranging from minerals and food to intellectual property and investment.

Following a period of supply chain disruptions, corporations are finding that disruption is not receding and the reliability of inputs such as transportation is not normalizing. There is a demonstrated need to invest in resilience projects that cut risk and improve profitability, such as reshoring and spending on supply chain technology enhancements. Failure to invest now could result in continued or even heightened exposure to future disruptions.

Companies also need to consider decarbonization, but there is little willingness to spend on reducing emissions. Few companies have backed their public climate commitments with investments in higher-cost, zero-carbon logistics solutions offered by the major ocean carriers and freight forwarders. This presents a conundrum to container lines that handle 45% of global trade by value but face the prospect of not having an effective mechanism in place to pass along the higher costs of zero-carbon fuels to customers.

Supply chain pressure is coming from other directions as well, including labor. Climate change, demographics, public health and corporate responsibility related to labor will have far-reaching impacts on supply chains in the coming years. There are growing demands on companies to monitor and manage labor risks within their end-to-end supply chains, coming from a growing number of mandatory due diligence regulations requiring companies to protect worker rights across the value chain.

This *Look Forward: Supply Chain* journal also dives into detailed case studies on the electric vehicle revolution.

Trade wars, geopolitical battles and infrastructure issues have tempered initial excitement surrounding EVs. A global battle is shaping up to secure the critical minerals and raw materials needed to manufacture sophisticated batteries and other EV parts. Asia, and particularly China, holds a dominant manufacturing advantage for EV parts, but national security concerns are quickly changing the narrative.

Chris Brooks,
Executive Director,
Journal of Commerce
by S&P Global

Chris Rogers,
Head of Supply Chain
Research, S&P Global
Market Intelligence

Peter Tirschwell,
Vice President, Journal of
Commerce, S&P Global
Market Intelligence

Supply chain politics: National security meets economic growth

Government policies will become even more national security-focused but remain engines of economic development. Elections bring uncertainty.

Carlos Cardenas, Head of Latin America Insights and Analysis, S&P Global Market Intelligence, carlos.cardenas@spglobal.com

Jose Perez-Gorozpe, Head of Credit Research, Emerging Markets, S&P Global Ratings, jose.perez-gorozpe@spglobal.com

Vishrut Rana, Senior Economist, S&P Global Ratings, vishrut.rana@spglobal.com

Elijah Oliveros-Rosen, Senior Economist II, S&P Global Ratings, elijah.oliveros@spglobal.com

Ken Wattret, Vice President for Global Economics, S&P Global Market Intelligence, kenneth.wattret@spglobal.com

Diego Iscaro, Head of European and CIS Economics, S&P Global Market Intelligence, diego.iscaro@spglobal.com

Kevin Murphy, Research and Analysis Director for Metals and Mining, S&P Global Commodity Insights, kevin.murphy@spglobal.com

Chris Rogers, Head of Supply Chain Research, S&P Global Market Intelligence, chris.rogers@spglobal.com

Highlights

Governments' supply chain policies will continue to shift toward national security priorities, while some economic aspects will become less important.

Nation-state cooperation and competition for access to critical supply chain inputs are set to heighten as geopolitical conflicts continue. Protectionism and sanctions will remain a key part of nations' policy tool kits and may find new applications.

Supply chain policies have boosted economic growth via investment subsidies but carry the seeds of future inflation in materials and labor. Resource-guarding, partly to boost royalties, will widen.

Focusing on local policy implementation is as important as tracking global geopolitics, especially considering the numerous local elections in the next two years that could disrupt policies.

Government supply chain policies are increasingly seeking to meld national security and economic development policies. That will inevitably lead to greater rivalry with rising protectionism, resource guarding and investment incentives. Uncertainty will continue to

cloud the outlook as elections across most major economies could herald new governments with new policies heading into 2025.

Security first: Supply chain and national security policies intertwine

In the period following the COVID-19 pandemic, supply chain policies have been put to work to deliver national security priorities in direct and indirect ways.

Direct actions will continue to focus on the technology sector, particularly semiconductors, with their use in military and domestic applications. Governments will also enhance measures to prevent technology-related leakage to adversaries and, as the EU is pursuing, reduce the risk of the "weaponization of economic dependencies or economic coercion," as indicated in its economic security strategy.

Indirect actions include protecting key commodities and manufacturing capabilities as well as building supply chain resilience through a strengthened industrial base and enhanced domestic production. Such actions will likely be more frequent as countries become more inward-looking and engage in retaliatory actions centered around industrial policy subsidies.

Competition over the control of the supply of critical inputs will increase, risking new conflicts and rivalries. Food has become a susceptible topic, with recent weather-related shortages of rice and onions leading governments such as India's to impose export restrictions. This situation will expose supply chains to new sanction regimes and compliance requirements. It will also create opportunities for reshoring to countries with less protectionist trade policies and fewer geopolitical entanglements such as Mexico and Vietnam.

The private sector will play a crucial role, partnering with the state (external affairs) and defense ministries over the next few years. However, corporations may be limited by financial considerations in their willingness to participate, as discussed in "Footing the bill: Paying for resilience."

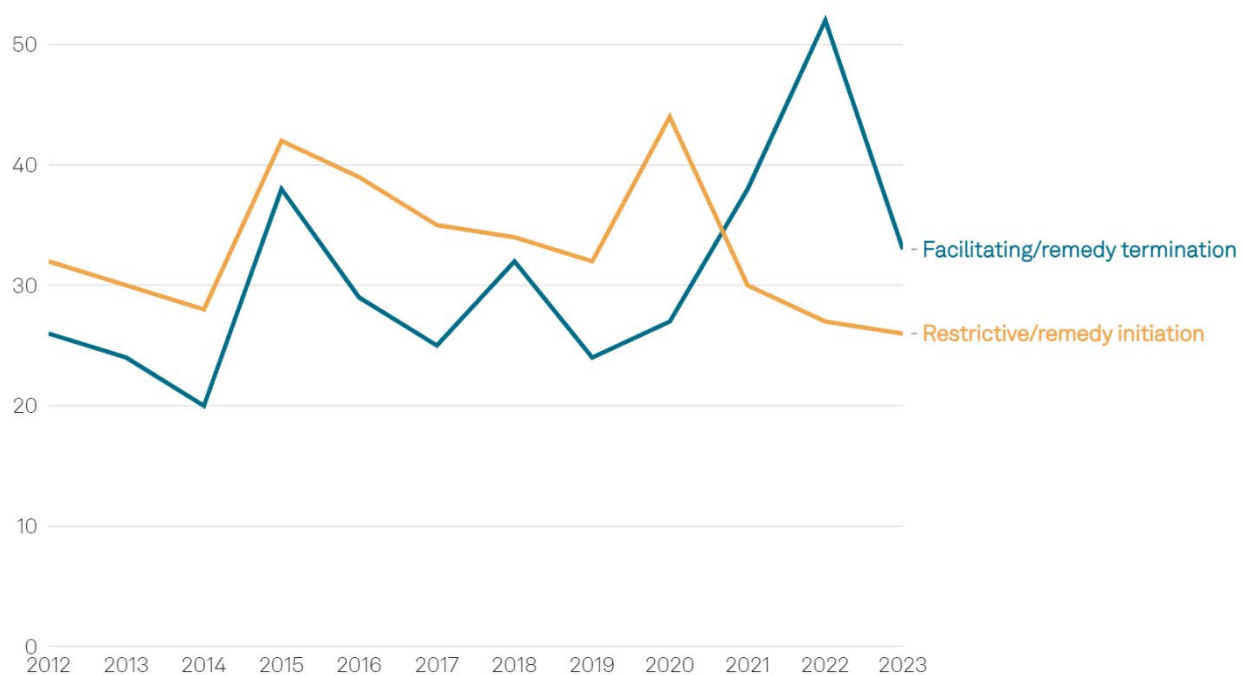
The US Defense Department has already intervened in critical supply chains, and its involvement has expanded over the past five years. In February 2021, the Biden administration implemented an executive order giving the presidential assistants for National Security Affairs and Economic Policy coordination powers over developing critical supply chains. The Defense Department has also entered agreements to boost domestic production of nickel and lithium under the Defense Production Act Title III.

Protectionism protected: Tariffs and nontariff barriers continue

Protectionism remains rife and will continue to be so in the coming years. This is mainly because trade measures such as tariffs and nontariff barriers are part of industrial policy, which was adopted by the previous US and Indian governments. Although significant, tariff-busting trade deals are fewer now; the number of trade-restricting measures has also decreased globally, while the number of trade-facilitating measures has increased.

Trade being liberalized in 2022 and 2023

Average number of trade measures applied per month globally



Data compiled Nov. 30, 2023.

Sources: S&P Global Market Intelligence; World Trade Organization.

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<https://public.flourish.studio/visualisation/16622441/>

During the pandemic, 203 trade-restrictive elements — mostly export restrictions — were implemented as countries sought to secure medicine and personal protective equipment for their citizens.

While most of those policies are no longer in place, trade restrictions may increase again in 2024 and beyond.

Several factors could contribute to this, including tariff usage for industrial policy, state-supported investment programs and trade policies aimed at environmental outcomes. Such protectionist measures can hurt the country's economy, as they increase inflationary pressure, distort supply chain decision-making and act as an effective tax drag.

BOX: Free trade deals to watch

Although major trade deals seem to be on hold for now, there are several situations to monitor.

The EU had a challenging year in 2023 for finalizing free trade agreements, and it might restart the process over the next three years. Its deal with the Mercosur group came to a halt in December 2023. Restarting the agreement with Australia is complicated due to agricultural interests and might have to wait until the EU Parliament elections.

The Comprehensive and Progressive Agreement for Trans-Pacific Partnership trade group is expanding, and many markets, including mainland China, Taiwan and South Korea, are waiting

to join. The UK, which is the most remote candidate, might have the best chance of joining because it has no regional, geopolitical or territorial issues.

The UK is also trying to replace inherited deals and create new ones after Brexit. Negotiations with Canada, Mexico, the Gulf Cooperation Council, Israel, Switzerland and South Korea are underway and could yield traditional, tariff-cutting and regulation-busting agreements.

In Asia, the Regional Comprehensive Economic Partnership established in 2022 will gradually reduce trade barriers among members. The bloc is open to expansion, although interest has been modest so far, with smaller regional economies such as Sri Lanka, Hong Kong and Bangladesh looking to join. However, this could change as the deal matures.

Alternative trade negotiation structures are also emerging, such as the US-sponsored Indo-Pacific Economic Framework, which has several chapters under discussion. The India-Middle East-Europe Corridor faces regional conflict challenges but has the impetus of competing with the Belt and Road Initiative. The latter has lost momentum due to higher debt-servicing costs and default rates.

A final challenge is the lack of a quorate judiciary in the World Trade Organization's appellate body, which hinders its ability to serve as an arbitrator in trade disputes. This is because the US has blocked new appointments since the Trump administration. There is little prospect of a resolution at this stage, leading countries to adopt ad hoc measures instead. Without a unified dispute resolution process, further trade protectionism will likely persist.

Conflicts to continue, sanctions to remain

Conflict between nations can significantly affect global supply chains, both directly and indirectly. This impact can persist beyond the initial conflict as supply chain managers find alternative solutions to mitigate the effects. The impact of these conflicts can change over time as the conflict spreads and policies evolve in reaction.

For example, the conflict between Russia and Ukraine has significantly affected the energy industry and related sectors. The EU has diversified its gas supplies to reduce its dependence on Russia, while Russian oil exporters have found new markets. The food industry has faced challenges due to diminished supplies and higher prices, but shipping remains unaffected.

Israel's conflict with Hamas has affected the natural gas industry, but its impact on global trade has been felt more via reduced shipping through the Red Sea. That, in turn, has led to higher shipping costs and diversions in deliveries, but it has yet to fundamentally remap global trade.

The impact of future conflicts will depend on their targets, escalation pathways and international reactions. Conflicts in regions such as Taiwan, the Korean peninsula or the South China Sea could be particularly disruptive to electronics-based supply chains and global trade flows.

Sanctions are often used to enforce policy decisions but can be challenging to impose and remove. The ongoing sanctions against Russia for its actions in Ukraine have significantly

affected its economy and trade relations. Russia has sought new markets in Asia and pivoted toward using the renminbi rather than the US dollar.

The expansion of the sanctions coverage has been forced to adapt to changes in supply chains, particularly in the technology sector. This may require secondary sanctions against third-party countries unwittingly involved in transshipment evasion strategies.

Lastly, the use of sanctions to enforce forced labor regulations has steadily increased. The US, for example, has increased its use of withhold release orders to expand its coverage of forced labor regulations. More information can be found in "Labor: A critical component of supply chains under growing pressure."

BOX: Trade data hints at supply chains healing around sanctions

An analysis of nearly 5,200 products exported from the EU to Russia revealed that 627 products met the following conditions of materiality during the third quarter of 2023 compared with the third quarter of 2021.

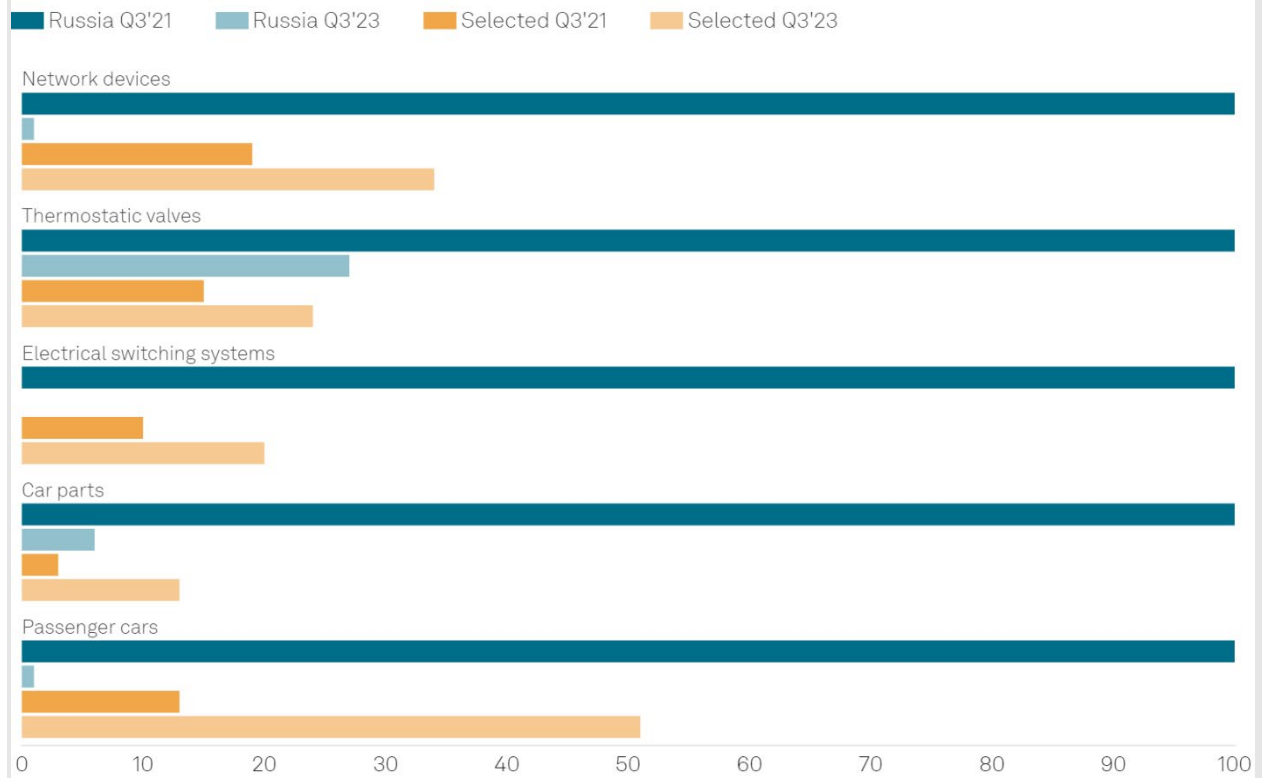
- *EU exports to Russia fell by at least 70%, which indicates that sanctions have had an effect.*
- *EU exports to selected countries, including Azerbaijan, Georgia, Kazakhstan, Kyrgyzstan, Turkmenistan, Uzbekistan and Tajikistan, increased by more than 40% compared with the rest of the world, showing abnormal growth in shipments.*
- *The increase in value of EU exports to the selected countries was more than 20% of the drop in value to Russia, suggesting a degree of diversion.*

Passenger cars and parts, centrifugal pumps, construction machinery parts, parts for utility-grade electrical switching systems, and printing machines were the largest products that met the three criteria.

A further 1,501 products met two of the three criteria. The largest of these included network-connected devices (such as modems and routers), thermostatic valves, parts for domestic-grade electrical switching systems and computer processors.

EU exports being diverted to countries close to Russia

EU exports to Russia and selected countries, rebased to Russia Q3'21 = 100



Data compiled Dec. 1, 2023.

Selected countries are Azerbaijan, Georgia, Kazakhstan, Kyrgyzstan, Uzbekistan and Tajikistan.

Source: S&P Global Market Intelligence.

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<https://public.flourish.studio/visualisation/16631598/>

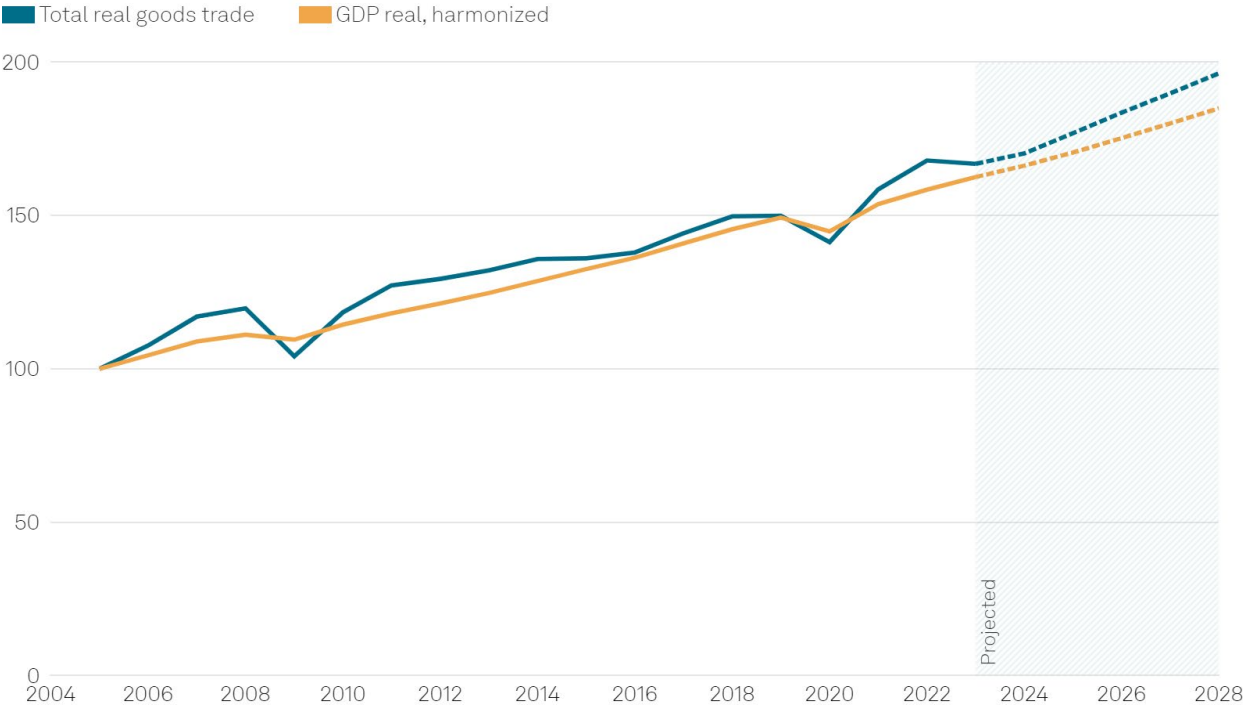
Central to growth: Supply chains' part in economic policies

Supply chains contribute to global economic growth by making production more efficient, leading to stable inflation rates. The international trade sector plays a major role in this. The percentage of world trade as part of global GDP has remained steady since 2005 at 22%.

We continue to see supply chains expanding globally, especially in Southeast Asia and other emerging markets. S&P Global Market Intelligence forecasts indicate that global trade will grow at a compound rate of 3.3% through 2028, while GDP growth will be 2.6%.

Trade growth set to outpace GDP through 2028

Global international trade in goods and GDP, rebased 2005 = 100, adjusted for inflation



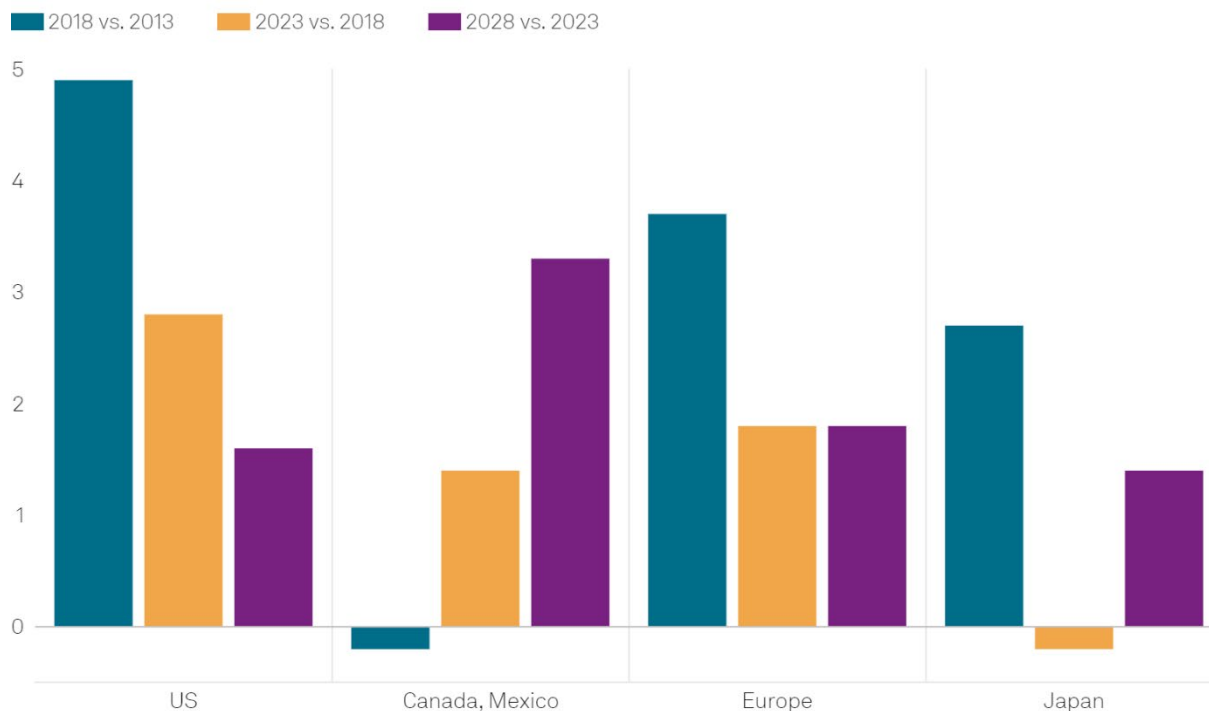
Data compiled Dec. 1, 2023.
Source: S&P Global Market Intelligence.
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Supply chain development as a contributor to economic growth

Small, open economies are likely to benefit from connecting to global supply networks, as seen in the East Asian growth story. However, spending on "subsidy farming" and the need to replace existing capital stock could crowd out investments in supply chain resilience. There is also evidence of a reconfiguration of trade in certain sectors in Asia and ongoing reshoring to Mexico due to US industrial policies. Chinese investors are becoming leading players in financing manufacturing abroad, particularly in sectors where supply chain reconfiguration is taking place.

US investment growth lead erodes as government support plans mature (%)

Compound annual growth in private, nonresidential fixed investment adjusted for inflation



Data compiled Dec. 4, 2023.

Source: S&P Global Market Intelligence.

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BOX: Openness is key to successful reshoring

Reshoring is a far from simple process and has been the subject of deep research from across S&P Global, including, "[Nearshoring to Mexico: National trends and regional disparities](#)," "[For Mexico, Nearshoring's Potential Benefits--And Obstacles--Are Significant](#)" and "[Look Forward: India's Moment](#)." Vietnam, Malaysia and Turkey are also expected to benefit from the reshoring trend. Future Look Forward: Supply Chain journals will dig into the topic in more detail.

Common policy-driven lessons include the following:

An openness to global trade in the form of minimal trade barriers and rule-of-law implementation of antidumping mechanisms. That is not to say that import or export barriers are never used, though less is more when trying to encourage inbound investment.

A large domestic market provides a ready source of financing in the form of local customers, reducing the reliance on maintaining international competitiveness over the long term. Mexico's membership of the US-Mexico-Canada Agreement and India's large population are examples of inherent advantages.

A willingness to pivot on policy in response to negative commercial or popular feedback can ensure that mistakes are rapidly corrected. India's decision to postpone limits on imports of

laptop computers — part of a push to onshore manufacturing of such devices — is a recent example.

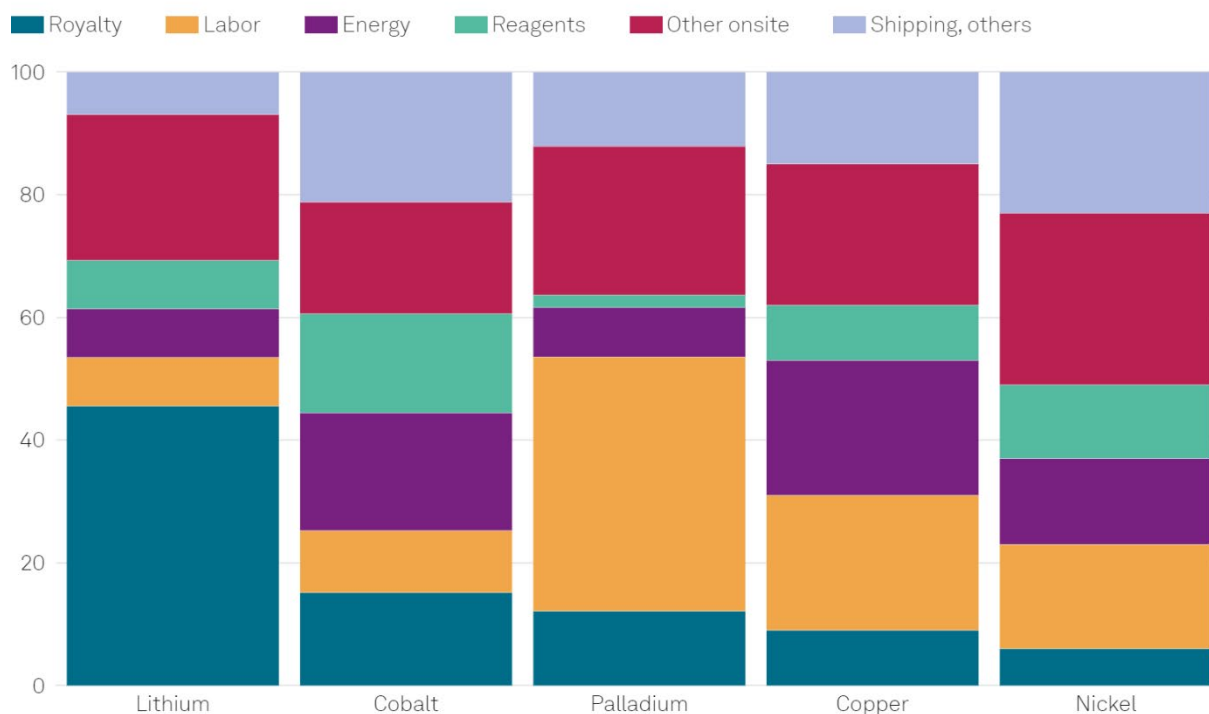
Countries looking to attract reshoring investments will have to balance their neutrality between the emerging rival geopolitical blocs carefully.

Resource guarding at heart of nexus between resilience and security

Government policies are becoming increasingly focused on securing domestic production of critical materials, such as minerals for energy transition and high-tech components. This competition is likely to lead to export restrictions, investment barriers and renegotiation of resource access agreements, with states seeking to maximize royalty incomes from resources. The security concerns underpinning these efforts have been seen in mainland China's restrictions on exports of certain materials, and food protectionism may continue due to historical drivers of commodity market disruptions and the impact of climate change.

Royalties make up 46% of lithium mines' cash costs (%)

Share of cash costs, 2023 mines in operation



Data compiled Dec. 4, 2023.

Source: S&P Global Commodity Insights.

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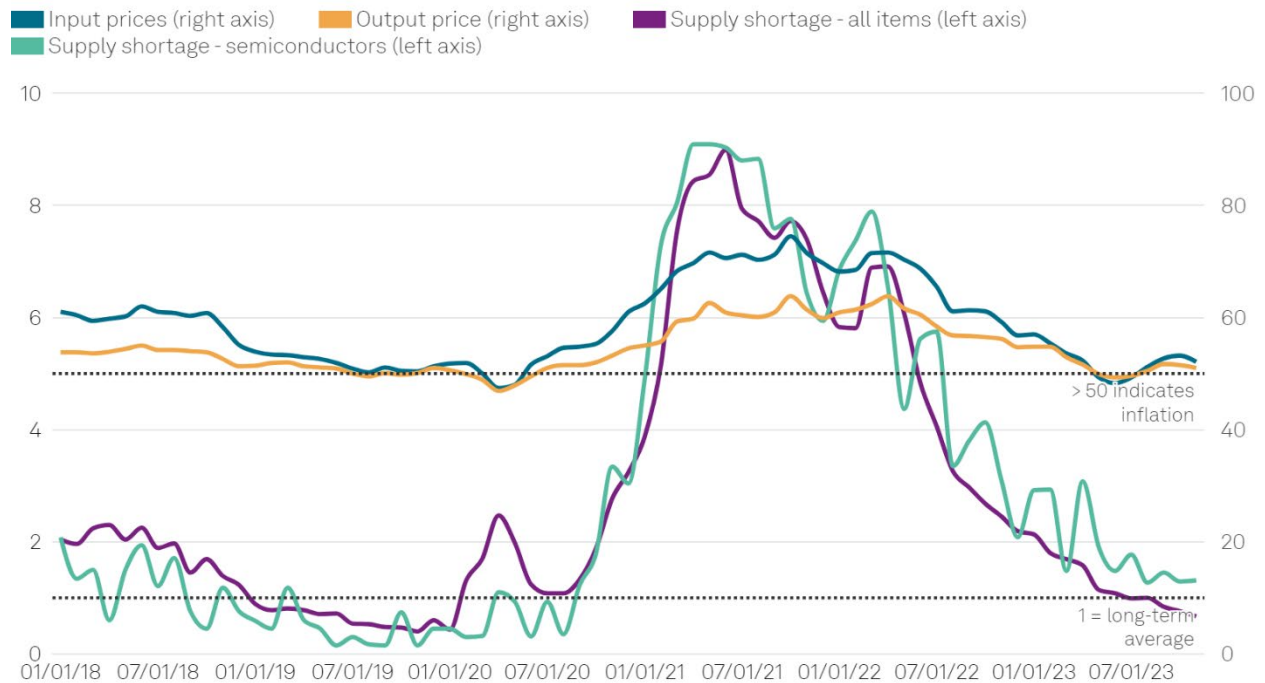
Supply chain disruptions as a driver of inflation

The Biden administration has linked supply chain policy to inflation reduction, but other countries have not followed suit. Supply chain shortages have dissipated, leading to disinflation in manufacturing input and output prices. However, there are potential upside

risks to inflation in the commodity sphere, while disruptions to shipping through the Red Sea have increased shipping costs. Reshoring production can provide near-term advantages for a country's growth and employment. Still, it results in a higher underlying cost structure and introduces distorting measures such as subsidies and tariffs. (See chart, "Producer price inflation has slowed as supply shortages have dissipated")

Producer price inflation has slowed as supply shortages have dissipated

Purchasing Manager Index for prices (right-hand axis, > 50 indicates inflation) and supply shortages (left-hand axis, 1 = long-term average)



Data compiled Dec. 4, 2023.
Sources: S&P Global PMI; JP Morgan.
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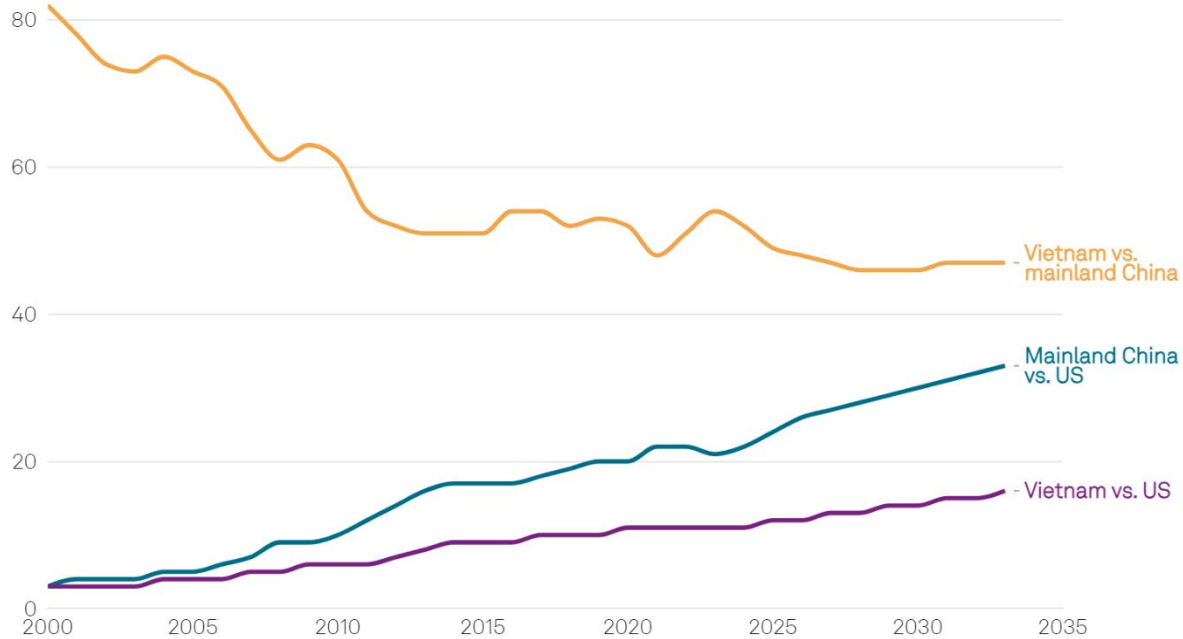
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Tensions between supply chain resilience and employment priorities

Many countries are implementing new industrial policies to benefit from generational shifts in supply chains, such as the electrification of transport. This has led to higher labor costs, which may be a drag on resources needed for supply chain resilience. Labor strikes resulting from failed negotiations over pay, terms and conditions have been an emergent challenge for supply chains in 2023 and will continue to pose a risk in 2024 and beyond. S&P Global Market Intelligence forecasts wage inflation to slow in the US, but Vietnam's advantage over mainland China may widen. The need to invest in staff for growing sectors, as well as economically or politically motivated protests, will continue to disrupt supply chains.

Wage advantage vs. US narrowing but still wide in 2033

Ratio of manufacturing hourly wages, denominated in US dollars



Data compiled Dec. 4, 2023.

Source: S&P Global Market Intelligence.

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<https://public.flourish.studio/visualisation/16662395/>

There is also a need to invest in staff for growing sectors, as manifested by challenges in enhancing semiconductor supply chains in the US. Skills-matching will be a significant challenge in delivering governments' policy aims, as discussed in more detail in "Labor: A critical component of supply chains under growing pressure."

Multiple elections will occur in 2024, including in the US, EU, Mexico, India and South Africa, granting unions the opportunity to obtain state support because governments will likely favor resolving wage disputes before electoral campaigns begin.

Economically or politically motivated protests not connected to wage negotiations will also continue, potentially disrupting supply chains, as protest groups target highways, rail infrastructure and project sites.

Global trends, local implementation: Issues to watch by region

Supply chain decision-makers must consider a variety of political issues, which can change over time, particularly as a result of national elections. The next two years bring elections across Mexico, the US, the European Parliament and many other countries.

The impact of US and EU elections is more likely to be felt in 2025, though election campaigns will set their policy tone and responses from key emerging economies. We remain convinced that supply chains will stay global.

Europe may be experiencing a renewed swing to populist politics at the same time as the European Parliament elections. Europe is at the epicenter of the convergence of supply chain and environmental policymaking with the Carbon Border Adjustment Mechanism, a deforestation-free directive, a corporate sustainability directive and an expanded emissions trading scheme. Many of these will be characterized by EU rivals as little more than trade protectionism.

Both the US and Mexico have national elections in 2024, with the potential for a new stack of supply chain policies — as well as the repealing of prior administrations' actions — to take effect in 2025 and beyond.

The future of supply chains in the Middle East and North Africa will, in part, be defined by the Israel-Hamas war, with a potential knock-on effect for supply chains both regionally and globally if the Suez Canal remains under threat. More positively, the India-Middle East-Europe Corridor brings potential benefits to regional trade and economic integration. Governments will continue to be challenged by disrupted energy and food supplies linked to the conflict in Ukraine.

Sub-Saharan Africa continues to struggle with adequate policy action on the availability of energy and logistics services. Energy issues could be resolved through renewable investments including carbon- and nature-for-finance credits and bonds. Governments are starting to tighten control over critical minerals, with measures such as localization and value-added demands. Elections in South Africa and Ghana bring uncertainties. New logistics projects that could address problems are being implemented, but the fiscal aspects will be a challenge.

In Latin America, Brazil and Argentina recently had a change in administration, with potential implications for the future configuration of trade within Mercosur. Newly elected Argentina President Javier Milei voiced his opposition to the trade group. The US-Mexico relationship will be challenged by the run-up to the US election, particularly if the US campaign focuses critically on migration, Mexican labor rights and drug trafficking.

One of the biggest potential risks for global supply chains comes from the South China Sea, Taiwan Strait and Korean peninsula. Like Africa and Latin America, most Asian governments will continue to seek to expand their value chain of critical minerals via regional partnerships and protectionism. There will be intensifying trade ties between mainland China and the Association of Southeast Asian Nations, including growing mainland China foreign direct investments in manufacturing to bypass US direct-supply restrictions.

Finally, India's reshoring-led manufacturing expansion is in flight and unlikely to be disturbed, barring a shocking election outcome or sharp change in policy direction. The challenge is shifting from policies focused on industrial incentives to the delivery of state-supported logistics investments, as discussed in "['Make In India' Manufacturing Push Hinges on Logistics Investments.](#)"

Learn more

- [A disjointed world: Themes for 2024](#)
- [Global Credit Outlook 2024: New Risks, New Playbook](#)
- [Canal route pain: Red Sea shipping disruptions' impact on North American supply chains](#)
- ['Make in India' Manufacturing Push Hinges on Logistics Investments](#)
- [For Mexico, Nearshoring's Potential Benefits--And Obstacles--Are Significant](#)

Footing the bill: Paying for resilience

Even as supply chains return to normal, the need for resilience is as important as ever. Firms will prefer strategies that lower costs and risk, such as technology investments and reshoring. They will likely cut back investments in purely risk-reducing projects, including just-in-case inventory strategies and supplier diversification.

Chris Rogers, Head of Supply Chain Research, S&P Global Market Intelligence, chris.rogers@spglobal.com

David Teshler, Head of Credit Research, North America, S&P Global Ratings, david.teshler@spglobal.com

Andrew Palmer, Managing Direct Methodologies COE, S&P Global Ratings, andrew.palmer@spglobal.com

Mark Fontecchio, Analyst, Internet of Things, S&P Global Market Intelligence, mark.fontecchio@spglobal.com

Highlights

Corporations are emerging from a period of supply chain disruptions, with a tailwind from improvements helping their profitability. However, this does not eliminate the need for investing in future supply chain resilience strategies.

Firms must balance generating short-term cash flow with spending on long-term material resilience. Inventories are being cut back to pre-pandemic levels, which is unsurprising given higher interest rates and financing costs. This will, however, leave firms at risk of short-term inventory shocks.

Supplier diversification has reversed, reflecting a focus on cost-cutting and simplification. This could lead to more fragile supply chains, increasing geopolitical and logistics network risks.

Investments in technological improvements and reshoring can provide cost improvements and risk mitigation, but such strategies can be organizationally complex, expensive, take years to deliver and introduce new forms of risk.

Supply chain activity normalized in operational terms during 2023, but there are significant risks across the board heading into 2024. Supply chains need to be more resilient, but questions remain over whether corporations and their investors can make the necessary investments to fortify them.

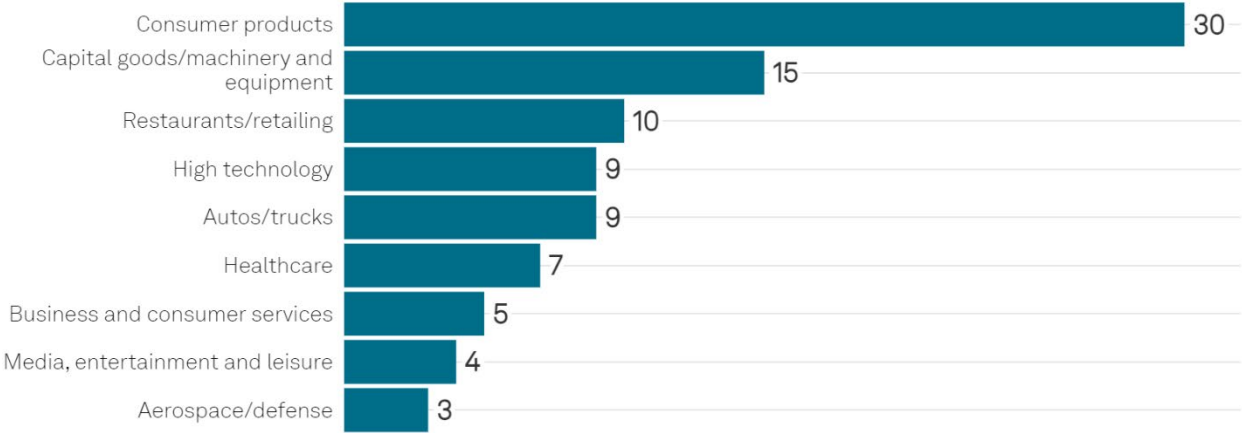
Supply chain spending to be squeezed by lower profits, replacement capex

The supply chain disruptions caused by the COVID-19 pandemic took a toll on firms' creditworthiness. According to "Supply-Chain Risks: A Credit Perspective," S&P Global Ratings took negative rating actions on over 200 corporate issuers due to supply chain events and bottlenecks in 2020–2022. These negative rating actions included downgrades, placements on CreditWatch with negative implications and outlook revisions to negative.

Consumer products was the industry that experienced the largest number of negative rating actions, accounting for 30% of the activity. (See chart, "Consumer products leads supply chain negative rating actions") A material disruption at any point across a supply chain can have consequences for a business' ability and willingness to meet its financial obligations, thereby affecting its creditworthiness.

Consumer products leads supply chain negative rating actions (%)

Supply chain-related negative rating actions by industry, 2020–2022



Data compiled Nov. 30, 2023.
Source: S&P Global Ratings.
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<https://public.flourish.studio/visualisation/16539459/>

High-profile examples of supply chain disruptions include restrictions on Russian gas and Ukrainian grain supplies due to conflict, container and shipping shortages in 2021 and 2022, and semiconductor shortages that began in 2020. These have elevated supply chain matters from procurement to the C-suite and the attention of investors.

Looking ahead, S&P Global Market Intelligence data shows that gross operating profit margins for manufacturing firms globally are expected to fall to 10.4% of sales in 2024 from 10.7% in 2022. We see the computing and electronics sector and domestic appliance manufacturing being particularly affected.

At the same time, capital expenditures are expected to exceed gross operating profits by 5% in 2024 after being equal to them in 2022. Investing in capital stock to maintain existing facilities and meet earnings growth objectives is another area that may take priority over spending on supply chain change.

S&P Global Ratings' credit condition outlooks also see risks from cost pressures, squeezing profits and eroding credit quality. Although risks remain high, the trend is toward improvement.

In North America, many corporate borrowers are finding it difficult to pass along high input prices such as wages and energy costs to end-consumers and end-customers. If profit erosion becomes more widespread and steeper than expected, credit quality could further suffer.

In Asia-Pacific, there are risks from global supply chain realignments. A further reduction in supply chain reliance on mainland China by Western and other importers could push up costs over the next few years, adding to inflation pressures. An escalation of international disputes over the seas and lands in south and southeast China would damage economic activity.

In [Europe](#), the emphasis is on an extended period of favorable real interest rates that could expose financial vulnerabilities for issuers that find access to financing restricted and the cost of debt service prohibitive. That may squeeze issuers' surplus capital for investment in supply chain enhancements.

BOX: What companies are saying about supply chain stress

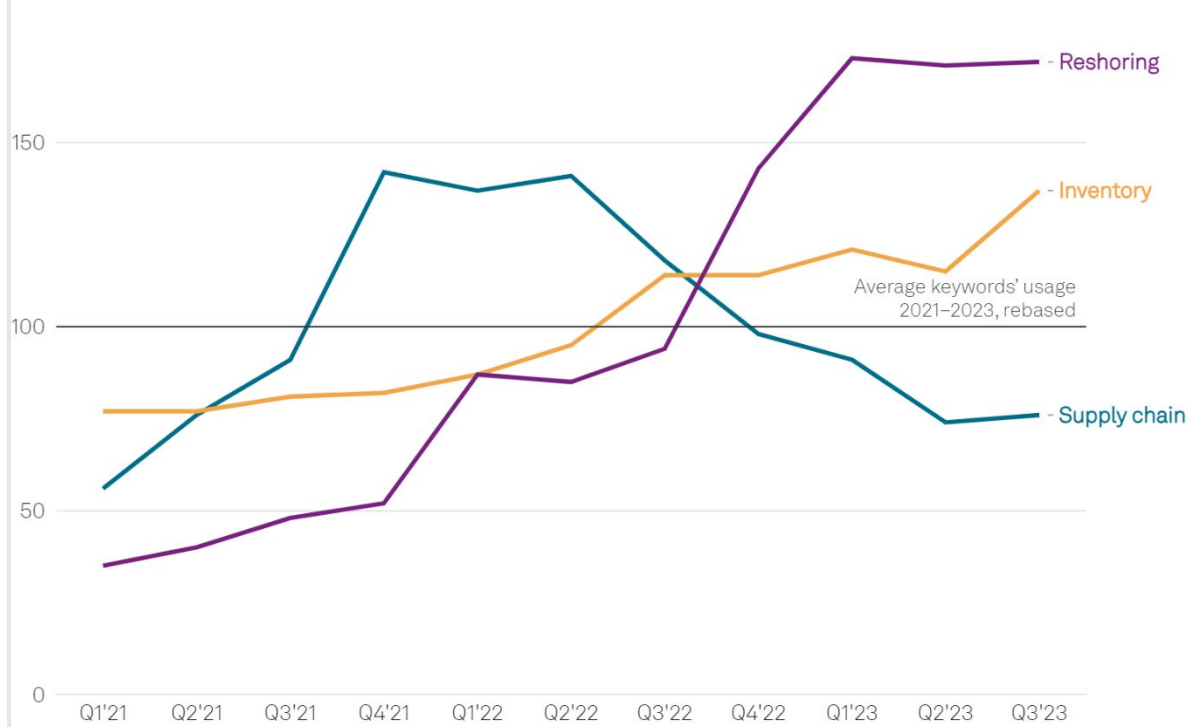
Quarterly earnings conference calls, analyzed using S&P Capital IQ machine-readable transcripts, show that mentions of "supply chain" as a topic (including semantically related keywords) soared during the pandemic, reaching a peak of 1.4x their 2021–2023 average for calls held during the second quarter of 2023. There has since been a decline in mentions of the topic, with calls held during the third quarter of 2023 mentioning supply chains just 76% of their average for the 2021–2023 period. Regardless, with 2,900 companies having mentioned the topic during the third quarter of 2023, there is still a wide-ranging focus on the state of supply chains.

As companies move beyond recent supply chain disruptions and implement longer-term strategic adaptations, one topic that has become more important is reshoring, which is associated more with longer-term inventory transitions than short-term turmoil.

Mentions of reshoring and related keywords have soared to 172% of their three-year average. This suggests an increased focus on a strategy that can take years to implement. The increased discussion about inventories comes partly at a time of slowing sales and may not necessarily reflect a decision to abandon just-in-case inventory strategies.

Supply chain focus declining, reshoring becoming more important

Mentions of keywords in corporate conference calls, rebased keywords' 2021–2023 average = 100



Data compiled Oct. 17, 2023.

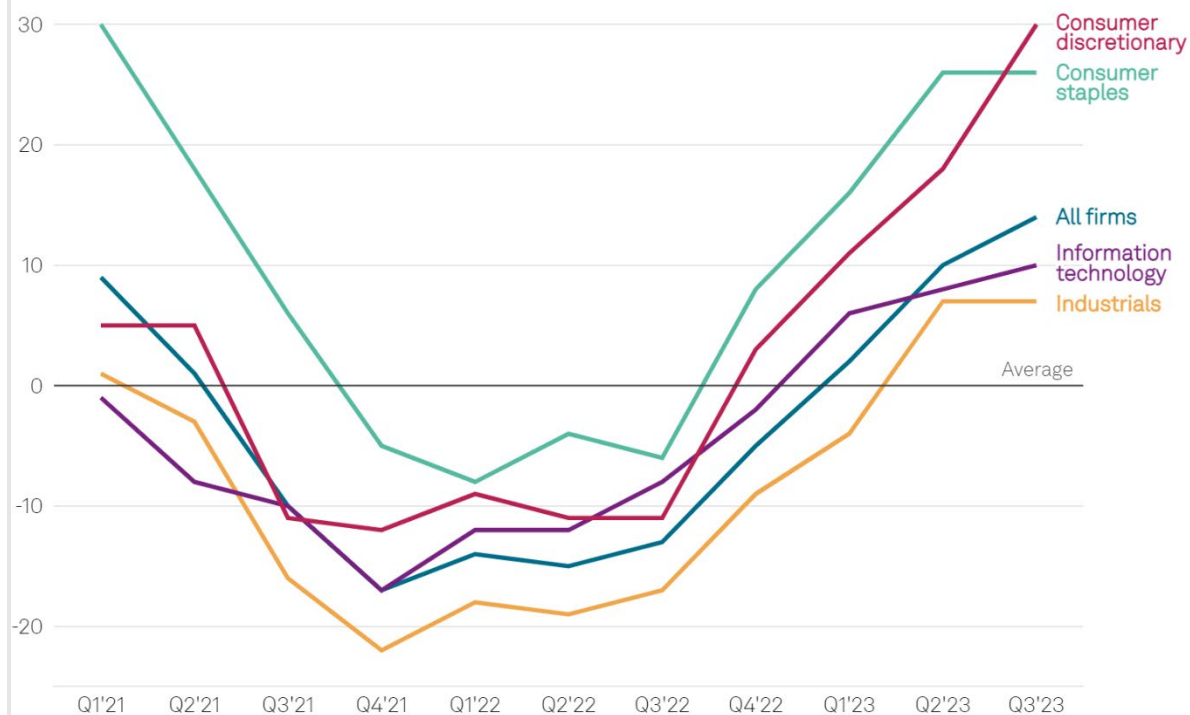
Sources: S&P Global Market Intelligence; S&P Capital IQ Pro; ProntoNLP.

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Firms broadly positive about impact of supply chain issues on balance (%)

Net positivity of mentions of "supply chain" in corporate conference calls



Data compiled Oct. 17, 2023.

Sources: S&P Global Market Intelligence; S&P Capital IQ Pro; ProntoNLP.

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<https://public.flourish.studio/visualisation/16539956/>

Just not time for just in case

One of the most tangible signs of supply chain challenges during the pandemic was empty shelves. The shortage of inventories led many firms to over-order and cut stock levels in late 2022 and into 2023. While it is understandable to want to reduce inventories in a high-interest-rate environment, retaining a just-in-time approach can leave firms vulnerable to future shocks, whether political, operational or financial.

Data from the S&P Global Purchasing Managers' Index (PMI) [indicates](#) that most companies are returning to their pre-pandemic stocking strategies, with manufacturing stocks of finished goods in retreat for nine of the 10 months through September 2023. While the computing sector has experienced a particularly notable inventory decline, the downturn in consumer goods has been more sporadic.

Corporate financial data presents a mixed picture. As of Sept. 30, 2023, the inventory-to-sales ratio for the Russell 3000 group of manufacturers and retailers of goods was 54.1% on a trailing three-month basis compared with an average of 50.1% for the 2016–2019 period.

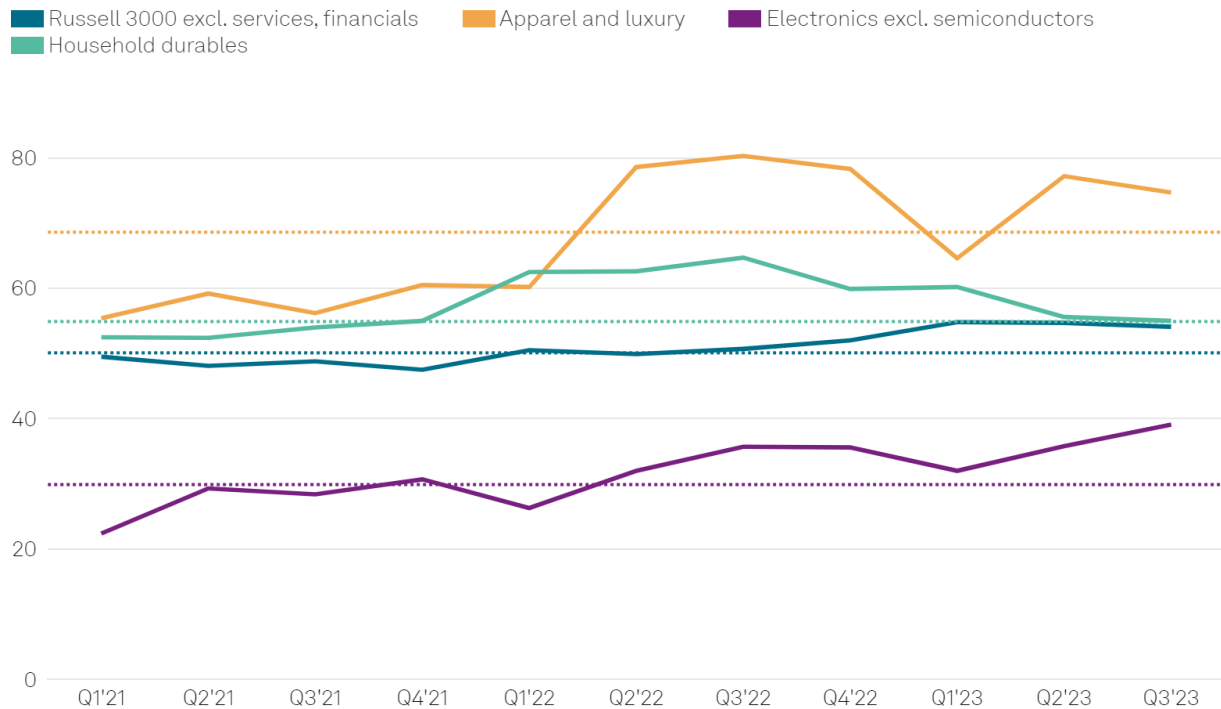
- The elevated level is not necessarily indicative of a change in inventory patterns, as it is below the peak of 54.8% reached in March 2023.
- The elevated level is caused by a handful of sectors. Apparel (including retailers and manufacturers) has an inventory-to-sales ratio of 74.7% versus 68.6% historically, while

electronics (excluding semiconductors) stands at 39.1% versus 29.9% historically. Firms in both sectors are committed to reducing their inventories.

- Sectors with longer sales cycles, such as household durable goods, are closer to balance. In September 2023, the inventory-to-sales ratio for that sector was 55.0%, well below the peak of 64.7% from a year earlier and in line with the historical average of 54.9%.

Corporate financial data shows inventories still elevated in some sectors (%)

Inventory-to-sales ratio, sector last three months reported (dotted line = 2013–2019 average)



Data compiled Oct. 4, 2023.

Sources: S&P Global Market Intelligence; S&P Capital IQ Pro.

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<https://public.flourish.studio/visualisation/16540619/>

According to S&P Global Ratings credit conditions research, only a few sectors in North America plan to increase their inventories in 2024. These include containers and packaging, autos, healthcare and pharmaceuticals, and homebuilders. Others expect to maintain or cut their inventories.

Over the next three years, between 20% and 50% of companies across various sectors are anticipated to adjust their supply chains. We expect the ratio will likely be over 50% for capital goods and consumer products.

Most capital goods, consumer goods and retail firms are adjusting their strategies

Share of firms adjusting their supply chain strategies over next three years

How companies plan to change inventory levels in 2024	<20%	20%-50%	>50%
Increase	Business and tech services Containers & packaging	Autos and OEMs Healthcare Homebuilders Pharmaceuticals Unregulated power	
Maintain	Media and entertainment Gaming, leisure and lodging	Aerospace & defense Regulated utilities Transportation	
Decrease		Building materials Technology	Capital goods
Varies or N/A	Metals and mining Midstream energy Oil and gas Oil refineries REITs Telecoms		Consumer products Retail and restaurants

Data collated Dec. 14, 2023.

N/A = not applicable; OEM = original equipment manufacturer; REIT = real estate investment trust.

Source: North American corporate ratings analysts' survey in November 2023, S&P Global Ratings.

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Diversification falling out of favor

Companies can reduce supply chain risks by implementing supplier diversification and reshoring strategies. The two are often interrelated, but the diversification of suppliers can come in and out of fashion depending on the need for cost reductions. In the next three years, firms may focus on cost-cutting measures that could lead to shorter supplier lists and an increased concentration of orders among fewer suppliers to secure better prices.

Panjiva data shows that among the top 500 US importers from 2019 to 2023, the number of suppliers (shippers) per ultimate buyer (consignee) increased 13% in 2021 compared with 2019. This indicates the use of more suppliers to manage disruptions.

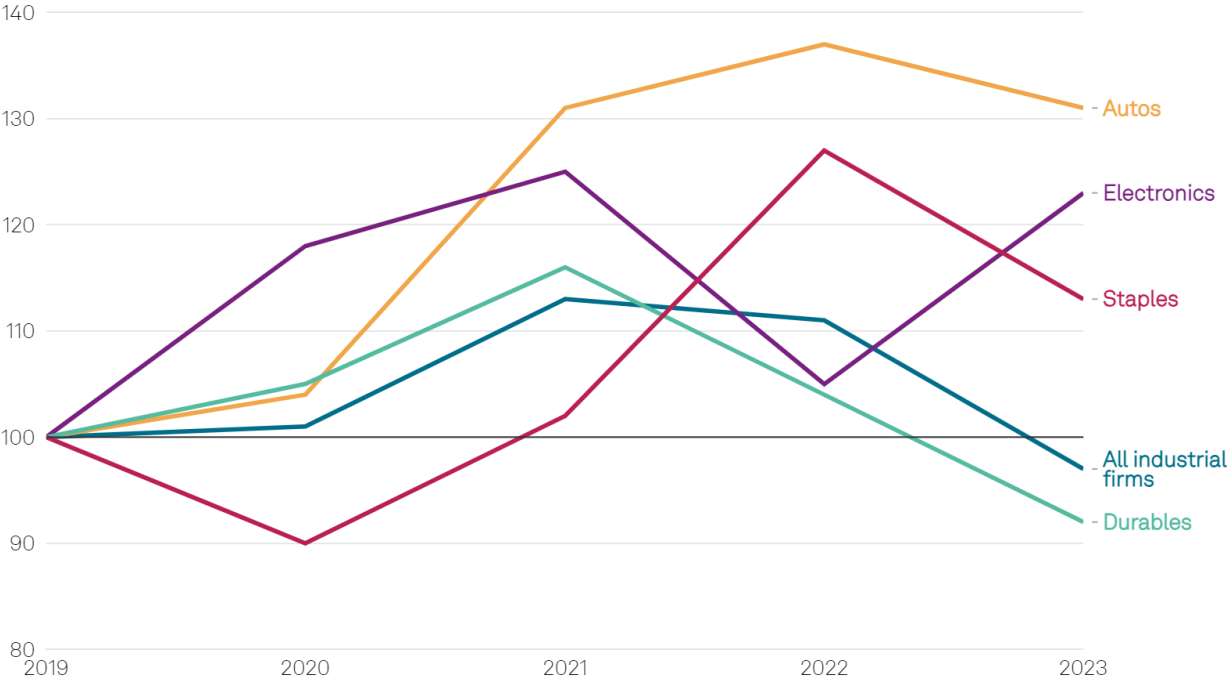
In 2022, there was a 2% decline, while data for the 12 months through Nov. 30, 2023, suggests a return to 3% below 2019 levels. At the sector level, there are signs of a more extreme run-up among consumer durables firms during the pandemic. At the same time, the reduction in diversification has also been faster, with the number of suppliers per buyer in 2023 down 8% versus 2019.

The auto industry has continued to expand the number of suppliers per buyer. This potentially reflects the sector's shift to EV production while maintaining its internal combustion engine production.

In the long term, abandoning diversification may lead to problems in the event of single-supplier risks or systemic issues, including geopolitical influence and large-scale logistics network interruptions.

Pandemic-era supply chain diversification reverses in most sectors

Shippers per ultimate parent consignee, rebased 2019 = 100



Data compiled Dec. 5, 2023.
Sources: S&P Global Market Intelligence; Panjiva, the supply chain research unit of S&P Global Market Intelligence, a division of S&P Global Inc.
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<https://public.flourish.studio/visualisation/16539026/>

Technology – Plenty of choice, organization and ROI matter

Investments in supply chain technology can provide benefits including administrative cost reductions and improved planning accuracy through risk mitigation measures such as alternative route planning and supplier risk identification. The costs of implementing such data are much smaller than changes in inventory levels and supplier diversification.

Yet, the reputation of disruptive supply chain technologies — most notably in freight forwarding and trucking — has taken a hit due to business setbacks to high-profile startups in the sector. Digital paperwork, predictive analytics and AI tools can help enhance service-based, human-relationship-focused businesses but cannot completely replace them. S&P Global Market Intelligence has found examples of firms that have saved millions of dollars in logistics costs through systems consolidation, centralized planning and improved visibility.

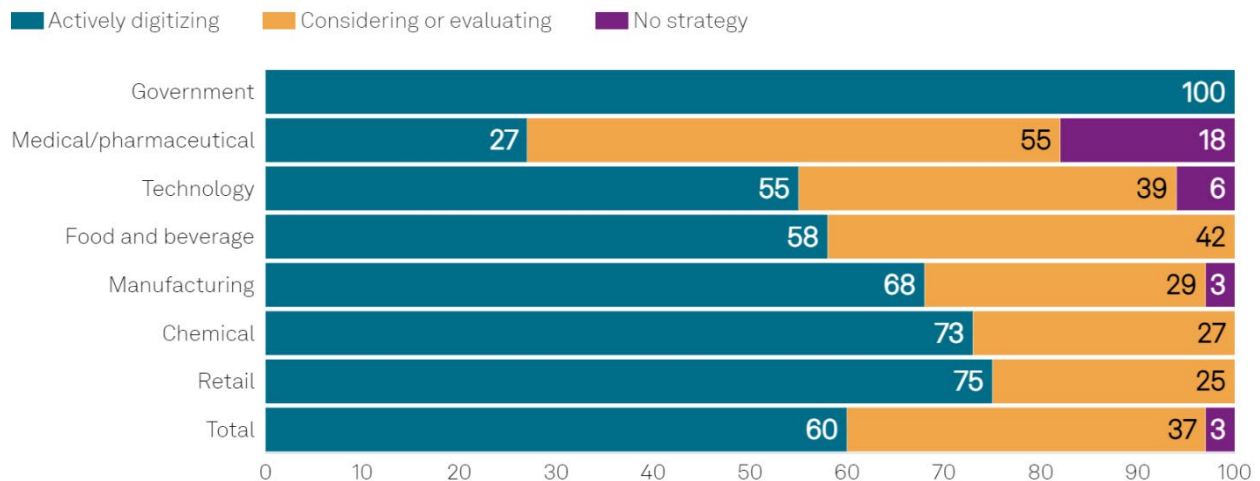
A recent "Supply Chain Digital Transformation" survey by S&P Global Market Intelligence 451 Research found that six out of 10 supply chain organizations have a digital transformation

strategy and are digitizing their business practices. The remaining companies have such plans in flight but have not yet launched them.

The level of development by sector varies markedly, with 75% of retail firms having a strategy underway while only 27% of the medical and pharmaceutical sectors are actively digitizing (though a further 55% are investigating a plan).

Retail, chemical sectors at forefront of supply chain digital transformation (%)

Which of the following best describes the status of your organization's digital transformation strategy?



Data compiled January 2024.

Source: S&P Global Market Intelligence 451 Research's Supply Chain Digital Transformation Survey 2024.

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<https://public.flourish.studio/visualisation/16567127/>

BOX: Electronic logging device rules show potential for organized technology investments

The electronic logging device mandate was implemented about five years ago to promote national road safety. It required commercial vehicles to have a telematics device to track how many hours drivers worked and operated their vehicles. The goal was to reduce the number of tired truck drivers on the road.

As a result of the mandate, there was a huge jump in the volume and types of data that fleet managers could start collecting from their vehicles, drivers and cargo assets. This led to a major disruption in over-the-road distribution in the US, with projects including route optimization, preventative maintenance and driver monitoring.

BOX: Digital bills of lading foundational to supply chain transformation

Digitizing logistics workflows is vital to broader supply chain technology investments. This is because bills of lading are crucial to the operational, compliance and finance functions of most manufacturing and retail firms. In early 2023, the Digital Container Shipping Association committed to achieving 100% digitization of bills of lading by 2030. The move could have cascading effects, including creating a new and comprehensive dataset that can be used for tracking, fraud prevention, contract enforcement and trade finance. A recent S&P Global

survey showed that 80% of cargo owners and 70% of logistics service providers have implemented or are in the proof-of-concept stage for document digitization.

BOX: AI augments human judgment

S&P Global Market Intelligence analysis shows that AI technologies in supply chains cannot prevent disruptions on their own, but they can help predict probabilities of future ones if deployed in an organizationally integrated manner. AI-based tools may also shorten recovery times by indicating where there should be inventory redundancies. Additionally, these tools can be used for scenario planning, finding optimal distribution routes, and cost-cutting measures via document and customer service improvements.

Delivering successful technological improvements through the supply chain is highly complex, with long lead times and organizational changes required. Firms may therefore prefer less-speculative technologies while firmwide profitability remains depressed. The blockchain and autonomous vehicles are examples of technologies hailed as revolutionary that have yet to yield returns.

Additionally, technology investments cannot just be the purview of the IT department. After a period of experimentation, an honest assessment of returns versus investment based on realistic assumptions can prevent subsequent disappointments — vital for shareholder-owned firms.

At the implementation stage, buy-in from operational divisions and careful coordination with legal and compliance operations are required. The latter is particularly important where data must be shared with suppliers, customers or service firms such as logistics partners and newer IT partners in AI.

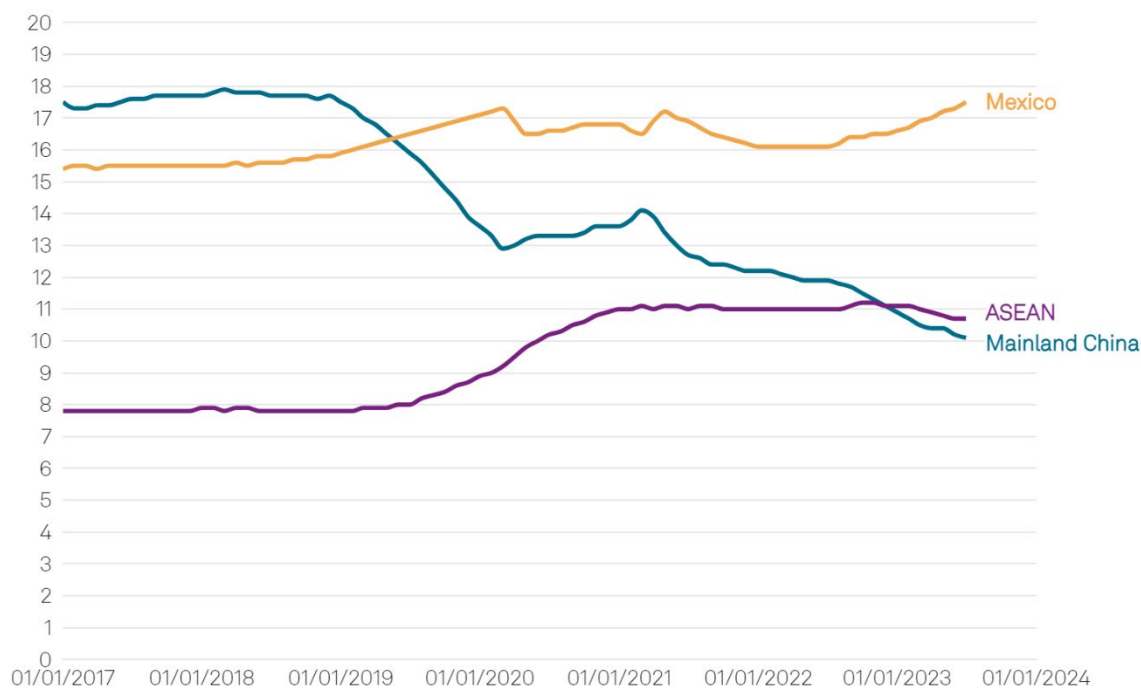
Reshoring – Cutting costs and cutting risks

The decision to reshore supply chains is driven by cost minimization and risk mitigation, S&P Global Market Intelligence analysis shows. It is a well-established strategy and is set to continue for many years.

- Geopolitically driven supply chain diversification strategies have been taking place across power tools, apparel, washing machines and computers. Geographic diversification will likely continue as the political backdrop for Asia-Europe and Asia-North America supply chains evolves. The rivalry between the EU and mainland China may increase, thanks to the former's review of the latter's EV industry. The outcome of the US elections in November 2024 could drive a rivalry with mainland China in 2025 and beyond.
- Onshoring production to India is partly driven by the scale of the Indian market and the exigencies of the government's Production Linked Incentive program and tariffs, as discussed in "['Make In India' Manufacturing Push Hinges on Logistics Investments.](#)"
- Nearshoring to Mexico for the North American market may enter a new phase in 2024, as flagged in "[Mexico as a supply chain reshoring leader.](#)" However, the market has to compete with the US as a production center in several sectors, particularly in the electrification of transport.

Mexico, ASEAN gain from mainland China's loss of share

Share of US imports of products covered by Section 301 tariffs applied to mainland China, trailing-12-month total basis



Data compiled Oct. 13, 2023.

ASEAN = Association of Southeast Asian Nations.

Source: S&P Global Market Intelligence.

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<https://public.flourish.studio/visualisation/16567296/>

Although reshoring has multiple benefits, it is costly and carries risks. Investment in new production facilities, qualification of new suppliers, establishment of quality control systems and meeting regulatory requirements can run into the tens of millions of dollars. Replicating integrated supply chains may require bringing several suppliers on board rather than a single investment decision, while geographically lengthy supply chains introduce operational risks. Moving manufacturing away from a country can lead to a loss of sales in that market, so firms often only use reshoring for incremental investments.

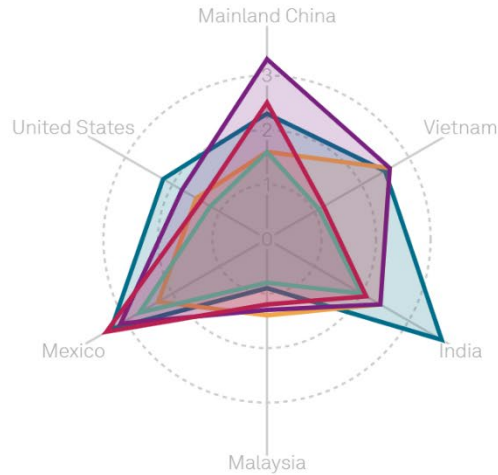
Additionally, the human factor should not be underestimated. Training skilled staff and instilling a culture of quality control requires time and effort. Moving to a different country also does not remove all risks. Managing such long-term decisions requires balancing operational risks raised by labor strikes and cargo disruptions with contract risks and policy uncertainty. S&P Global Market Intelligence country risk scores show that Vietnam generally offers lower risks than mainland China, except for infrastructure disruptions, while Malaysia is a lower-risk alternative to India.

Trade-off between risk types necessary for most reshoring locations

Country risk score (0-10, log scale)

Click to see individual risk types

All	Labor strikes	Infrastructure disruption	Regulatory burden	Cargo and transport	Policy instability
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Data compiled Dec. 20, 2023.

Source: S&P Global Market Intelligence.

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<https://public.flourish.studio/visualisation/16567419/>

Learn more

- [The Big Picture: 2024 Supply Chain Industry Outlook](#)
- [Leveraging corporate commentary and earnings data for supply chain insights](#)
- [Credit Conditions North America Q1 2024: A Cluster Of Stresses](#)
- [Credit Conditions Asia-Pacific Q1 2024: China Slows, India Grows](#)
- [Credit Conditions Europe Q1 2024: Adapting To New Realities](#)

Decarbonization and development: Logistics network investments

Container shipping handles 45% of global trade. How it will decarbonize is an open question.

Peter Tirschwell, Vice President, Journal of Commerce, S&P Global Market Intelligence, peter.tirschwell@spglobal.com

Chris To, Managing Editor, Global Container Markets, S&P Global Commodity Insights, chris.to@spglobal.com

Turloch Mooney, Director, Port Performance, S&P Global Market Intelligence, turloch.mooney@spglobal.com

Mayank Agarwal, Principal Analyst, Ship Characteristics, S&P Global Market Intelligence, mayank.agarwal2@spglobal.com

Highlights

Container shipping provides a case study of the challenges in decarbonizing maritime transport. The highly competitive industry is responsible for transporting 45% of global trade by value, accounting for 0.75% of global greenhouse gas emissions.

The International Maritime Organization (IMO) has mandated that the shipping industry achieve net-zero GHG emissions by or around 2050. This will result in higher industry costs and require shipping companies to find efficient ways to spread these costs across the supply chain.

However, there are concerns that the IMO may not approve a meaningful carbon tax, potentially leaving the industry ill-equipped to finance the transition. The next two years will be critical for the UN agency to develop regulations that can create a viable pathway toward the 2050 decarbonization target.

The year 2023 was a milestone in container shipping. All ships ordered with a capacity greater than 5,000 twenty-foot equivalent units will be able to operate on alternative fuels such as ammonia and methanol, reflecting the growing momentum in the sector's decarbonization journey. Still, questions surrounding key aspects of the plan remain, starting with who will bear the cost of the massive bill that will come due in the next few decades.

Regulated for success: A pathway to decarbonization

The shipping industry is working on reducing its carbon footprint. Though the process is underway, the outcome is uncertain in terms of timing and methods.

The container shipping sector presents multiple challenges. Container shipping transports about 45% of the value of international trade, with two-thirds of all seaborne trade by value being containerized, according to the UN Conference on Trade and Development. It is the primary mode of transport for consumer goods, manufactured goods, specialized agriculture and specialized chemicals. For decades, container shipping has absorbed cargo previously moved by other maritime transport modes, including bulk, breakbulk, refrigerated and roll-on/roll-off.

Approximately 3% of GHG emissions come from the maritime industry, while container ships account for 25% of maritime emissions, according to industry data. Maritime was not mentioned in the 2015 Paris Agreement on climate change, leaving the IMO with the responsibility of decarbonizing the sector.

Unique among hard-to-abate sectors, maritime is an inherently transnational industry regulated by a global agency that has long created and enforced safety, security, operations and emissions rules. This is seen as an advantage because it provides an opportunity to create a global pathway to decarbonization, which is not available in other sectors. In mid-2023, the 175 member states of the IMO unanimously agreed to more ambitious global decarbonization goals. The agreement replaced the prior goal of achieving a 50% reduction in carbon emissions by 2050 (versus 2008 levels) with a new goal of eliminating carbon emissions "by or around" 2050, in line with the Paris Agreement's objective of limiting global warming to 1.5 degrees C above preindustrial levels.

The agreement included waypoints, such as committing international shipping to zero or near-zero carbon energy sources for at least 5% of energy use by 2030 and reducing total GHG emissions by at least 20% by 2030 and 70% by 2040 compared with 2008 levels. To ensure these goals are met, the IMO launched a two-year process of writing and approving regulations to establish a pricing mechanism for carbon and implement measures like fuel requirements.

Technology available, payment wanted: Delivering decarbonization

The process of decarbonizing maritime, as for all other sectors, comes with significant costs. It is unclear who will bear that cost, as pricing for such things as zero-carbon fuels is set by the market, not by regulation. Efforts to decarbonize have involved investments by container lines in eco-friendly ships where operation and fuel costs can be absorbed with marginal financial implications for the carriers. But as the carriers scale up, the cost will increase exponentially and would need to be shared with cargo owners and their customers.

The container industry's first step toward decarbonization was to use LNG, which emits 25% less CO₂ than traditional bunker fuel. However, the impact of LNG is still minimal; only 74 container ships run on LNG, representing just over 1% of all container ships in operation,

based on S&P Global Market Intelligence data. Another 186 LNG ships are on order, meaning LNG will represent roughly 4% of container ships in operation once those ships are delivered. LNG ships on order are nearly a quarter of container ships under construction, which shows that ship owners are increasingly emphasizing orders for eco-friendly vessels.

Green ammonia and methanol are two potential zero-carbon fuels that could achieve scale. Both are chemicals produced from renewable energy sources. While batteries can operate on small vessels such as ferries, they are considered inadequate for deep-sea ocean shipping due to their weight and limited energy density compared with other energy sources.

Methanol has progressed faster as a zero-carbon fuel compared with ammonia, which is highly toxic and will require extensive safety precautions. As of late 2023, one methanol-powered container ship was in operation. Orders have been placed with shipyards for 125 container ships that can operate with methanol upon delivery and another 50 ships that can be retrofitted to use methanol later, according to S&P Global Market Intelligence.

There are no existing orders for ships that can be powered by ammonia upon delivery, but orders have been placed for 50 ships that can be converted to ammonia power post-delivery. Ammonia is moved today by ship as cargo and has influential advocates within the maritime industry. Less than 2% of container ships in operation are running on alternative fuel, nearly all of that LNG, but a rapid scaling-up is underway, with about 40% of all container ship orders being for ships that can run on reduced or zero-carbon fuels upon delivery. All container ships ordered in 2023 with a capacity greater than 5,000 twenty-foot equivalent units will be able to operate on alternative fuels either upon delivery or later.

Greening of the container fleet is underway

Current orders for container ships able to operate on alternative fuels upon delivery

Alternative fuel equipped	Count	Percentage of total current containership orderbook (%)
LNG	194	23.54
Methanol	125	15.17
Ammonia	0	0.00
Others:		
Biofuel	0	0.00
Ethane	0	0.00
Gas boil-off	0	0.00
Hydrogen	2	0.24
Liquefied biogas	7	0.85
LPG	0	0.00
Low volatile organic compounds	0	0.00
Total: 328	39.80	39.80

Data compiled Jan. 10, 2024.

Source: S&P Global Market Intelligence.

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As the industry scales up, the question of who pays for the conversion of the fleet and bunkering facilities is emerging as a key issue. A UN Conference on Trade and Development report said that up to \$28 billion would be required annually to decarbonize ships by 2050, in addition to up to \$90 billion to build the infrastructure to store, deliver and transfer zero-carbon fuels. Theoretically, the cost should be shared across the value chain, but in practice, accomplishing that is far from simple or assured.

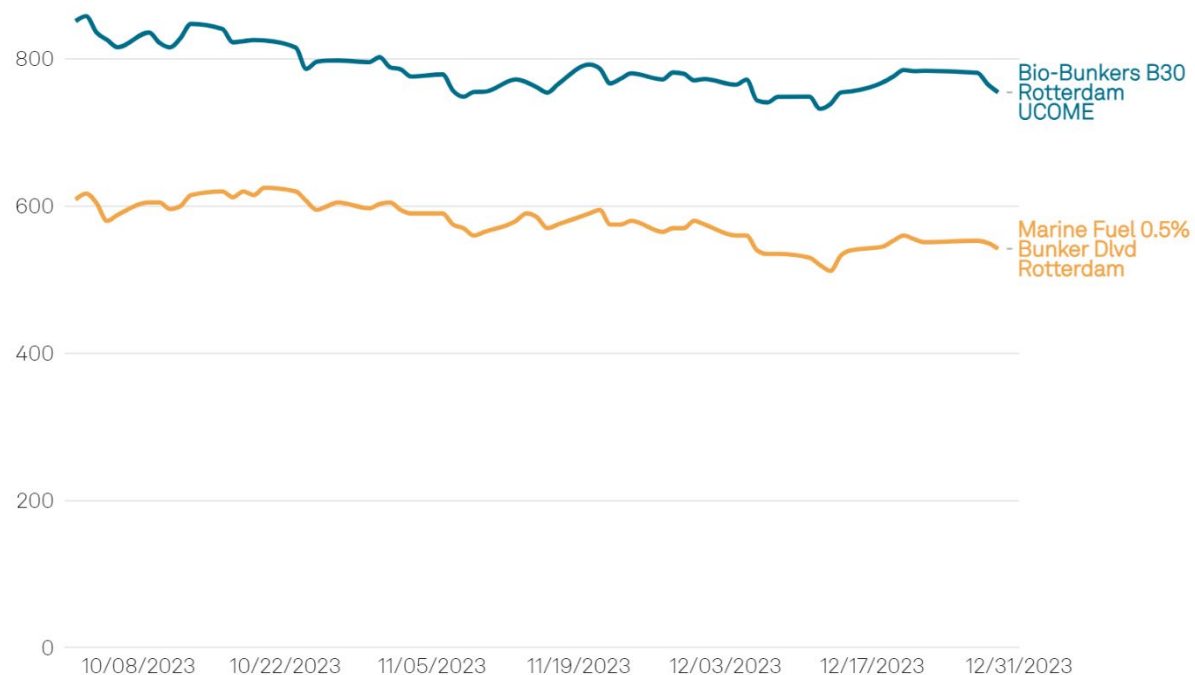
There is limited evidence, at least so far, that retailers, manufacturers and other shippers are willing to pay higher-than-market prices to ship goods using alternative fuels, except for a few pioneers. Despite S&P Global Sustainable1 reporting that about 4,000 companies have publicly committed to reducing Scope 3 emissions, which includes outsourced maritime and other forms of transportation, only a few large container shippers have agreed to pay above-market rates for zero-carbon solutions. Among them are members of a buyers' association led by the Aspen Institute and including Nike, Levi Strauss, Tchibo and Schneider, which has pooled members' cargo and is seeking competitive bids from ocean carriers for zero-carbon transport.

For most cargo owners, the voluntary system alone will not achieve the IMO's revised targets. The IMO must introduce regulations within the next two years to bridge the gap between zero-carbon and traditional bunker fuels. A key question is whether IMO member states can agree to a carbon price that is high enough to neutralize or mitigate the significant cost differential between the fuels. As of October 2023, the effective price of methanol was more

than six times that of low-sulfur fuel oil, while the effective price of ammonia was nearly nine times the price of low-sulfur fuel oil, according to one ocean carrier's analysis. Data from S&P Global Commodity Insights shows "bio-bunker" fuel prices are approximately 40% higher than crude oil-based products.

Biofuels priced at a 40% premium to traditional fuels

Bunker fuel prices, delivered into Rotterdam, US\$ per metric ton



Data compiled Jan. 8, 2024.

Source: S&P Global Commodity Insights.

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Container line companies have introduced green shipping services that allow shippers to reduce their CO₂ emissions through a process known as carbon insetting. However, interest in these services has been modest at best.

Beyond ships: Pricing carbon to encourage change

The carbon price debate within the IMO is controversial and emotional. Two primary carbon pricing mechanisms — the bunker levy and cap-and-trade system — face significant opposition. For example, some remote island nations fear that a high carbon price will lead to higher transport costs and ultimately higher consumer prices, akin to a transnational tax. Negotiators will need to agree on a common strategy by spring 2024 to meet the IMO's timeline for new regulations.

An alternative way to reach those goals is by setting a global fuel standard, one that is neutral regarding fuel type but mandates a progressively larger zero-carbon component of fuels used by the global fleet of 50,000 deep-draft vessels.

But that option, while politically less divisive, still requires container lines to pass along the cost of zero-carbon fuels, which are certain to be higher than for traditional bunkers because of limited supplies, the multistep refining process required to produce them and competition for those fuels from other industries.

A preview of such a scenario came in December 2023 when China did not recognize additional fees introduced by container lines in accordance with the EU Emissions Trading System (ETS), which will cover maritime transport from Jan. 1, 2024. China saw the cost as an unfair tax on its exporters, preventing carriers from passing along decarbonization-related expenses as an additional surcharge. Despite this, several carriers have shown their intent to publicize these ETS surcharges on at least a quarterly basis to shippers globally.

With the EU ETS phase-in period in its infancy of charging 40% of half of inter-EU emissions in 2024, S&P Global Commodity Insights expects the impact on overall shipping trading patterns to be minimal in the near term. However, ETS fees of €9.00-€83.00 per twenty-foot equivalent unit as of November 2023, depending on the carrier and route, will pale in comparison to the costs of zero-carbon fuels. This reveals the long-term liability carriers face if they lack a clear mechanism for sharing the costs with customers. The result could be a structural squeeze on an industry that has historically been minimally profitable, potentially leading to further consolidation.

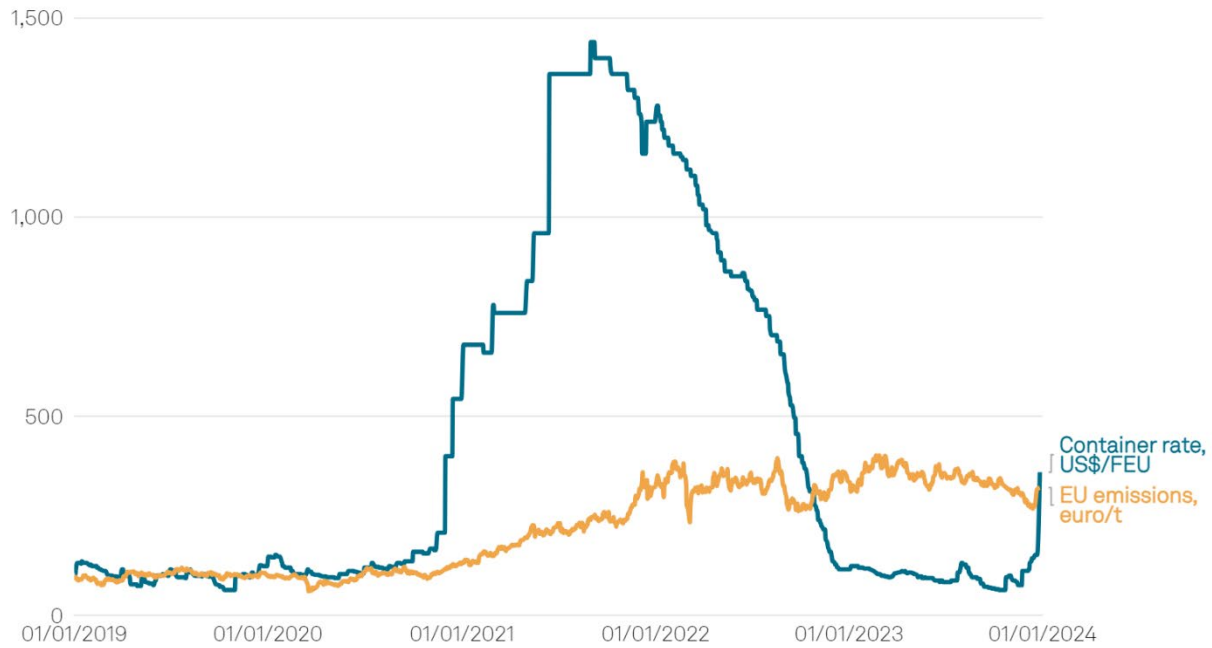
A comparison of the prices for Asia-to-Europe container shipping and EU ETS permits shows the complexity facing supply chain operators. The ETS price is a function of the power-generating industry due to its share of issued ETS permits, making hedging a complex exercise for logistics firms including shipping companies.

ETS and container prices have experienced significant volatility over the past three years. Container shipping rates in mid-2021 reached 14 times their 2019 level, eventually dropping to their 2019 average in November 2023. Also, in late 2023, rates rose to 3.6 times their 2019 level within a few days following attacks against container ships passing through the Red Sea.

ETS prices have increased steadily due to elevated natural gas prices versus coal. The program's steady expansion to include a wider range of sectors, along with the removal of freely allocated permits, has left prices at 3.2 times their 2019 average.

Shipping, carbon emissions largely uncorrelated, both volatile

Container shipping and EU emissions rates, rebased 2019 average = 100



Data compiled Dec. 28, 2023.

FEU = 40-foot equivalent unit; t = metric ton.

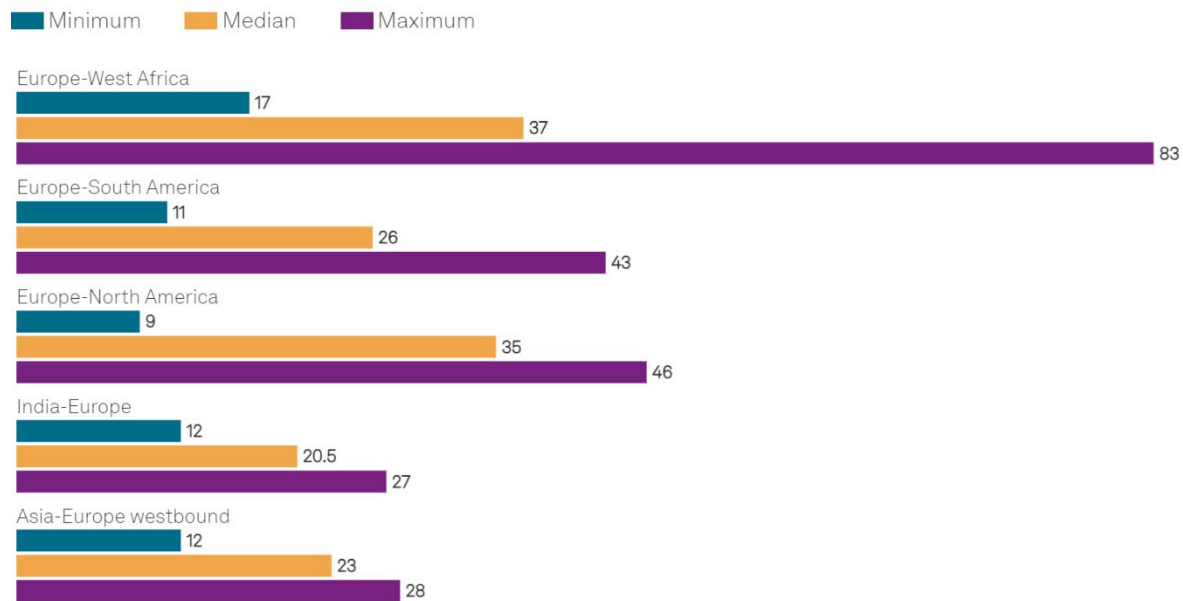
Source: S&P Global Commodity Insights.

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Wide range of EU Emissions Trading System surcharges

EU Emissions Trading System surcharge, euros per 20-foot equivalent unit, Jan. 1, 2024



Data compiled Jan. 8, 2024.

Based on company filings.

Source: S&P Global Commodity Insights.

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<https://public.flourish.studio/visualisation/16662832/>

Concerned about the prospects of a meaningful carbon tax over the next two years, carriers are escalating a campaign to argue the case in public. If the primary mechanism to drive decarbonization in container shipping is a fuel standard, it could be difficult for the profit-challenged industry to pass along the higher costs of zero-carbon fuels. This could be a game changer, not just for the sector but for containerized supply chains writ large.

Learn more

- [Renewable natural gas and hydrogen: fuels of the future for transportation decarbonization](#)
- [Can the Shift to Net Zero Accelerate Amid Growing Headwinds?](#)
- [Singapore's EMF steps up decarbonization, to include LNG bunkering in portfolio](#)
- [Listen: 2024 trends that sustainability leaders are watching](#)

Sidebar: Container ports + emissions management

Ports and terminals are primary factors in the container decarbonization agenda. Container ships can spend up to 20% of their total rotation time in ports. In 2019, the IMO passed a resolution encouraging ports and shipping lines to work together to reduce GHG emissions.

Ports can help in the transition to clean energy by providing refueling points for green fuels and shoreside power for ships at berth. They can also work with shipping lines to optimize port calls and move toward systemwide, just-in-time ship arrivals. Knowing in advance the time ships can berth enables them to slow down en route, conserving fuel and limiting emissions.

Container services often have fixed sequences of port calls and terminal berthing windows, which makes it predictable for shippers, shipping lines and ports to plan and allocate resources. However, global port call processes are inefficient and usually subject to delays and schedule disruptions. In 2022, about 30% of global container port call time was spent on pre-berthing processes, and ships had to wait an average of eight hours offshore for each call, according to S&P Global Market Intelligence.

Delays occur at all stages of port call processes, from preparations to work ships, to loading and unloading containers, and further to clearing ships for departure. The global best practice to complete processes before moving containers after a ship berths is about 20 minutes, but at hundreds of terminals globally, ships are routinely alongside for several hours before cargo operations start. When network volumes rapidly increase, even ports functioning efficiently can quickly struggle with additional demand, causing congestion that can spread globally.

Addressing inefficiencies can increase predictability and reduce wasted port hours. Ship operators can invest that time in subsequent journey legs to control speeds and curb fuel burn. This can lessen incidents of ships needing additional fuel to maintain schedules or recover services, which can involve higher sailing speeds, fuel consumption and emissions.

One solution is to analyze and monitor port time performance to uncover gaps and improve processes. Fit-for-purpose infrastructure and suitable labor are critical components, but globally, digitization presents an opportunity to transform operations by supporting higher levels of collaboration, data-sharing and decision-making around port calls.

Labor: A critical component of supply chains under growing pressure

Labor to support supply chains is coming under growing pressure from climate change, public health, corporate responsibility and other factors.

Peter Tirschwell, Vice President, Journal of Commerce, S&P Global, peter.tirschwell@spglobal.com

Bruce Thomson, Director, Global Social Specialist, Sustainability Research, S&P Global Ratings, bruce.thomson@spglobal.com

Yacine Rouimi, Principal Economist, S&P Global Market Intelligence, yacine.rouimi@spglobal.com

Highlights

Labor is a critical supply chain input facing mounting pressure from multiple fronts, including climate change, demographics, public health and corporate responsibility. These factors will have far-reaching impacts on supply chains in the coming years.

The COVID-19 pandemic brought to light growing labor shortages in industrialized countries, revealing challenging demographic trends that cannot be easily reversed, partly due to political restraints on immigration in developed markets.

Climate change is a major factor in this equation; worker productivity has been shown to decline when temperatures exceed certain levels.

There is a growing demand for companies to monitor and manage labor risks in their end-to-end supply chains. In recent years, there has been a marked rise in mandatory due diligence regulations to protect and respect worker rights across the value chain.

It is not an overstatement to say that, due to increasing labor pressures, supply chains will experience higher costs and be more prone to disruption in the coming years. However, amid these challenges, there are also opportunities for workers and firms that can best anticipate and adapt to the changing dynamics.

Supply chains involve the physical production and movement of goods and mostly rely on human labor. But a handful of factors, including climate change, public health and worker demographic trends, can have a serious impact on the labor supply and thus cause disruption in supply chains. Developed and developing markets are moving in opposite demographic directions, with developed economies facing an aging population and labor shortages while much of the developing world is experiencing population growth.

Labor and supply chains are interdependent, with growing pressures

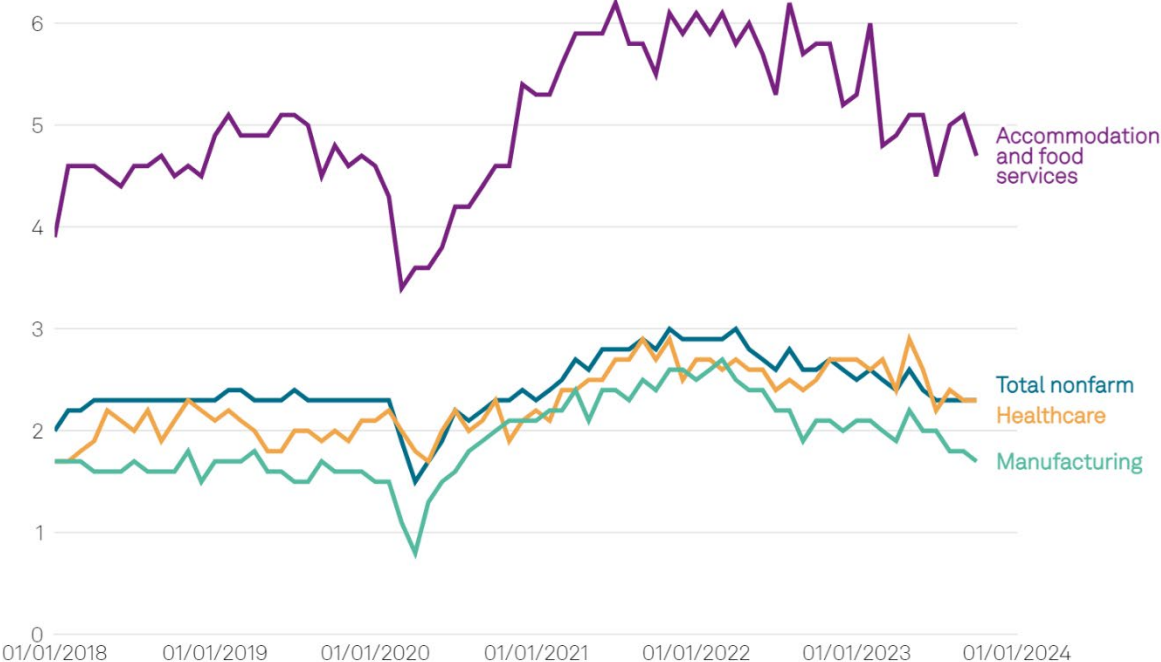
Labor remains an essential component of supply chains amid the rise of technological advances such as 3D printing, robotic warehouses and automated vessels.

Acute labor shortages were widely reported during the COVID-19 pandemic, particularly in the healthcare, food service and hospitality industries. In late 2021 and early 2022, the US saw a 20-year high in quit rates — a measure of voluntary turnover tracked by the Federal Reserve — as businesses struggled to hire and retain workers to meet demand. (See chart, " US worker quit rates have come down off their recent peaks") By the end of 2022, the Federal Reserve Bank of Atlanta reported that the quality and availability of labor was the top concern amongst senior corporate executives.

Some of the supply chain disruptions that occurred from 2020 through 2022 can be traced back to labor shortages in factories and freight transport.

US worker quit rates have come down off their recent peaks

Percentage of monthly voluntary quits/employment



Data compiled Dec. 16, 2023.
Sources: US Bureau of Labor Statistics; S&P Global Ratings.
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<https://public.flourish.studio/visualisation/16538830/>

Looking forward, worker demographic trends stand out as a major global theme in labor's impact on supply chains. The aging population is causing workforce declines in the developed world, including China, while much of the developing world is experiencing simultaneous

workforce growth. This presents a growing disparity with wide-ranging implications on politics, economics and trade.

Demographic trends could disadvantage industrialized market supply chains

According to research from the Center for Global Development, Organisation for Economic Co-operation and Development, countries will lose an estimated 92 million working-age people and gain over 100 million elderly people by 2050. Without migration, the 38 countries of the OECD, representing over 40% of global GDP, will require an additional 15 million workers per year beyond the number that can be expected from native growth to meet the needs of their basic social infrastructure, such as retirement and healthcare programs. Long-term systemic supply chain impacts of labor shortages are expected to be seen in the US as early as 2028 when new domestic workers in the economy will be insufficient to meet the needs not only of elderly and childcare services but also healthcare, construction, cleaning and maintenance, and food preparation and service.

At the same time, the trend in emerging regions is the opposite. According to the Center for Global Development estimates, sub-Saharan Africa, South Asia, Southeast Asia, Latin America and the Middle East could see a combined net increase of 1.4 billion working-age individuals between 2015 and 2050, leading to a potential surplus of 590 million workers by 2050. As such, though a practical solution may be greater cross-border labor mobility, this sets up a fundamental conundrum in which worker shortages that could be mitigated by immigration may be held back by politics in developed economies, limiting policy options to encourage labor mobility to fill gaps. The emerging world will also likely face challenges, including support of domestic needs.

While demographic imbalances are likely to be most acutely pronounced in labor-intensive, non-tradeable services sectors, the effects on manufacturing and global supply chains are more ambiguous. The workforce growth disparity between developed and developing economies could bode well for global trade, given the long-term availability of labor for manufacturing in markets outside those that consume the manufactured goods.

Climate change will increasingly impact labor productivity

Climate change is another major factor shaping labor and supply chains, with its impact likely to grow over time. Studies have shown that worker productivity declines when temperatures exceed certain levels. Such a drop in productivity occurred in the manufacturing and transport sectors during the height of COVID-19, resulting in port bottlenecks, inventory dislocations and lost revenues. Climate-related productivity impacts are likely to have similar disruptive effects, potentially including increased migration and social unrest.

Temperatures and work duration are generally uncorrelated, except after a temperature threshold is crossed (between 81.0 degrees F and 83.5 degrees F, depending on the industry). Beyond this threshold, as observed in the US, a gradual reduction in the average work week can be observed in industries such as manufacturing (7.4 minutes lost per week per worker

for each additional Fahrenheit degree), leisure/hospitality (4.1 minutes) and construction (4.0 minutes). The thresholds are likely different in other countries.

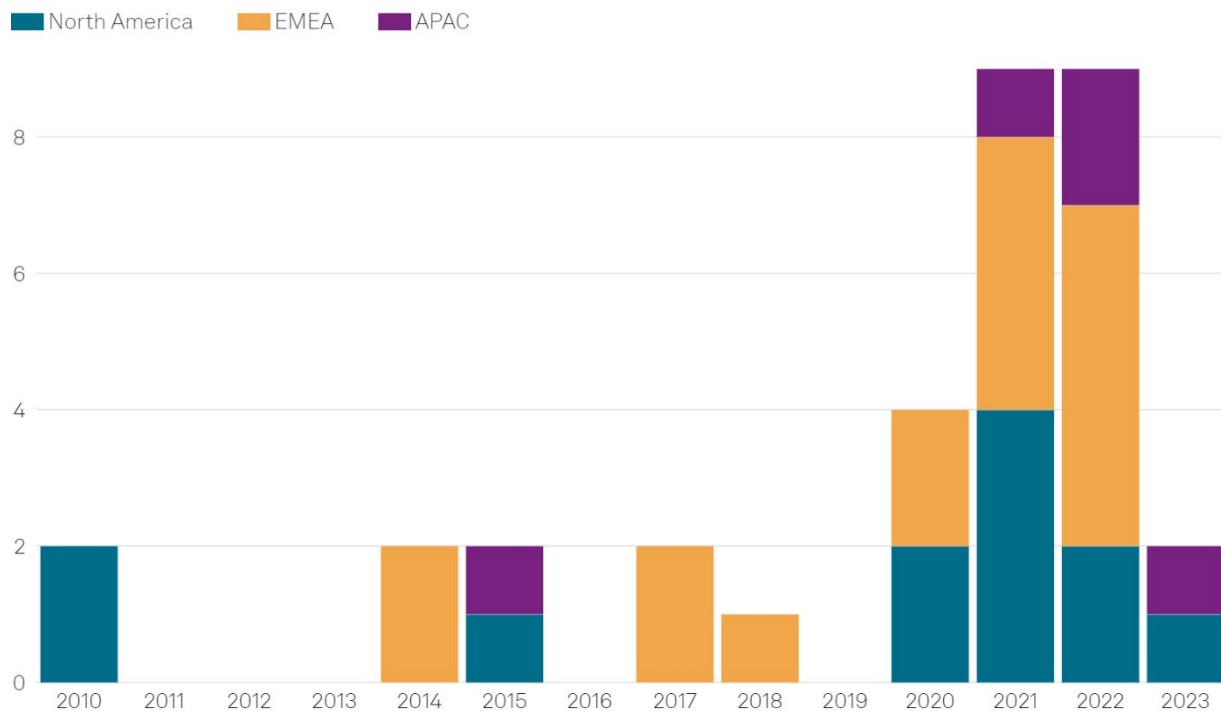
In July 2023, temperatures exceeded these thresholds in some US states. S&P Global Market Intelligence research suggests a total loss of over 13.5 million work hours in the US private sector, primarily in Texas and Arizona in the leisure/hospitality, construction and transport services segments. While these losses may have a negligible impact on overall US GDP (accounting for a mere 0.1 percentage point of annualized quarter-over-quarter growth in the third quarter), prolonged high temperatures could manifest in a nonlinear manner going forward. As sectors such as construction and transport services — vital to US supply chains — experience losses of labor input, it could lead to operational challenges in downstream industries reliant on these services and potentially increase economic damage.

Expanding corporate social responsibility mandates focus on labor

Labor imbalances and climate concerns affecting worker productivity give rise to a third major theme: rising demand for companies to monitor and manage labor risks in their operations and supply chains. In recent years, S&P Global has noted a marked increase in the quantity of mandatory due diligence regulations, which govern corporate responsibility to protect and respect worker rights across the value chain. Voluntary guidelines are becoming legal requirements, covering more companies and issues, and carrying tougher enforcement mechanisms. (See chart, "Rise in number of mandatory due diligence laws since 2010, by region")

Rise in number of mandatory due diligence laws since 2010, by region

Year mandatory due diligence law was introduced



Data compiled Jan. 3, 2024.

Source: S&P Global Ratings.

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Of note, the EU Corporate Sustainability Due Diligence Directive, approved by the European Parliament in 2023, would apply common supply chain due diligence requirements for companies based or operating in all 27 EU member states. Though not yet finalized, the directive is estimated to cover approximately 12,800 European companies and 4,000 non-European companies. In the US, the 2021 Uyghur Forced Labor Prevention Act is being used, alongside US Customs and Border Protection-issued withhold release orders, to deny shipments' entry into the US unless importers can convincingly document steps taken to ensure the goods were not manufactured in whole or in part using forced labor. Since mid-2022, shipments valued at over \$2 billion have been targeted at ports of entry, principally affecting electronics, industrial materials, textile and apparel, and agriculture.

As more due diligence requirements become law, it is evident that transport worker rights are within the scope of compliance expected of companies for worker welfare. It is the responsibility of transport companies and the brands or cargo owners who use those services to ensure worker rights protections. This may lead to more frequent audits based on references such as the Maritime Labor Convention.

Companies will come under pressure to invest in systems, workflows and people to ensure compliance with new legal requirements. They may also look to adapt their business, operating or sourcing models to manage risk and limit legal exposure. For instance, brands may choose to streamline their sourcing model, reducing the number of suppliers to larger,

potentially more expensive ones, or change sourcing geographies. Others may update their production timelines or inventory practices to avoid introducing risk.

Due to growing labor pressures, supply chains are expected to face higher costs and become more prone to disruption in the coming years. This creates an opportunity for workers and firms that are best able to anticipate and adapt to the changing dynamics.

Learn more

- [How Changing Workforce Dynamics May Affect US Companies](#)
- [The challenges of aging: Fast and slow](#)
- [Key 2024 sustainability trends driving the year ahead](#)

Deep Dive: Electric vehicles and batteries

The automotive industry is undergoing a generational shift in its supply chain and must navigate a complex confluence of geopolitics and technological developments.

Chris Brooks, Executive Director, Journal of Commerce by S&P Global, chris.brooks@spglobal.com

Graham Evans, Director-Auto Supply Chain and Technology, S&P Global Mobility, graham.evans@spglobal.com

Vittoria Ferraris, Managing Director and Sector Lead-Automotive EMEA, S&P Global Ratings, vittoria.ferraris@spglobal.com

Calum MacRae, Director-Supply Chain and Technology Director, S&P Global Mobility, calum.macrae@spglobal.com

Ashima Tyagi, Economics Associate Director, S&P Global Market Intelligence, ashima.tyagi@spglobal.com

Highlights

The electric vehicle revolution is upon us, although trade competitions, geopolitical battles and infrastructure issues have tempered initial excitement and momentum.

A global battle is shaping up to secure the critical minerals and raw materials needed to manufacture sophisticated batteries and other EV parts.

Asia, and particularly China, holds a dominant manufacturing advantage for EV parts, but national security concerns are quickly changing the narrative.

The evidence around electrification and the shift to battery-powered electric cars points to one indisputable fact: The future is here, even if the fervor of early adopters who saw a rapid transition from the gas-powered engine of the last century is proving to be a bit too much, too soon.

The future is here

Attaining mass-market acceptance of EVs is a slow process and still far from certain. Some markets — China, other parts of Asia, Europe, and some regions within the US — are embracing the EV movement, but recent signs from S&P Global Mobility point to more and more EVs sitting in dealer showrooms.

One of the keys to mass-market adoption is achieving price parity with combustion engine vehicles. But other factors are also relevant, such as the need for longer-lasting battery charges and more efficient and ubiquitous charging stations. Both represent hurdles to converting buyers accustomed to a world built around the combustion engine.

If successful, however, the electrification transition will depend on the industry's infrastructure, economics, technologies and supporting services in a way that stakeholders are only starting to address and comprehend.

But what is the path, and what is standing in the way?

A warning about the supply chain

In the combustion-engine era, the automotive sector became well versed in dealing with supply chain risk. With electrification, risk now shifts further upstream given its reliance on critical raw materials and components.

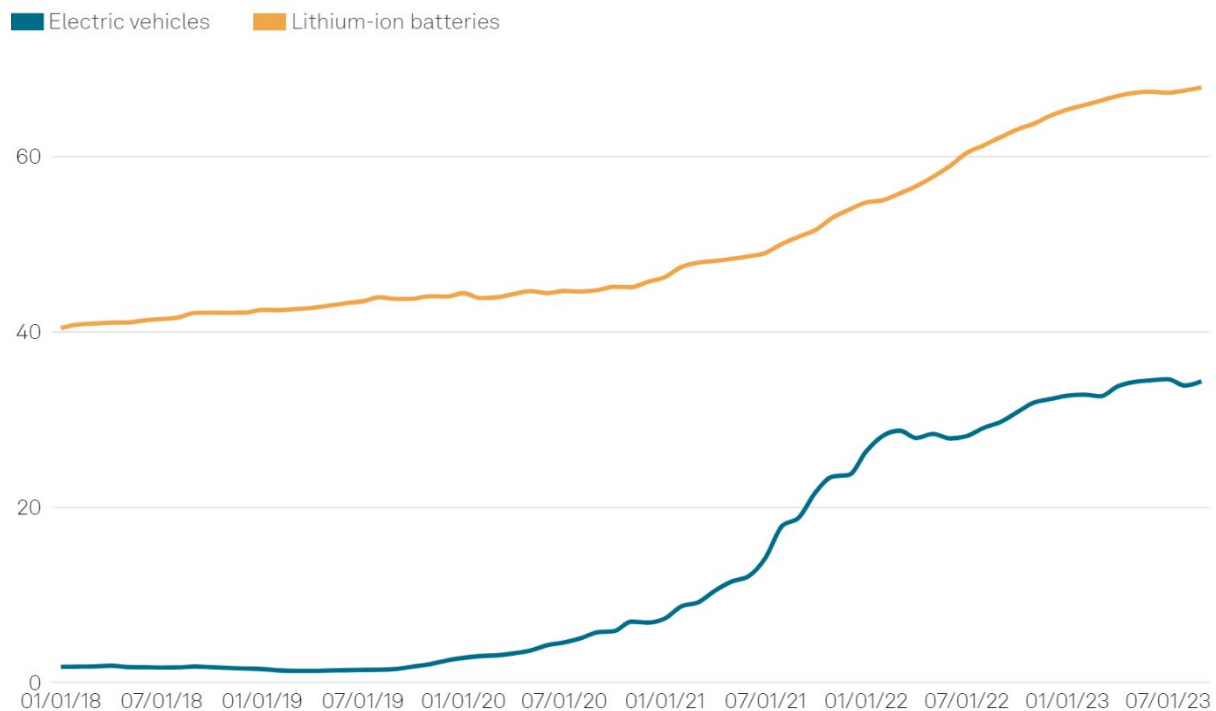
Efforts by China's automotive industry to establish a dominant position throughout the EV supply chain have been successful. Chinese suppliers have acquired the elements necessary to construct EV batteries at scale: the cathode and anode in traction-battery cells and the pack itself. They have also acquired significant stakes in inverters, converters, controllers and charging technology.

A sign of China's success can be seen in its emerging dominance of EV exports globally. (See chart, "China builds dominance in electrification products") China exported 1.47 million vehicles in the 12 months to Oct. 31, 2023. That represented 34% of all exports by value, up from 30% the same month a year earlier and 2% in 2019, according to S&P Global Market Intelligence.

Similarly, China accounted for 68% of all global exports of lithium-ion batteries — including EV and electronic devices products — over the same period, up from 63% a year earlier and 44% in 2019. The chart "China builds dominance in electrification products" illustrates China's rapid rise in the share of global exports of EVs and lithium-ion batteries that power them.

China builds dominance in electrification products (%)

Mainland China share of global exports, 12-month trailing average



Data compiled Dec. 22, 2023.

Source: S&P Global Market Intelligence.

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<https://public.flourish.studio/visualisation/16663190/>

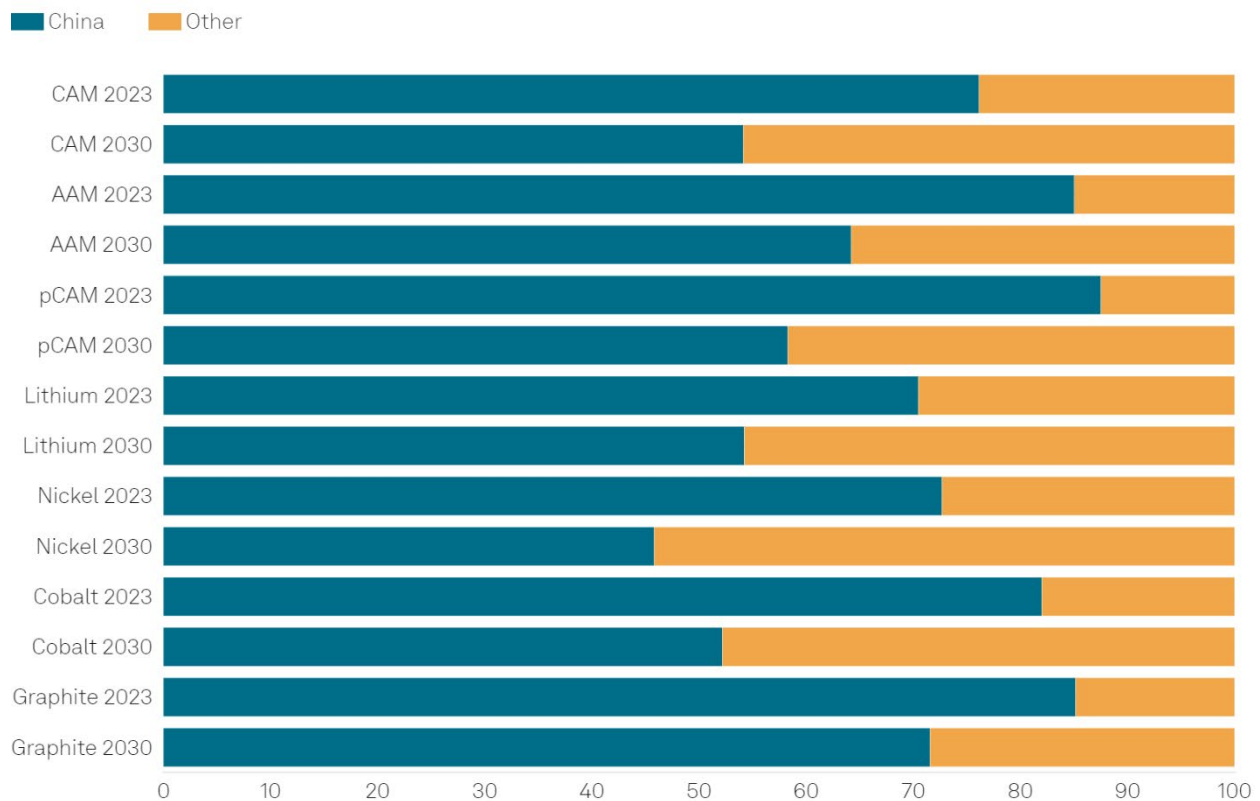
Some regions are turning to legislative pressure and trade controls to compete with China.

In October 2023, the European Commission launched an investigation into Chinese subsidies of its EV industry. The investigation is expected to take up to 13 months and could result in the EU imposing duties on Chinese EV imports. The Chinese government has stated that it is "very much dissatisfied" with the investigation, which it asserts lacks evidence and does not meet World Trade Organization regulations.

But those components are nothing without their raw materials, and in that area, China holds a further advantage either in accessing them locally or sourcing from other countries. The chart "Chinese producers dominate in battery markets for light passenger vehicles" highlights S&P Global Mobility's May 2023 forecast for key raw materials, including lithium, nickel, cobalt and graphite, and their sourcing.

Chinese producers dominate in battery markets for light passenger vehicles (%)

2023 vs. 2030 comparison of global production for major battery manufacturing and raw material process steps



Data compiled Jan. 29, 2024.

CAM = cathode active material; AAM = anode active material; pCAM = cathode precursor.

The percentages are based on the location of the material production, or raw material extraction or refining. The influence through ownership is not included. The numbers reflect only the parts of the supply chain associated with light duty vehicle battery application.

S&P Global Mobility battery raw material forecast, data as of January 2024.

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<https://public.flourish.studio/visualisation/16675234/>

In the case of battery raw materials, a supply crunch could materialize within this decade. For lithium, S&P Global Mobility forecasts a sixfold increase in demand between 2022 and 2030, from some 60,000 metric tons to 370,000 metric tons for light passenger vehicle applications alone. Lithium supply will be unable to meet demand by 2027, creating a bottleneck for automotive supply. Lithium takes nearly 16 years on average to reach the market after initial discovery; thus, there is no readily available source of additional supply. For this reason, the industry is prioritizing battery recycling.

BOX: Timing mismatches present additional challenges

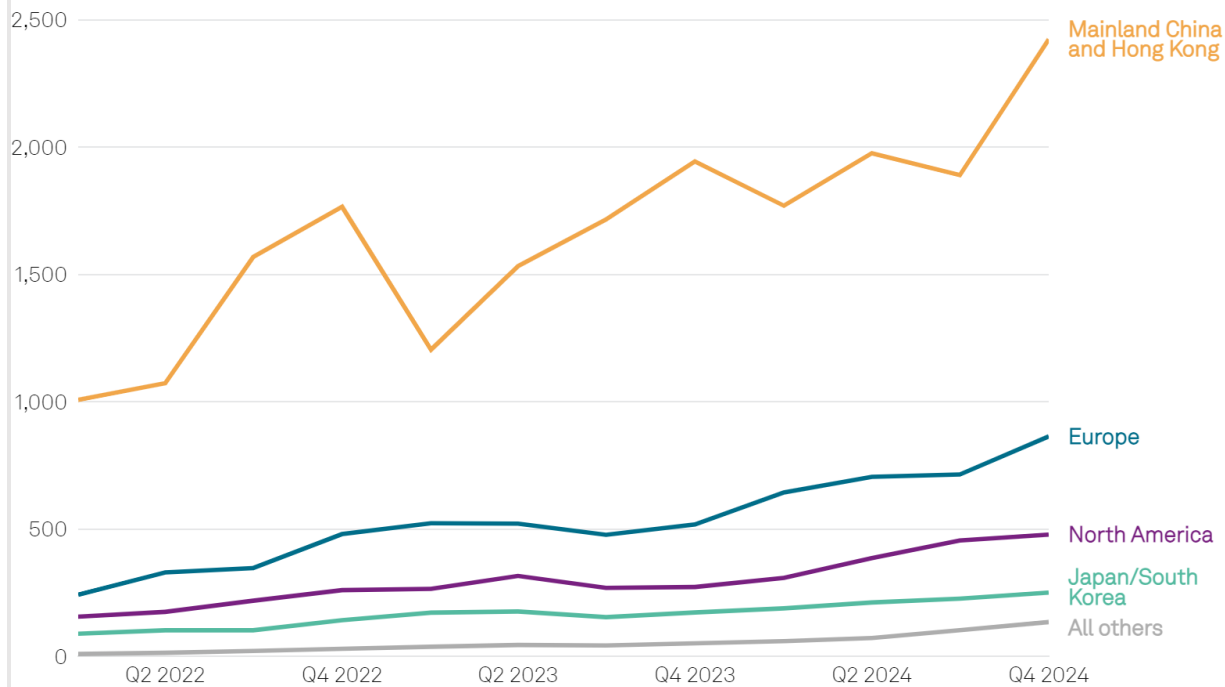
Simultaneously, while navigating long-term structural challenges, the industry must deal with a series of timing mismatches, including the following:

- *Short-term volatility in vehicle demand and the resulting near-term manufacturing volumes required versus the multiyear process needed to build new factories and charging infrastructure. The volatility in production can be seen in manufacturing rates, which slowed to 10% year-over-year growth in the fourth quarter of 2023, in part due to labor*

strikes by the United Auto Workers union, from 18% a quarter earlier. Growth is expected to accelerate back to an average 33% rate in 2024. (See chart, "Slowdown in production expected to be fleeting")

Slowdown in production expected to be fleeting

Manufacturing of battery electric vehicles by region, thousand vehicles per quarter



Data compiled Dec. 28, 2023.

Source: S&P Global Mobility.

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<https://public.flourish.studio/visualisation/16675516/>

- Short-term volatility in commodity prices for key materials, driven in part by the balance of supply and demand for vehicles, versus the multiyear process needed to identify, develop and commercialize new sources of materials.

Geopolitics and the race to secure critical minerals

Certain raw materials are considered critical and share some common characteristics:

- There is no alternative or substitute for their high-technology usage. These are typically found in the energy transition, green transportation and intelligent manufacturing.
- Their distribution and availability are inconsistent across global regions.
- They are subject to a volatile geopolitical environment.

In the US, for example, the passage of the Inflation Reduction Act of 2022 resulted in intensified demand for cobalt, nickel, lithium and copper. This prompted Indonesia, among other nations, to pursue negotiations with the US toward free trade agreements to plug

supply gaps. Other countries, including Australia, India and South Korea, have devised their own critical minerals strategies.

Although critical minerals vary across geographies depending on domestic availability, supplier countries have a glut of certain bulk minerals (copper and aluminum, for example) and high-tech minerals (cobalt, lithium, etc.). But the situation is fluid; today's oversupply could turn into a deficit in a few years. Estimates suggest that demand for the raw materials needed to manufacture EV batteries will outstrip supply starting in 2030. This is because developing a raw materials mine takes seven to eight years, while the turnaround time for downstream manufacturing facilities is much quicker.

With the race on for countries to secure materials, the definition of supply chain security will change over the next five to seven years, from one in which countries seek a diversified, sustainable solution for sources of critical materials to comprehensive supply, technology, political and trade competition. Those who succeed will develop a "whole chain" mindset whereby exploration, mining, beneficiation, separation, metallurgical applications and recovery will be undertaken by establishing exclusive alliances and trade partnerships.

At the same time, countries that supply critical minerals — including Indonesia, Malaysia and Mongolia — may avoid these alliances and indulge in nationalism to drive economic prosperity at home, in turn creating regional divergences in production costs.

Asia's manufacturing superiority

Beyond raw materials, China has a sourcing advantage on rare earth elements necessary for electric motors. It recently announced that it wants to control exports of gallium, germanium and graphite as well as rare earth mining equipment and technologies, prompting other countries to reassess their supply chain exposure. The move marks an important shift for China, whose primary focus has been on batteries, because rare earths are more difficult to replace than raw materials.

Asia, led by China, South Korea and Japan, is by far the most sophisticated region in terms of EV parts manufacturing, especially batteries. To maintain its lead, many EV battery suppliers in the region are increasingly investing abroad.

In China's case, battery manufacturers expanded rapidly ahead of demand with the result that capacity utilization rates have slumped to less than 50% in the first eight months of 2023, according to S&P Global Ratings estimates. The industry may therefore be ripe for consolidation.

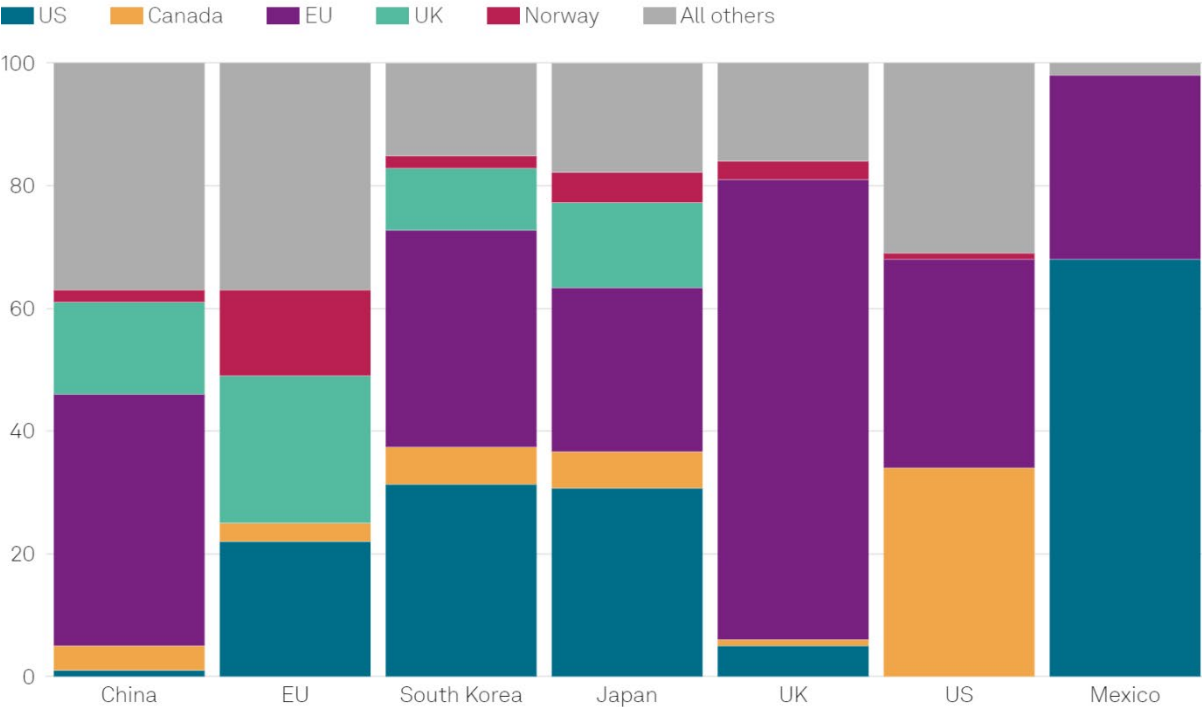
Exports are helping to ease some of the effects for Asian manufacturers. South Korean and Japanese companies see more robust opportunities in North America, while China is making a bigger splash in Europe.

Global exports of EVs from the seven largest export markets reached \$100 billion in the 12 months to Sept. 30, 2023, with China and the EU accounting for one-third each, according to S&P Global Market Intelligence. (See chart, "Chinese exporters focus on EU, others on US") South Korea and Japan represented 13% and 6%, respectively.

- The EU accounted for 41% of China's exports of EVs, followed by the UK with 15% and the US with only 1%.
- The US and Canada combined accounted for 37% of exports from South Korea and Japan, respectively, while the EU represented 35% and 27%.
- Other major export markets include the UK, with 75% of exports headed to the EU, and Mexico, with 68% headed to the US and 30% to the EU.

Chinese exporters focus on EU, others on US

Share of exports (colors) by origin (bars) of electric vehicles, 12 months to Sept. 30, 2023



Data compiled Dec. 28, 2023.
 Source: S&P Global Market Intelligence.
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<https://public.flourish.studio/visualisation/16675766/>

The changing landscape

Although overall EV demand was sluggish in 2023, some markets are showing relative strength. And, because battery manufacturing and supply chains are less developed outside of Asia, many global automakers are relying on imports to meet their demand. For Chinese battery manufacturers, the upside is especially strong in Europe, where Chinese producers already have been capturing market share from South Korean competitors.

Europe has proven politically and economically more attractive for China's producers. The 25% tariffs imposed by the US on EV imports since 2018 have been continued by the Biden administration as it strives to reduce its reliance on technology supplies from China. The political landscape will continue to shift into 2025 following the US elections, as discussed in "Supply chain politics: National security meets economic growth."

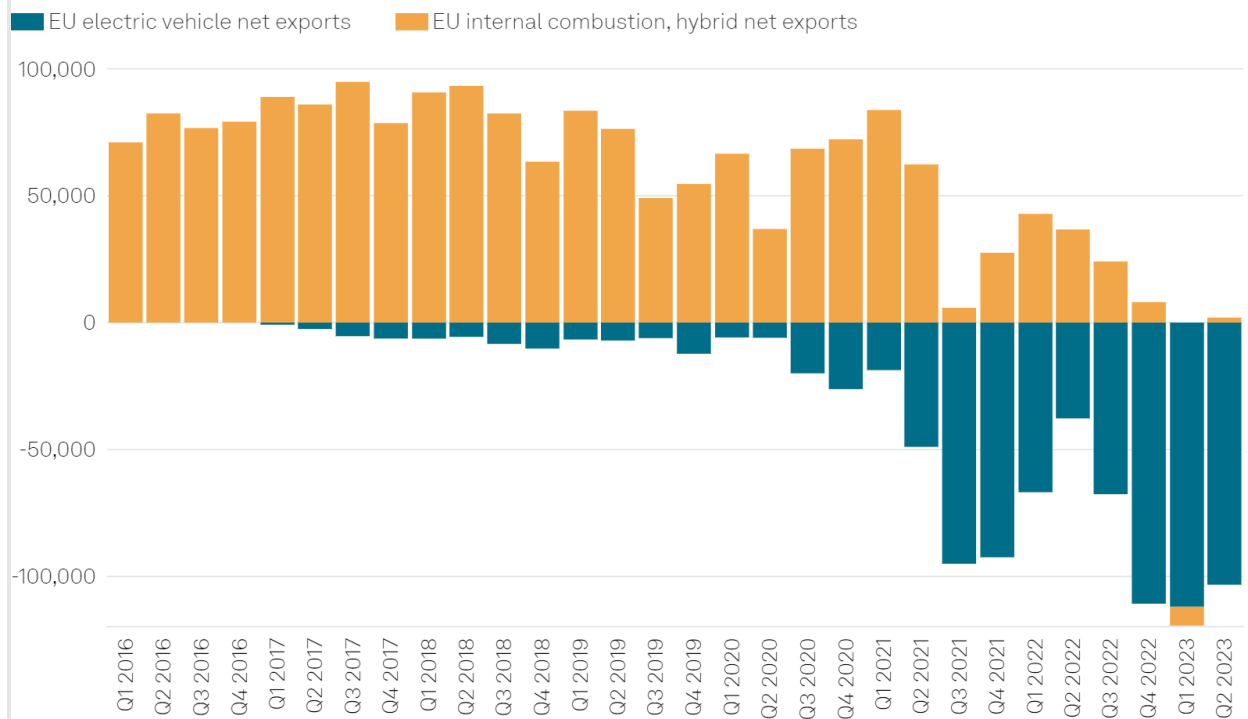
BOX: A rebalancing of trade between the EU and China

There has been a rapid shift in the balance of trade between China and the EU in the automotive sector. While the EU's automakers have set up shop in China, the latter's manufacturers have accessed the EU more directly with exports.

S&P Global Market Intelligence data shows the EU exported 309,500 vehicles to China in 2016. (See chart, "EU swings to net buyer of vehicles from China") In the 12 months to Sept. 30, 2023, the EU was a net importer of 389,600 vehicles including all propulsion technologies, including a net import of 406,185 EVs and a net export of just 16,584 internal combustion and hybrid vehicles. That shift is a significant driver of the European Commission's adoption of the Trump administration's concern about the trade-in-goods deficit with China.

EU swings to net buyer of vehicles from China

EU net exports of light vehicles with China, number of vehicles



Data compiled Dec. 28, 2023.

Source: S&P Global Market Intelligence.

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<https://public.flourish.studio/visualisation/16675803/>

That European promise has been undermined by a recent European Commission investigation into Chinese subsidies of its EV industry. Ultimately, European automakers need batteries to supply their EVs, and European suppliers do not have the capacity to satisfy that demand. Further enhancing China's prospects is that some Chinese battery manufacturers are setting up production facilities in Europe.

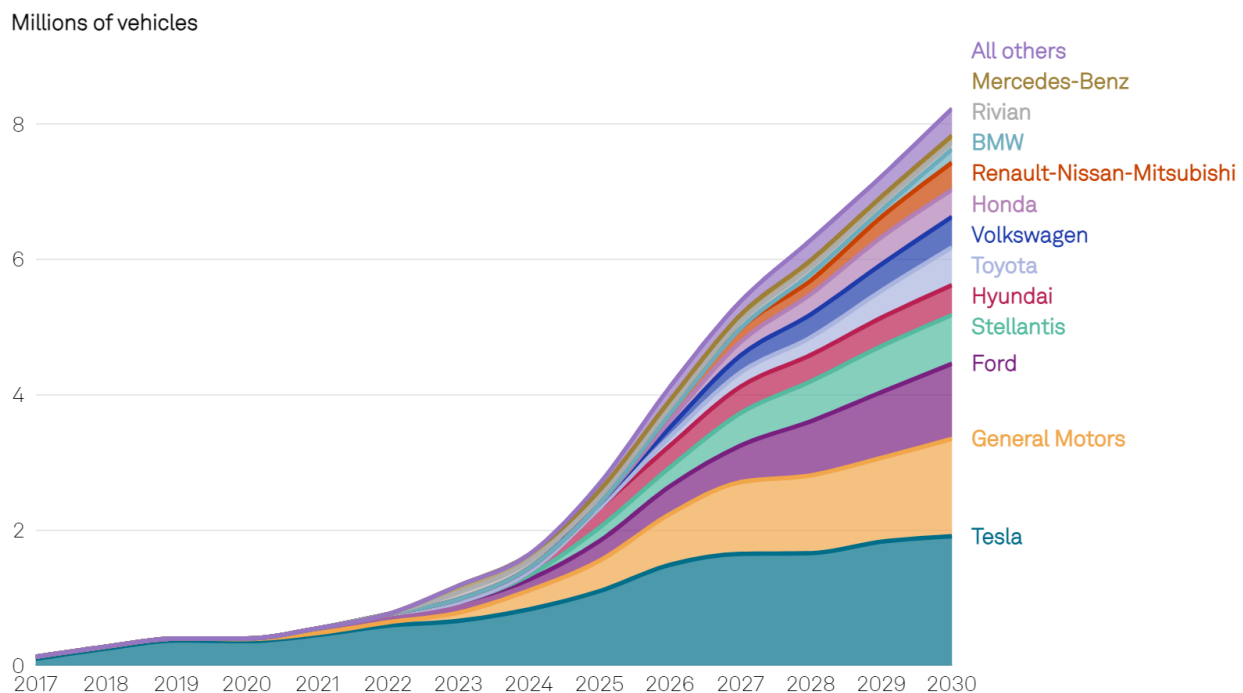
There are risks to both China's manufacturers' prospects in Europe and European manufacturers' sourcing of critical materials and products — particularly in the rare earths sphere — based on the EU's investigation. Should it result in tariffs, China may respond with export restrictions over rare earth magnets needed for EV motors.

While Chinese companies are expanding into Europe and boosting their exports, South Korean manufacturers — once the dominant suppliers of batteries to the continent — are expected to make a big move in the US over the next two to three years. The reason is a tax incentive under the Inflation Reduction Act, created as part of a strategic initiative to establish its own EV value chain. By producing clean-energy parts such as batteries in the US, South Korean companies are eligible for the Advanced Manufacturing Product Credit under the act.

S&P Global Mobility forecasts show that Hyundai Motor will be the fourth-largest producer of EVs in the US, Mexico and Canada combined in 2025, though it will slip behind Stellantis in 2026 and Toyota and Volkswagen by 2030 based on current factory rollout plans. (See chart, "Tesla set to maintain lead in US EV production")

Tesla set to maintain lead in US EV production

Battery electric vehicles produced in the US, Mexico or Canada



Data compiled Dec. 28, 2023.
 Source: S&P Global Mobility.
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<https://public.flourish.studio/visualisation/16675842/>

Under the terms of the Inflation Reduction Act, starting in 2024, any electric car with battery components supplied by what the US deems "foreign entities of concern" is ineligible for tax credits. As such, manufacturers affected by the law could lose cost competitiveness and the incentive to invest or produce in the US market. The precise list of "foreign entities of concern" has yet to be defined, providing the US government with some latitude in implementing the regulations. Notably, the January 2024 list of approved vehicles does not include any built in China or with battery packs manufactured in China.

BOX: Dealing with range anxiety: Challenges from charging

Once an EV is built and sold, the next challenge is the equivalent of refueling for the owner — in this case, recharging. The EV is more flexible than the internal combustion engine, which is captive to refueling at service stations. Charging can occur in a multitude of scenarios — at home, in public parking lots or garages, and at roadside rest stops. Such options, however, are limited or face other constraints: not enough chargers, inconsistent reliability of the charging stations, the length of time to achieve a full charge, and the battery's ability to receive the charge itself.

A developed-versus-developing world component is another consideration. Because many developing nations may not have the infrastructure to support a mass charging network, much of the underdeveloped world will likely remain an internal-combustion haven for the foreseeable future.

Four major questions must be addressed, many of which require government policy intervention that has yet to clearly emerge.

- *Who will pay for the chargers? There is no shortage of candidates, including oil companies (BP and Shell have teamed up to put chargers at their gas stations, for example), utilities (which can support both home stations and "around town" systems), startups (which are causing a confusing fragmentation), car manufacturers (Tesla being the prime example with its supercharger network) and other infrastructure owners (Starbucks with Volvo, for example).*
- *Which equipment should be used? Standardization is approaching rapidly for fast charging, driven by Tesla's standard being adopted by other automakers in the US. That has yet to happen in the rest of the world.*
- *Is there sufficient infrastructure? Rapid charging has significant voltage requirements, which may require strengthening backbone networks, particularly in emerging markets and underdeveloped networks such as the US.*
- *Will the charger supply chain be sufficient? The charging boxes are simple enough, but given that cheaper is better, there may be some confrontation on producing and exporting the boxes. It is likely that local-content rules (like in the Inflation Reduction Act) will be implemented.*

Learn more

- [2024 Automotive Materials Forecast: EV batteries...and more](#)
- [Looming EV raw materials supply crunch has OEMs eyeing battery recycling and production scrap](#)
- [2024 EV forecast: the supply chain, charging network, and battery materials market](#)
- [Fuel for Thought: Warning signs on the path to mass EV adoption](#)
- [Asian Battery Makers Are Shifting Strategies To Hold Onto Global Lead](#)



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